Lighten Up
LANCASTER COUNTY
In partnership with Penn Medicine Lancaster General Health

Community & School Garden Guidebook

Lighten Up Lancaster County Community & School Garden Guidebook

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INTRODUCTION

Lighten Up Lancaster County in partnership with Lancaster General Health is a group of concerned citizens working to increase the number of individuals maintaining a healthy weight. This toolkit was produced to aid in the effort to combat obesity. As you will see in the resources throughout the document, gardens are an evidence-based strategy that can reduce chronic disease among Lancaster County residents. Gardens can also contribute to increasing awareness of environmental and sustainability issues.

If you are thinking about starting a school garden, or if your school already has one, you have come to the right place. We have assembled information regarding all aspects of gardening with specific reference to schools. In addition to providing information for school gardens, the manual offers valuable resources that can be utilized by all gardens within the Lancaster community. Most of the material for schools is applicable to other organizations as well.

Who Can Use This Toolkit?

- K-12 schools
- Pre-schools
- Child care centers
- Youth and family serving organizations
- Community gardens
- Faith-based organizations
- Worksites

There is a vast amount of information available on gardening and school gardens in particular. The manual includes specific Lancaster community garden information and provides links to broader gardening tools.

We hope this manual will be a community resource, with new materials contributed by community members. We welcome your comments, corrections, and contributions for the manual; please contact coalition@lightenuplancaster.org.

Why Start a School/Community Garden?

If you are already thinking about a school garden, you probably have given some thought to the goals for your garden. Here we provide some background on the issues that are motivating educators in Lancaster County, nationwide and throughout the world. However, every school is unique and every garden is unique, so think carefully about what a garden can accomplish for your students. These topics will influence the planning, implementation, and assessment of your program.

Many educators and health care professionals are motivated to start gardens as a way to address serious issues about the health and nutrition of Americans, particularly overweight and obesity. Lighten Up Lancaster County is joining local efforts to address these problems broadly.

The US Centers for Disease Control and Prevention reported in 2016 that 37.9% of Americans ages 20 and older were obese.[1] An additional 34.8% were overweight.[1] For Americans ages 2-19, 17.2% were obese and another 16.2% were overweight; 1 in 3 U.S. children and adolescents was overweight or obese.[1] The obesity percentage has tripled in 30 years among children and doubled among adults.[1] A recent study in Lancaster County indicated that 15% of children in grades K-6 were obese, and another 21% of children in grades K-6 were overweight.[2] Among teens, 17% were obese and another 23% were overweight. These percentages continue to rise faster than in Pennsylvania as a whole.

It is no surprise that children who are exposed to predominantly sugary and fatty foods early in life will tend to prefer the same types of foods throughout their lives. The inadequate intake of vegetables and fruits is related to the national problem of overweight and obese children. The vegetables and fruits that can be grown in a garden are major sources of important nutrients, especially vitamins and minerals, yet many of these are often inadequately supplied by the typical American diet, with significant consequences. A lack of access to these healthy options via fresh markets, nearby stores, and school and community gardens is one of the largest barriers to helping individuals maintain a healthy weight. Lancaster County has its share of rural and urban “food deserts”, areas where access is limited. Unhealthy food and beverage choices may be more readily available and less expensive.

Of the vegetables and fruits American children do eat, large proportions are French fries and fruit juices. These foods, though high in calories, may displace other more nutritious foods. Children ages 6-11 consume slightly more than half of the minimum recommended vegetable servings[3].

While adolescents are reported to have vegetable intakes closer to recommendations, potatoes, most of them fried, account for more than a third of the servings.[3]

According to the American Heart Association, well-documented research has shown that:[4]

- Garden-based nutrition intervention programs may promote increased fruit and vegetable consumption among youth.
- Children may be more willing to try new vegetables if they grow them.
- In addition to the potential to improve nutrition habits, community and school gardens can teach and reinforce responsibility, leadership, group cohesion/team building, environmental awareness and concern, science processes, problem-solving skills, math skills, pride, confidence, and self-esteem.
- Children who have been educated about sound nutritional choices will pass that knowledge to others, especially their families.

The Collective School Gardens Network in Arizona and California has identified the following four major benefits of school gardens. [5] Although the climate in California is different from ours and thus some aspects of their gardens are different, programs in California are models for the "why" and "how" of school and community gardens. As you plan your garden, think about how it can help achieve each of these goals:

Environmental Stewardship

A school garden is a powerful environmental education tool. Through gardening, students become responsible caretakers. They have an opportunity to engage in agricultural practices on a small scale, learning about the responsibilities and impacts of land cultivation. They explore the web of interactions among the living and nonliving players that sustain life.

Community and Social Development

Community and social development lessons do not receive the attention of academic achievement, but they are as crucial to the survival of our country as reading and writing. Children must learn how to take responsibility for their environment and develop a strong sense of community to ensure the continuation of our society.

A Healthy Lifestyle

Beyond academics, the garden provides broader life lessons including contributing to students' knowledge of how to maintain a healthy lifestyle. The state of California is experiencing a major health crisis as the number of overweight and obese youth is growing at an epidemic rate, as also seen across the country in a number of other states.

Academic Achievement

Academic achievement is the primary focus of educators throughout the country. Emphasis is placed on ensuring students perform at satisfactory levels guided by local, state and national academic standards. All lessons and activities must complement mandatory standards to merit the use of valuable classroom time.

When considering exemplary garden projects around the world, in a variety of settings, researchers with the United Nations Food and Agriculture organization established a wide-ranging set of benefits, shown below. Those planning a school garden will be inspired by reading about the history, philosophy, and successful outcomes of model programs[6,7] Gardens provide authentic learning opportunities across disciplines, emphasizing hands-on work and the development of problem-solving skills. A garden offers opportunities for students with different learning styles, different academic and personal strengths, and different career aspirations.

Your school garden, a very local activity, can also help your school and community make global connections. In our increasingly diverse schools, students can learn through the garden about the various cultures of other children in their classes. As part of curriculum units with a global focus, a garden enables students to develop a broader perspective about the world. Imagine the power of garden pen-pals across the county or across the world..

Your garden can become a key component of broader community efforts to change behavior. Gardens can bring people together across generations and cultures. Good nutrition and health can best be understood as depending on influences from the individual, group, community, and government (public policy). Efforts at multiple levels are often the most effective.

But why a school garden, at a time when student attainment of standards-based benchmarks is a top priority? Here is one educator's response:

"…[T]here is a danger that the standards will become a series of rote lessons. A garden in every school is even more essential to make our standards come alive. We must not lose the creativity, problem solving, and sheer love of learning that come from hands-on, experiential learning…. Gardens should not compete with our standards; gardens should be an avenue to high standards."[8]

High quality education should not be based solely upon what takes place within the four walls of a particular room. The garden functions as an extension of the classroom – a dynamic place where students experience learning on many levels. Experiential learning, a key feature of school gardens, helps address the issue of varied learning styles among students. A garden can expand the ways that educators teach the standards.

Additional information on the role of the garden in the curriculum and in other school programs will be presented in the "Curriculum and Other School Programs" section of this manual.

Below is a reflection written by a dedicated and experienced gardener and environmental educator. This essay captures one person's motivation to help others.

A Personal Perspective

Lydia Martin, Lancaster County Master Gardener and
Director of Education with Lancaster County Conservancy

Gardens are springing up everywhere to meet the growing need for children and adults to get dirty while learning! Exploring nature through hands-on observation has never been so important. What child would not be inspired by the power of a tiny sunflower seed growing to ten feet tall or observing pollination first hand while watching a bumblebee moving from one flower to another? When children have space to learn and experiment in nature through growing vegetables and fruits, studying the soil through composting, or exploring their own native meadow, they develop a connection to the cycle of life.

Today, many urban and suburban children have few opportunities to experience nature daily; they may have little interest in or even an aversion to nature. In addition, video games and other forms of media compete for their attention. We owe it to our children now and in future generations to instill a love of nature! A garden can provide the first gentle step in getting children excited about learning in the great outdoors. Schools and community groups can broaden the garden experience to a more all-encompassing effort through educational activities and natural spaces for discovery. At the same time, gardens can help address the significant problems of childhood nutrition and obesity.

As a child I learned to love nature early, waking up on brisk, spring mornings and running through open fields in search of insects, collecting rocks, and stopping to check my plants to see how much they had grown from the day before. Bonding with nature left a lasting impression on my life that drove me to want to get outside and get dirty often. As an adult, I have volunteered and worked in horticulture-related fields. Observing my own children's imagination outdoors, I wanted to share my knowledge with others by showing people how to appreciate and learn about our environment.

In the last several years, my passion for gardening led me to help guide local schools, such as Conestoga Elementary and George Washington Elementary, to develop and implement their own community school garden. The desire to see these children and, yes, even adults get excited over harvesting their very own tomato or watching their own flowers open for the very first time became irresistible! Observing passionate leadership from parents, teachers, and the community gave me hope: people know that being in nature through gardening is important to learning. This realization prompted me to support their efforts in any way possible

A garden is many things: an opportunity to connect children and adults with nature through meaningful, environmental education-related activities; a way to significantly improve health and diet while learning how to grow and provide nutritious food for themselves; a way to improve water, air, and land quality; and a respite from the daily grind of life. The information in this manual will help parents, teachers, and community leaders create their own garden, with directions that range from establishing an initial budget and project timeline to developing lesson plans and activities that are linked to the curriculum. A garden is not about an individual process but about a holistic approach to sustaining all life. Having access to a garden can teach people to value a healthy ecosystem that provides innumerable services from local to global.

At the heart of every budding gardener is the reward of knowing there is always something new to learn! Develop an intimate connection to our world and we will save the world. Future generations will thank us for building hands-on learning opportunities within our schools and communities. Giving everyone access to learning how to care for our world while making healthier, lasting choices will be our outcome.

Applications and Uses of Garden Based Learning[9]

Academic skills

- To support core academic training, particularly in science and math
- Real world hands on experiences
- Enrichment of core curriculum in language arts through introduction of new learning landscapes
- To support standards based education in countries with national or regional education standards

Personal development

- To add a sense of excitement, adventure, emotional impact and aesthetic appreciation to learning
- To improve nutrition, diet and health
- To teach the art and science of cooking with fresh products from the garden or local farms
- To re-establish the celebratory nature of a shared meal

Social & Moral Development

- To teach sustainable development
- To teach ecological literacy and/or environmental education
- To teach the joy and dignity of work
- To teach respect for public and private property

Sustainable Development

- Gardens are an appropriate arena to introduce children to the interconnections that link nature to economic systems and society

Vocational Education

- Gardens represent a historic and contemporary model for developing vocational skills in agriculture, natural resource management, and science

Vocational and/or Subsistence Skills

- To teach basic skills and vocational competencies
- To produce food and other commodities for subsistence consumption and trade

Life Skills

- To teach about food and fiber production
- To engage youth in community service and environmental care
- To engage youth in lessons of leadership and decision-making

Community Development

- Gardens often serve as a focal point for community dialogue capacity building, and partnerships
- Gardens often organize individuals for action for water delivery, cooperatives, and transportation

Food Security

- Gardens can address hunger at the individual, family, and community levels through planning, growing, and sharing
- Gardens can be the beginning point for teaching and developing food policy

School Grounds Greening

- Gardens provides practical productive strategies to transform sterile school grounds into attractive and productive learning centers
- Hands-on activities in outdoor classrooms make learning more interesting while demonstrating other benefits such as decreased absenteeism and discipline problems

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PLANNING

In this section, you will find information on how to do the planning for your garden. Don't underestimate the value of careful planning for a successful project. Refer to the other sections of this manual as you plan each component. In particular, information on developing a budget is in the ***Garden*** *section and on fundraising, in the* ***Cultivating Support*** *section.*

Words of Wisdom from School and Community Garden Leaders

The experiences of garden leaders in Lancaster are reflected throughout this manual. Here are a few of their insights that will help you keep your focus and avoid getting overwhelmed by the details.

1. The garden can be a great equalizer: children and adults can dig and harvest together. The garden can unite people who might never have worked together otherwise. Be open to new directions that may arise serendipitously. Understand the unique situation of your garden, and plan accordingly – do not put a square peg in a round hole. If your school serves an urban population, it may be that many children do not have a back yard and have never had an opportunity to dig in the dirt; just digging and finding a worm may be a new and exciting experience. In a rural area many children may live on a farm but that does not guarantee that they have themselves done any vegetable gardening.

2. Experienced gardeners advise you not to over-plan or over-intellectualize. Consider your garden as a place to experiment. You will make mistakes, though probably not anything serious or that you cannot readily fix. Do not be afraid to back off from your initial plans if

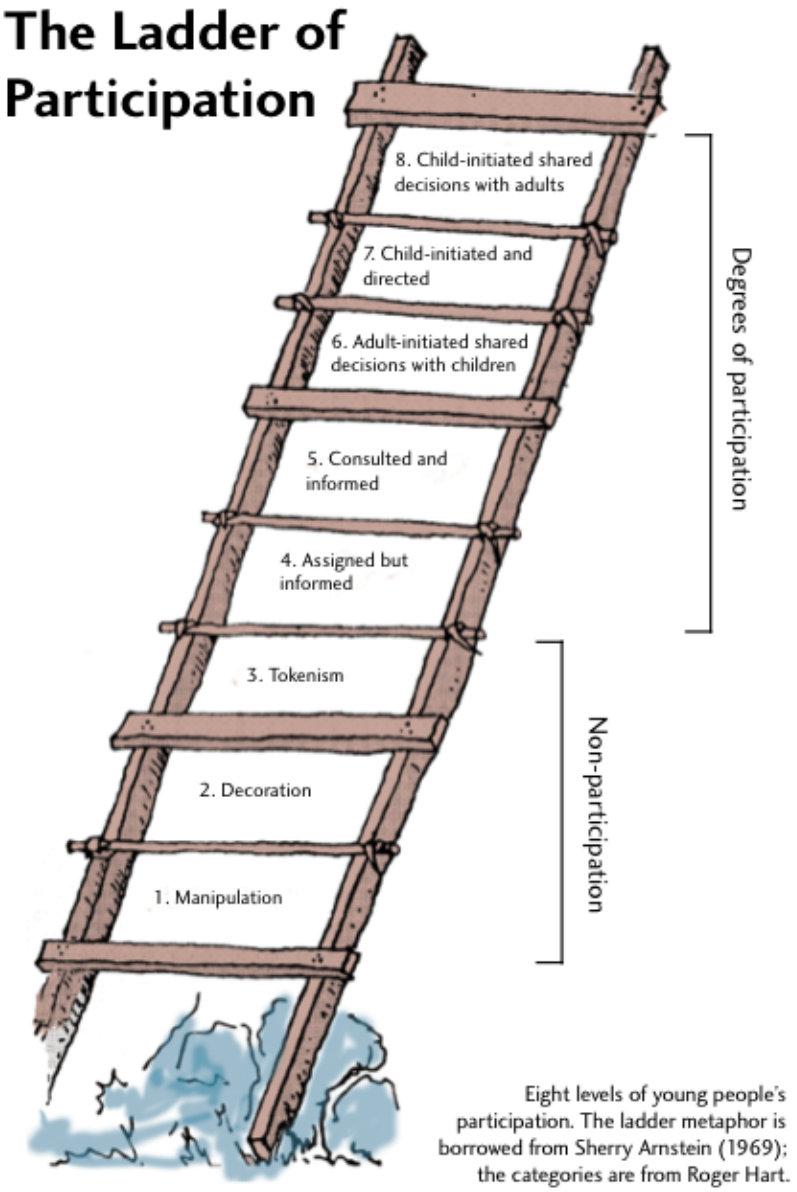
you find they were too ambitious or unfeasible. Make sure that everyone, especially the children, has fun. The children will rush up to an adult with a worm or an insect; they will run home to their family to tell about the day's adventures; they will want to do research on the internet.

3. Who is on your team and how will you engage each individual to build on each person's strengths? The idea for a garden may start with different people – it may be the school principal, or a teacher, or a parent, or a community member. People may have read about or visited successful school gardens. As the project begins to move forward, some people may be enthusiastic, others may have reservations. Everyone is busy, facing many sometimes competing demands. It is vital to understand their concerns and to engage in constructive discussions. Find out what the blocks are, and develop "hooks" that will enable people to overcome the blocks. Over time, garden champions will emerge, sometimes unpredictably. Be ready to welcome the leadership and hard work that such individuals can provide.

4. The adults should remember that the garden belongs to the children. For a school garden, it is important that volunteers support students but not do all of the work. The children, therefore, should care for the garden. Students need to plan, plant, weed, water, harvest, clean, decorate, trim, compost, etc. If our purpose is learning, they will benefit more from the work and sometimes failure of the garden, weeds and all. Adults should ensure safety and provide help when needed; there is a tradeoff between control by the adults and giving students freedom to explore.

Engaging Youth: The Ladder of Participation

Do you engage children and youth in planning and decision-making in your program? Let's use Hart's Ladder of Participation to find out! [1]



Eight levels of young people's participation. The ladder metaphor is borrowed from Sherry Arnstein (1969); the categories are from Roger Hart.

Dr. Roger Hart (co-director of the Children's Environments Research Group, http://cergnyc.org/) created this "ladder" of participation to help us think about where we really are and where we'd

like to be, in terms of children's participation in our programs. This ladder was not created to suggest that we have to be "at the top" rung, but rather, that we ought to be aiming to get out of the lower rungs of non-participation, and think of ways to genuinely engage children and youth.[2]

Below are the main points to consider from the ladder:[2]

Degree of Participation at Each Rung

8. Child-initiated, shared decisions with adults:

- Goal is not about "kids' power."
- Young people feel competent and confident enough in their role as community members to understand the need for collaboration and that in asking adults for their input, the project may be strengthened.
- Lots of trust involved.
- Adults serve as listeners, observers and sounding boards (i.e. they don't jump in with their own designs on the project, or to organize the project). For example, young people may determine that they want to clean up an old wooded hang out area in their community to create a nature trail. They learn about all aspects of creating such a trail, hold meetings to plan it, but check in with a friend's parent in local government, several parents, and a teacher with an interest in ecology, for their diverse ways of thinking about certain aspects the project.

7. Child-initiated and directed projects:

- Adults notice a youth-led project emerging and allow them to occur in a youth-directed fashion.
- Hart places this second on the ladder because occasionally young people don't trust adults enough to seek their input. The caution with this rung is in children carrying out their projects in secret because of fear of adults, or being intimidated by them. An example is a literally secret garden/ landscape that adults are not aware of.

6. Adult-initiated, shared decisions with children:

- Adults assume nothing about what children want in the landscape.
- Children are involved to some degree on every part of the process of garden planning, design, and implementation.
- Children understand issues such as fundraising, garden design, or organization and management.
- Children understand how and why compromises are made, if they are necessary. They may also begin to cultivate a "language" of talking about this with others.

5. Children are consulted and informed about project:

- Project designed and run by adults, but the children's views and opinions are taken seriously.
- A good example is with a survey designed to gather young people's input into a school garden: children are informed of the purpose, they may be asked to volunteer, and afterward, they are fully informed of the results.

4. **Assigned but informed:**
   - Children are assigned to a project and may not initiate the project themselves, but they are fully informed about it (i.e. a school garden project).
   - Children may still have a sense of real ownership of the project.
   - A key aspect of this rung is the degree to which children are engaged in critical reflection. For example, are children just viewed as a free source of help for the garden project, or do they have a chance to reflect on it, consider it, and learn from it?

Non-Participation

3. **Tokenism:**
   - The most challenging and most common among very well-meaning adults.
   - Adults are genuinely concerned about giving children a voice, but haven't really begun to think carefully about the best approach for this.
   - The appearance of children's involvement is there, but in fact, they have had little choice about planning the garden project, communication around it, and no time in which to critically reflect and form their own opinions.
   - An example is that adults select charming, articulate youth to talk about the garden in a public venue, but those youth haven't had ample opportunity to critically reflect or consult with their peers. The key here is symbolic versus actual engagement and involvement.

2. **Decoration:**
   - Involves quite literally, decorating children
   - For example, they may sport garden T-shirts with no involvement in organizing or understanding the program.
   - Adults use children to bolster the program as if the children were understanding participants.
   - For example, adults make children sing garden songs at a harvest festival, and it may even appear that they wrote the song, or that they were involved in organizing the garden or the festival, when in fact they were not.

1. **Manipulation or Deception:**
   - Adults consciously use children's voices to carry their own message about the gardening project.

- For example, they produce a garden poster, advertisement, or publication with drawings by children, when children are not involved in the program planning.
- Adults may deny their own detailed involvement in meetings, planning, shaping the project because they think it diminishes the effectiveness or impact of the project – they may say that children are genuinely engaged, when engagement constitutes weeding or planting.
- Adults may design a garden, have kids do a simple planting, then tell the local newspaper that kids designed and built the garden.

The Planning Process

Planning involves considering each of the many components of the garden program. As you've read in the previous pages, remember to involve the children in the planning, in age-appropriate ways. Use their ideas as teachable moments. It's okay if they say they want to grow bananas in Pennsylvania; then they can learn about what plants can be grown in our climate.

The following article gives an overview of the major steps involved in program development.

Getting a Youth Garden Started[3]

Youth gardens are as distinctive as the people who create and enjoy them. Ideally, they're created to meet local program needs, and use the physical site and available resources to their fullest. Read more about youth gardening. Though each is unique, the steps required to put together a successful and sustainable program are the same. They include:

- Building the Case
- Gathering Support
- Planning the Program
- Designing the Garden
- Searching for Resources
- Digging In
- Maintaining and Sustaining the Garden

Building the Case

To rally support from administrators, teachers, volunteers, and funders, you need to build your case. Why do you need a garden? How will it benefit the youth in your community? Point to research-based evidence and anecdotes that illustrate how the hands-on nature of gardening can enrich the curriculum, will improve students' interest in learning, encourage them to eat well, and develop social skills. Introducing children to gardening instills a life-long passion for plants and respect for the environment.

Youth gardens:

- build an understanding of and respect for nature and our environment
- motivate kids to eat and love fruits and vegetables
- provide opportunities for hands-on learning, inquiry, observation and experimentation
- promote physical activity and quality outdoor experiences
- teach kids to nurture and care for other living things while developing patience

Gathering Support

Next you need to answer, "Who will you involve in your garden program?" The answer is, "Everyone!"

Gardens for Children with Special Needs

Make sure to engage children of all abilities and learning styles the garden project.

Here are some resources:

https://kidsgardening.org/designing-a-school-garden-designing-garden-programs-for-all/

https://schoolgardening.rhs.org.uk/resources/infosheet/hints-tips-for-gardening-with-SEN-students

https://my.chicago.botanic.org/education/therapy/gardening-and-autism

Etherington, Natasha. 2012. Gardening for Children with Autism Spectrum Disorders and Special Educational Needs: Engaging with Nature to Combat Anxiety, Promote Sensory Integration, and Build Social Skills. Jessica Kingsley Publishers.

- Involve the children in every step along the way. Educators across the country report that when students are involved in all stages of the process, they are more invested in the project's success, and are inspired to care for and respect their gardens.
- Obtain buy-in from administrators. Make sure you have solid investment from the top down. Supportive administrators can provide valuable help in finding the time and resources needed for a successful garden project.
- Recruit parents, staff and community volunteers for a garden team. Many hands are needed to ensure a successful, sustainable garden program.
- Creating a team or committee that is actively involved results in the best garden plan possible, and it broadens your reach into the community for resources, adds extra hands for installation, helps prevent volunteer burnout during maintenance, and ensures long-term sustainability.

Planning the Program

"What" comes next. What will your garden accomplish? Although it is tempting to start drawing up landscape plans once a gardening committee is organized, it is important not to skip the step of determining how you will use the completed garden. Each program should have defined goals and objectives. It is hard to chart a path without knowing where you want to end up. To have the most impact, school gardens should be integrated into the curriculum, and community gardens should be crafted to meet local needs. A purposeful garden will be a worthwhile and long-lasting garden.

Designing the Garden

Finally, it is time to design the garden. A very important tip: Plan big, but start small. A large project can exhaust the enthusiasm of your students and volunteers. Let them get excited about the success of a bountiful, enjoyable, small garden, then expand as your confidence and experience increases.

There are many different design options depending on the space and time you have. A traditional outdoor garden is planted in the ground. Unless the area has been cultivated before, you will need a tiller to break the compacted soil before you begin planting.

Another common option is to use raised beds. These are framed structures, typically 9 inches (on soil) to 2 feet (on paved surfaces), made of rot-resistant wood (like cedar), concrete blocks, or recycled plastic planking and filled with soil. Although they require more initial investment than a traditional in-ground garden, the benefits of raised beds pay off in the long run: they're easier to cultivate; you don't have to worry about toxins in the soil, such as lead; there are fewer weed and drainage problems; and the raised soil and plants are protected from crushing footsteps. Plus, design is flexible — you can build them to be handicap accessible, and to fit the space available, whatever the shape or size.

Another outdoor option is to plant in containers. Typically, garden containers are pots and troughs made of clay, plastic, or wood, but plants aren't fussy — they'll grow in anything that holds soil and has drainage holes. Experiment with whatever is at hand, from discarded 5-gallon buckets to an old bathtub! Window boxes and hanging baskets are great if you have little or no ground space.

By adding handles or wheels, or placing containers on wheeled platforms, you can make your garden mobile, and can move plants around the space to where they'll grow best as the season advances or as conditions change (e.g., the angle of the sun shifts slightly each day). If threat of vandalism is extreme, you can move containers to sheltered or locked area.

No room outside? Try an indoor garden. This is a good option for schools/youth organizations in areas where winters are long growing seasons are short. The simplest form of indoor gardening is to place plants in front of windows that receive a decent amount of light. Windows that face south and west are best they usually receive enough light to grow leaf and root vegetables (beets, carrots, lettuce, onions, and radishes) and herbs. East- and north-facing windows do not receive as much light, and are a good place for houseplants. Spend a few days monitoring your window space to determine how much light is available for an indoor garden.
Grow lights designed to hang low over growing areas are a more effective way to produce indoor crops. You can purchase grow lights or you can make your own. With grow lights, you can control the amount of light your plants receive and can expand your crop options to fruit crops like tomatoes and strawberries.

Once you have selected what type of garden you want to plant, it's time to focus on designing your space. Focusing on these concepts will help you create a useful and successful design. Remember these key things:

- a children's garden should be fun and functional

- incorporate sustainable practices
- keep it simple

Searching for Resources

Finding the resources you need to begin and maintain a children's garden is always a challenge, but is doesn't need to be a roadblock. Think of your funding search as an opportunity to allow other community members to participate in an extraordinary youth program. You can find donations, apply for grants, host fundraisers, start a youth garden business—get together with your committee and the kids and get creative! Think of it as a search for people and organizations that can share in your success.

Digging In

It's time to get your hands dirty and work up a sweat! Although the installation processes vary greatly with each design, typically this stage requires you to address:

- weed and grass removal
- soil preparation, including bringing in soil or amending existing soil
- planting of seeds or plants
- how to facilitate basic maintenance including watering, weeding, mulching, and harvesting

It's vitally important to have a dedicated group of parent and community volunteers to help you with garden installation and maintenance. A small adult-to-child ratio ensures a safe experience that provides kids with the most opportunities to contribute.

Here we need to emphasize the importance of good soil preparation. Ask any farmer or gardener—they'll tell you that the most important step in the planting process is preparing the soil. Soil rich in organic matter that drains well produces healthy plants that are more resistant to pest and disease problems.

Maintaining and Sustaining the Garden

Why think about maintenance and sustainability in the planning stages? Youth gardens are a significant investment of time, energy, and resources so you want them to last beyond one growing season! Make plans for maintenance before there is a garden to maintain. Consider long-term costs and volunteer recruitment before you put your first plant in the ground.

Here are a few resources that have information on the planning process, and you will find others among the materials in the "Resources" section of this manual.

Kids Gardening (National Gardening Association)
https://kidsgardening.org/designing-a-school-garden
https://kidsgardening.org/create-sustain-a-program

School Garden Wizard (Chicago Botanic Garden and U.S. Botanic Garden)
https://www.schoolgardenwizard.org/wizard/pdf/plan-guide.pdf

Throughout this guide there are suggestions on how to involve the children in the process. On the main page there are links to several other excellent guides on all aspects of school gardening.

GARDEN MISSION AND GOALS

This manual does not repeat the information you will find in the web resources and books, except for one aspect. Setting the mission and goals for your garden is a crucial step: everything else follows from that. So the next several pages present suggestions for that process.

An early key step is the development of a mission statement for your garden. As you plan and implement your garden, make sure to match your actions with the mission statement; avoid doing things that aren't consistent with the mission. Consider writing a brief (one or two sentences) mission statement followed by more specific statements of goals. You may also wish to prepare a vision statement, which describes what the situation will be upon completion of the mission. As you review your work each year, be sure to re-evaluate the mission statement and goals. *Do you need to refine your initial statements? Are you ready to enhance or broaden your mission?*

Conestoga Elementary School (Penn Manor School District)
Our purpose is to expose students to hands-on education through the use of the garden as an outdoor learning lab.

A mission statement and goals might be as follows[4]:

"Our school garden's mission is to improve the health and well-being of students, families, and the larger community."

Goals

- Cultivate student curiosity and exploration.
- Support student nutrition at school and at home, and encourage every child's ownership over his and her own health.
- Cultivate children's joy in learning by providing opportunities for hands-on learning in school curriculum subjects.
- Provide opportunities for students to take on leadership roles. Support students in sharing their own ideas and having their voices heard.
- Make your school a healthier and greener environment by practicing sustainable gardening techniques that restore natural resources and by teaching students that small steps can go a long way towards creating a healthier environment.
- Teach students and community members about the joys of hard work and physical activity.

Having clearly defined goals for your garden is crucial in helping your project run smoothly. It helps to ensure that those involved are on the same page, allows you to sell the vision of your project to important stakeholders, can help in engaging visitors and recruiting volunteers, and keeps you on track with your growth and development[3].

Whole Kids Foundation

J. Blaine Blayton Elementary School Williamsburg VA
Garden Plan Mission Statement[5]

To create a student-centered, hands-on, interactive garden learning environment to support:

- Grade-level cross-curriculum objectives (especially science education);
- Environmental education;
- Health and wellness education including the importance of nutrition, exercise, sun safety and safety;
- Social education including hunger and poverty issues;
- Children's wellness, curiosity, imagination, and exploration; and
- Parent and community involvement.

The garden will be maintained, as far as possible, using sustainable practices:

- Conserving water by planting native plants and using mulch, rain barrels, soaker hoses, etc.;
- Reducing, re-using and recycling materials;
- Promoting soil health through use of compost, cover crops, etc.; and
- Practicing integrated pest management.

What we grow in the Julian (California) Elementary Character[6]

We grow food. - *We promote good nutrition by planting, tending, harvesting and eating organic fruit, vegetables and herbs.*

We grow citizens. - *We connect children to the natural world and create environmental stewards.*

We grow character. -*We learn leadership, responsibility, and respect when we work in the garden.*

We grow practical gardening skills. - *We learn the nuts and bolts of growing a garden.*

We grow beauty. - *We enjoy our peaceful, beautiful garden as it relaxes our bodies, inspires our minds, and ignites our creativity and imagination.*

We grow academics. - *We study biology, ecology and natural history in our garden classroom.*

We grow stories. - *We develop a "sense of place" as we build a garden that reflects who we are as individuals, as a school and as residents of Julian and the backcountry.*

We grow community. - *We create positive relationships among students, staff, parents and neighbors when we work together.*

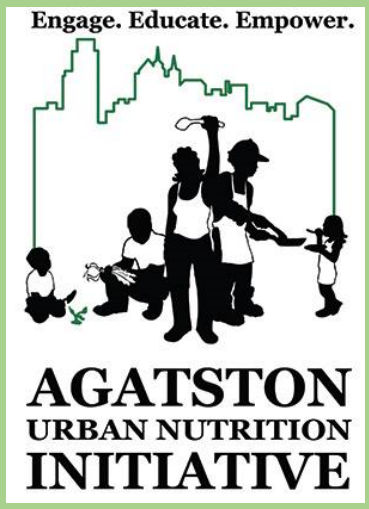
We grow nutrition. - *Childhood obesity harms far too many children in America.*

We grow justice. - *Healthy food gives ALL children a leg up on living well.*

Objectives of the Agatston Urban Nutrition Initiative (Philadelphia)[7]

Our school gardens emphasize nutrition education, sustainable organic agriculture, youth entrepreneurship and neighborhood beautification. We aim to:

- Create and sustain an interdisciplinary curriculum that focuses on improving community health
- Improve nutritional and health status by increasing fruit and vegetable consumption in low-income communities
- Improve the urban environment through school-based gardens
- Facilitate school-based community health promotion projects
- Foster socio-economic development through an entrepreneurial curriculum that includes business development activities



Holding a Vision Meeting[8]

The school garden team should hold a ***vision-creation session*** to formulate a better idea of what the garden should become. This exercise serves to generate discussion among teachers and students about the character of the garden, its primary uses, and the school's priorities for the space. The outcome of the Vision Meeting will be a mission statement and concept design for the garden and should be included in your proposal for support.

Do it democratically!

In addition to team members, invite other faculty, student representatives, a few interested parents, and active community members as appropriate so that everyone who is impacted by the garden has a voice in the planning process. Including a range of perspectives will result in a greater depth of information and will generate good will as well as increased support and participation in the entire school community.

Scheduling

Schedule the Vision Meeting at a time when most participants can attend, ideally setting aside at least 90 minutes for the exercise.

Roles

- Assign one team member to act as a facilitator.
- Another garden team member should take notes and be prepared to transcribe them so that no valuable ideas are lost.
- A third team member should keep track of the group's comments on chart paper, chalkboard, or another large writing surface, so that all can see and react to the input.

Start the session

A facilitator begins the discussion by posing a series of open-ended questions to the group.

- What would you like students to learn in the garden?
- What would you like them to do?
- What topics do you teach that might be enriched by a garden?
- What additional topics could you teach if you had a school garden?
- What student interests might be expressed in this garden?
- What are some potential educational goals for this project?
- What other purposes might this garden serve?
- What existing landscape features present opportunities for an educational garden?
- What are priorities for the garden's design and use?

Tip: Participants should be encouraged to consider a broad range of educational applications of the garden, including its application to math, geography, history, language arts, and fine art, as well as science topics such as biology and ecology.

Tip: As the team considers different possibilities, they can begin to identify teaching goals for their garden. These can be compiled on a separate list, which the school garden team will further refine into a formal garden mission statement as the process moves forward. The resulting list of educational goals will guide curricular activities and teacher training sessions, and ultimately connect classroom lessons with the garden.

During your meeting, you might find it helpful for participants to use a work sheet such as the one below:

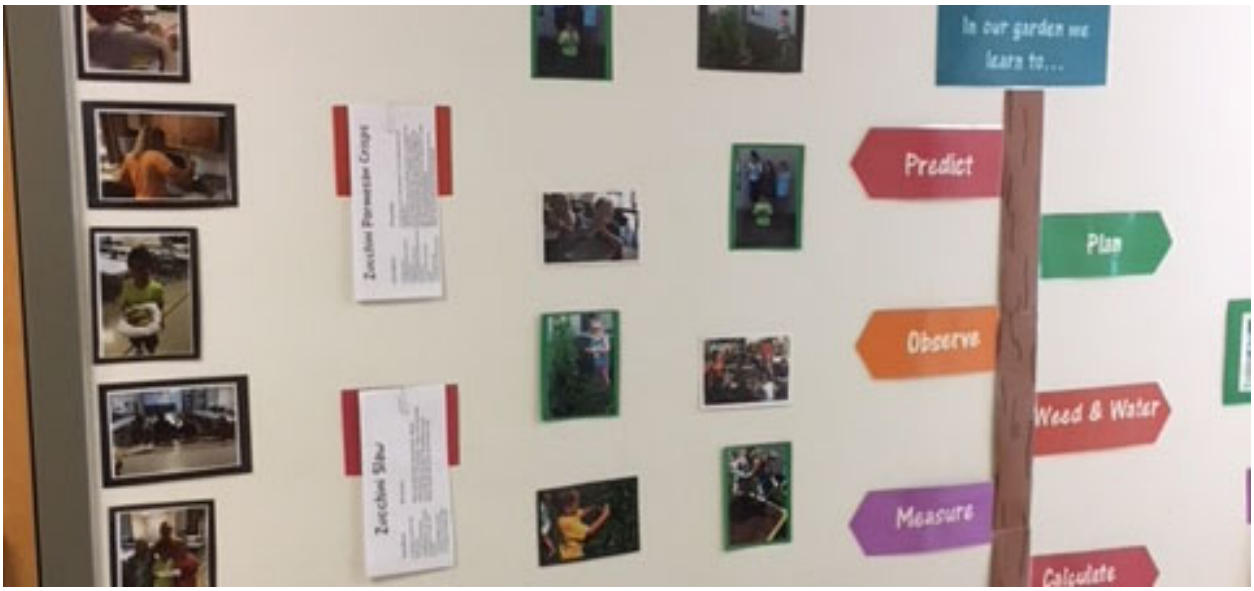
Developing a Vision for your School Garden Program[9]

Working individually, finish these thoughts:

a. A school garden program will be good for our school because…
b. In our school garden students will
   Learn about…..
   Experience…….

If you are here with a school team, share answers to the previous prompt and then together discuss the prompts below. If you are here on your own, think about your school team and their shared ideas and respond to these prompts from your perspective.

a. List 3-4 shared ideas that inspire your team to develop a school garden program
b. Develop a shared vision for your school garden. Describe what that includes.



Determining Your Goals Worksheet

This worksheet is intended to be a guide for you to summarize your goals for the entire project.

1. **Garden as a learning environment**
    a. How will the garden support the larger educational goals and values of the school?
    b. What educational activities and lessons will you incorporate into the garden?
    c. What activities are planned or could be planned to enable learners to:
        i. use the garden for scientific and multi-disciplinary learning?
        ii. gain confidence and enthusiasm for learning?
        iii. acquire gardening and environmental stewardship skills?
        iv. achieve other educational goals through active participation in the garden?
    d. How can the garden meet the learning objectives of a particular lesson or unit?
    e. Do some goals take priority over others? If so, how should this influence the design?
    f. How will you meet the needs of students with disabilities or special learning issues?

2. **School garden team**
    a. Does the team promote active participation by administrators, teachers, students, parents, neighbors, and volunteers?
    b. Who does the school hope to motivate and train to use the garden: the entire faculty, teachers from a specific grade level, only interested teachers?
    c. Is every team member involved, or does most of the work fall to one or two staff members?

3. **Garden maintenance needs**
    a. What are the special maintenance needs of the garden and how will they be met?
    b. Do you have a system for assigning garden chores?
    c. Do you have a system for maintaining the garden during the summer when school is not in session?
    d. If vandalism is a potential challenge, how might it be discouraged and minimized?

4. Teacher training

a. In what areas or topics is training needed? (e.g., garden care and maintenance, curriculum connections, etc.)
b. Are training workshops scheduled at convenient times and locations for the majority of the participants?
c. What topics or content would best meet teachers' needs and interests?
d. Do activities and lessons meeting the local, state, and national standards?
e. What are your sources of expertise for training?

5. Student involvement

a. How will the student body be involved with the garden?
b. What aspects of garden installation and maintenance will the students participate in?
c. What educational activities will the students conduct in the garden?
d. Will the students be engaged in active discovery, problem solving, and questioning?
e. If the garden has already been established, what activities are planned or could be planned for students to:
    i. use the garden for learning across the curriculum?
    ii. gain confidence and enthusiasm for learning?
    iii. acquire gardening and environmental stewardship skills?
    iv. achieve other educational goals through active participation in the garden?
f. What smaller scale events and activities make the garden part of the students' daily lives (such as recess time, story hours, etc.)?

6. Extra-curricular activities

a. For which extra-curricular and community activities will the garden be used?
b. What events, programs, or celebrations will be planned in the garden?
c. What ceremonies or cultural events will be held in the garden?

7. Parents, community, and networking

a. How will the garden team work with existing in-school networks of parents (PTO/PTA/Local School Council)?
b. Where are opportunities to tap into the support and resources offered by parents and parent groups?
c. Is there a citywide network of school garden projects and teams that the school might participate in? If so, how will participation help sustain the garden?
d. How will the school garden be used and supported by the community? What opportunities exist?

Guiding Questions

Once you've considered the general goals and benefits of your garden, it's time to consider your unique situation. The following guiding questions are examples of topics to consider with your planning committee. You may not wish to address all of these in your program; do what is right for your school. As you proceed, you can formulate other questions relevant to your garden. Your goals may change over the years, as you gain experience. For information on how different schools have addressed these issues, consult the subsequent sections of the manual and the materials listed in the *"Resources"* section.

As you decide on your goals, you can simultaneously devise the assessment tools and feedback systems you will use; see the "Assessment" section. Funding organizations are particularly interested in knowing about your goals and assessments. Often, the tools you use in the goal-setting and assessment processes can be similar; you establish the goals and then assess your attainment of each one, determining what may have facilitated or impeded progress and what you would change.

A. CURRICULUM AND OTHER SCHOOL PROGRAMS

1. How will you achieve the central goal of integrating the school garden into the curriculum? The more curricular areas the garden can touch, the greater may be its success. Health, the environment, and science are obvious areas, but so are math, language arts, social studies, art, music, and physical education. As much as possible, the activities should be hands-on and experiential in order to maximally engage the students. The garden leadership group should be knowledgeable about current curriculum standards and how a garden-based program can connect to the standards and reinforce nutrition education. Activities related to the garden should be part of the school day on a regular basis. Who will be responsible for leading the instructional activities in the garden, teachers or other members of the team or both? Will the instructors be given time to develop resources needed for teaching in the garden?

2. Which students will participate in the garden, and what will their roles be? Will all classes in all grades be involved? (The answer may depend on the size of your school and the size of your garden.) How can older children mentor younger children? How will special-needs children be included? If your school is part of a multi-school campus, are there opportunities to partner with the other schools/grades on the campus?

3. How will the garden become part of larger efforts to teach about the environment and sustainability? Are there other sorts of gardens existing or planned at your school, such as rain gardens or pollinator gardens? If so, how can you integrate these activities?

4. Will the garden be integrated with your after school programs and/or summer programs?

5. Given the concerns about nutrition in schools (breakfast, lunch, snacks, vending), how can you integrate the garden's produce and lessons into your school nutrition program? How will you engage with the school nutrition and school health staff?

6. Do your school and district have curriculum standards or general policies about gardens, nutrition, healthy food, etc.? How can you work with school and district leaders to establish and implement such policies to provide lasting benefit from your garden?

B. ORGANIZATION AND SUPPORT

7. Who will be on the garden leadership team? What are the members' roles? Consider broad representation from the many constituencies of your school and community.

8. What existing or new community partners in your school will you engage, such as youth-serving agencies, senior citizens (to pass along cultural knowledge), health agencies, nutrition programs, garden clubs and other garden experts, recreation and parks groups, local college interns, pre-service teachers in your school, etc.? Securing a commitment at the outset from an expert adviser to serve as a resource person could be important to your success.

9. How will you sustain the garden over time, as children and families move on and new ones enter the school, and as teachers, support staff, and administrators change? Funding agencies may expect evidence of a plan for sustainability.

10. What resources in your district are available to you (such as other schools with gardens, agriculture teachers, health teachers, school nurses, district and school nutrition staff, district wellness council, etc.)?

11. How will you engage families in running the garden and benefiting from the produce? Parents could come to school to help prepare food with their children, or recipes could be provided to families.

12. Will you try to secure the support of some organization as the lead sponsor of the garden? Can employees of that organization become volunteers in your program? How will you recognize and publicize the efforts of your lead sponsor and of all your partners and volunteers?

C. GARDEN OPERATIONS

13. Will you grow crops only when school is in session (spring and fall), or will you operate the garden in the summer as well? For spring and fall gardens, there are many fast-growing vegetable crops to choose from. In the summer, you can grow favorites such as tomatoes and peppers. But you will need to assure that people are available to care for the garden (remember recent heat waves and droughts!) and harvest the crops.

14. What do you intend to do with the produce of the garden? Will you use it in classroom or after-school activities, provide it to the school breakfast/lunch program, send it home to the students' families, organize a way for the students to sell it (either after school or at a local farmers' market), or donate it to community groups (such as food bank or senior centers)?

15. How will the garden develop a sense of responsibility, community, leadership skills, group cohesion, etc. among students, families, school staff, and community members?

16. What assessment tools will you use (either your own or from others) to evaluate the various program components you have decided to include? How will apply the results of the evaluation to program improvement?

17. Do you have plans for composting of garden and other waste at your school, so that the compost can be reused in your garden or elsewhere at the school? Can you incorporate lessons about composting into the curriculum?

Policies, Regulation, and Laws About Gardens

As you plan, you need to be aware of policies, regulations, and laws that relate to gardens. These can be specific to your district, or from local, state, or federal government. There will also be various guidelines and best practices. These cover matters such as food safety, accessibility, student privacy, liability, pesticides, etc. Many of these are probably already part of your school's procedures. These topics are addressed in the "Garden" section.

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[7] Setting Up Running a School Garden. United Nation Food and Agriculture Organization. 2005. [Retrieved February 22, 2018] http://www.fao.org/docrep/009/a0218e/a0218e00.htm

[8] School Garden Wizard: Plan for Success. http://www.schoolgardenwizard.org/wizard/pdf/plan_guide.pdf

[9] A Child's Garden of Standards: Linking School Gardens to California. California Department of Education: Nutrition Services Division. 2002. [Retrieved July 10, 2017] http://ucanr.edu/sites/MarinMG/files/122929.pdf

Garden Section

Garden-Introduction, Planning, Budget, What to do In The Summer, Sustaining The Garden

You're eager to dig–but there are many things to plan before you start. Allow plenty of time for planning. Once the weather is right, you'll be very busy, so it's essential that you have detailed written plans and schedules. But be prepared to adapt on the fly as necessary! Have all your material ready and your volunteers trained. Get the students involved early. Depending on the weather, you may be able to plant some seeds in the ground by late March, and you can begin growing plants indoors for later transplanting around that time also. As part of your plan for sustaining the garden, keep detailed records of what you did, what worked and what didn't, and what changes should be made in future years.

In the sections about the garden, you will find information for starting a garden from scratch. You may have to begin that work many months before planting-in the summer or fall before your first spring planting, for example. Developing a budget and a financial plan are important early steps. Here is information on choosing a site, deciding if you will use raised beds or plant directly in the ground, preparing soil, choosing what crops you'll grow and how (from seeds or from transplants), caring for the garden (watering, weeding, and fertilizing), and harvesting and using your crops. There is a vast amount of material available on the internet and in print about these topics; the "Resources" section in this manual contains an extensive list of information resources.

STARTING POINT: SCHOOL AND COMMUNITY GARDENS

A school garden is a place for children and adults to learn and to experiment. Part of the challenge and the fun and satisfaction is trying new things, finding out what works and what doesn't, and applying the experiences in the new year. But there will always be new wrinkles in terms of the weather or new ideas from the children. A garden is never boring! Keep in mind that just about everything you do in the garden is a teachable lesson. Remember that you are creating an engaging, educational, fun, and safe place for children and adults. It's a kid's space, so it may be a bit untidy, too.

The amount of information of the internet and in print about gardening is mind-boggling. It's hard to judge what is reliable. Generally, this manual relies mostly on (and provides references to) information from state and federal government resources, universities, and non-profit organization. Here are highlights of resources about vegetable gardening.

Each state has, through its land grant university (Penn State, Rutgers, Cornell, etc.), an agricultural extension service. These organizations, often with offices in every county, provide a wealth of information through web sites, publications, workshops, and in-person consulting. They have expanded their missions beyond traditional farm support to providing support for education, nutrition, waste management, home gardening, urban issues, etc. Many references to extension services are given in this manual; here are the main pages for the extension services in our region:

- Delaware- http://extension.udel.edu/
- Maryland- http://extension.umd.edu/
- New Jersey- http://njaes.rutgers.edu/
- New York- http://www.cce.cornell.edu/Pages/Default.aspx
- Pennsylvania- http://extension.psu.edu/

Your local certified master gardeners are an excellent source of information on all aspects of gardening and environmental stewardship. They work with the county extension office. Master gardeners are volunteers who have completed a rigorous curriculum on horticulture involving over 40 hours of instruction. They then commit to

serving their communities by providing advice, giving talks, maintaining demonstration and research gardens, working with youth groups and garden clubs, etc.

The Kids Gardening program of the National Gardening Association has dozens of valuable articles on all aspects of school and community garden programs, in the following parts of the web site:
https://kidsgardening.org/educator-resources
https://kidsgardening.org/gardening-toolbox

The Collective School Gardening Network has a complete downloadable guide to school gardening as well as much additional material, videos, handouts, and resource lists.
http://www.csgn.org/csysg

The Massachusetts Agriculture in the Classroom Program has manuals and guides on most topics covered in this chapter, along with many other resources. As you begin, read the detailed “Garden Start-Up Guide” on http://www.aginclassroom.org/ag-curriculum.

Of the innumerable books on gardening, local school and community gardeners recommend the following. See the "Resources" chapter for additional books and online materials.

- Bartholomew, M. 2013. All New Square Foot Gardening. Minneapolis MN. Cool Springs Press
- Bucklin-Sporer, A., and R.K. Pringle. How to Grow a School Garden. 2010. Portland OR. Timber Press
- Raymond, D. 1983. Garden Way's Joy of Gardening. North Adams MA. Storey Publishing

The catalogs and websites of seed companies provide lots of information. Use these to choose the varieties of crops you will plant. Even if you buy seedlings from a local nursery, the information from the seed companies will guide you.

Remember that from the beginning you should work with your building and district staff and administration. It is essential to get those people on your side and to keep them informed, engaged, and supportive. That will make your job and their jobs easier and more rewarding.

Make sure your garden is a safe place for everyone. Adults and children should receive instruction on using tools, avoiding tripping, washing hands, eating food only when permitted, etc. Make sure you read the label and follow safety instructions on all products such as soil amendments, fertilizers, and pest control materials. See the section below on safety for full details on all aspects of the garden program.

SITE SELECTION

Finding the proper site for your garden is a crucial first step. There may be few options on your school property, or you may have many possibilities. Some of the site selection criteria will relate to other features of your garden that you'll need to consider. See:

- "Siting the Garden" at http://www.aginclassroom.org/ag-curriculum
- If you have limited space, see "School Gardening In The City" at http://www.aginclassroom.org/ag-curriculum
- https://kidsgardening.org/designing-a-school-garden-designing-and-placing-the-garden/
- https://www.schoolgardenwizard.org/wizard/pdf/plan_guide.pdf

Here are some essential factors to examine.

- Work with the school and district administration on site selection.
- The site should receive at least 6 hours of full sunlight daily during the growing season. So take into account the location of buildings and trees. You should observe conditions the summer before you plan to start. There is additional information on sun requirements in the section on "What to Plant".
- The garden should be fairly close to the school building.
- The site should be fairly level, considering accessibility for people in wheelchairs.
- There must be access to water. At the minimum, there should be an outside hose bib close to the garden so you can run a hose to the garden. If possible, install a more permanent water supply at one or more locations in the garden.
- Find out if there are any plans for new construction on the school property, so that you are not faced with the need to relocate the garden.
- Your garden may start out small, but provide room for expansion (more vegetables, fruit trees, a natural area, etc.)
- Make sure there are no buried utility lines (water, sewer, electric, etc.) or other obstacles (old foundations, rock fill dumps, etc.) in the depth that you will be cultivating. On school property the district administration should be able to help you. In other areas consult the land owner, municipality, or PA-1-Call at http://www.pa1call.org
- You may choose to have your garden directly in the soil or you may use raised beds (see section below). Raised beds can be placed on the ground or on pavement. It will probably be cost-prohibitive to remove pavement, and it is not necessary.

- As you examine possible sites, you should simultaneously determine (in a preliminary way) the garden layout. In addition to space for the plants, you will need room for paths, instructional areas, benches and tables, a storage area, a composting area, etc. Remember that there may be dozens of children working in the garden at the same time.
- It is important to know the history of your site. If you suspect that the area has been contaminated with wastes, you should arrange to test for such materials. Raised beds are an alternative if the soil is unacceptably contaminated. In some areas lead contamination is a concern. In the past lead was used in many products, such as paint, automobile fuel, etc. Therefore, it may have accumulated in the soil if your garden is near a busy street or highway, is near old painted structures (a building or a fence), etc. Soil testing for lead is readily available; check with your school or local government. If older lead water pipes are a problem in your community, you should confirm that the water supply for your garden is safe. Here is a resource with a detailed discussion of precautions to observe if there is lead or other materials in the area:
- https://kidsgardening.org/designing-a-school-garden-plan-for-a-safe-and-successful-edible-garden/

IN THE GROUND OR IN RAISED BEDS?

Many school gardens use raised beds, but you may prefer to put your garden directly in the soil. You may decide to have some areas of each type. What are the advantages and disadvantages? See “Building The Garden” at http://www.aginclassroom.org/ag-curriculum

Raised beds involve expenses for the lumber and soil and then labor to construct the beds. Don't underestimate the quantity of soil it takes to fill the beds! But you can obtain a high-quality soil mixture with ideal composition for your plants. In the spring the soil in a raised bed will warm up faster, allowing you to start seeds earlier. This is an important consideration since you want to harvest crops before the end of the school year. You can construct raised beds of any height; a high bed is essential for children in wheelchairs. If your garden is on a paved area, then raised beds are your only option. Over time the wood of the raised beds may rot, so replacement may be necessary.

A garden in the ground may be much easier and less expensive to start, since there are no beds to construct and fill. The soils in much of Lancaster County are excellent for garden crops, although you may have to amend the soil with compost or fertilizer. This garden may require more or less extensive preparation before you can start. If the area had previously been lawn or meadow, then getting rid of the previous plants (now "weeds") may require persistent effort over a couple of years. Sheet mulching or “Lasagna Gardening” (described in the box below) can help you get started, but

several months are required. For faster results, though with a lot of work, dig out the turf and knock off all the dirt. The vegetation can then be composted. Check to see if there are problems with drainage, presence of debris or contaminants, etc. With an in-

Lasagna Gardening-Sheet Mulching

Sheet mulching is a great way to get your garden started if you need to do major improvements to an area that was a lawn, a meadow, or previously-paved. Some people establish raised beds by using this method to build the planting soil rather than or in addition to bringing in soil. You need to start at least 6 months ahead. For example, do the sheet mulching no later than late summer or early fall so your garden is ready the following spring. You can also use sheet mulching on established gardens after the growing season is over, or on a bed that will be idle between the spring and fall growing seasons (the decomposition occurs much faster in the warm weather). If you have extra land, consider sheet mulching areas that are not in use in a particular year to build their fertility for the future.

The basic idea is to create a weed suppression layer and then cover that with organic material that decomposes, as in a compost pile. If you are covering a lawn or other area with plants, the sheet mulching will kill those plants and their decomposition will contribute minerals to the soil that is built.

Cover the area with pieces of corrugated cardboard (cut open old boxes), or sheets of newspaper (a few sheets thick) can be used as an alternative. In the simplest version, you then cover with several inches of compost, and you can also add mulch on top. You might not have lots of compost, but check with your municipality's parks department to see if they can provide it, or you can purchase compost. Wet the area to start, and maintain moisture throughout the process. Watering will probably be necessary in the warmer months, but may not be necessary over winter.

If you don't have compost to start with, you will make your own compost on site by layering materials above the cardboard or newspaper layer. Because there are so many different "lasagna layering methods" to be found, there probably is much flexibility in how you go about it. Use the materials that you can most easily obtain. As described in the section on composting, place successive alternating layers of "green" (nitrogen-rich) and "brown" (carbon-rich) materials. You can pile materials one to two feet thick, since once decomposition starts, the material will compress significantly.

After several months the area will be ready for planting, with a much-improved soil. Before you plant, remove any remaining cardboard or newspaper and allow the soil to dry thoroughly. Shallow tilling can then be done. For another approach see: https://kidsgardening.org/designing-a-school-garden-building-a-lasagna-garden/

ground garden, weeds will easily spread into the crop, so you should keep the paths well mulched.

You may decide to grow some plants in containers. Because of the limited soil volume, they will require particular attention to watering and fertilizing. Make sure that containers have adequate drainage holes. There's no need to buy expensive containers; things such as five-gallon buckets or livestock watering troughs are fine. See:

- http://www.aginclassroom.org/ag-curriculum "ContainerGardening"
- https://kidsgardening.org/designing-a-school-garden-consider-container-gardening/

A recent innovation is the use of straw bales (not hay!) for gardens. Plants are placed directly into the bale, which serves as the container. This could be a novelty as part of your project. See: http://strawbalegardens.com for more information.

Here is more information on constructing raised beds: Children should not climb into a raised bed; the idea is to work from outside. Lumber 2"x8" or 12" is often used, but for durability some people suggest stacked 4" or 6" square timbers held together with spikes or rebar. For very young children, it may be better to keep the width to 3 feet so they can reach to the center (rather than the more conventional 4 feet). Raised beds are usually made with sides 8 to 12 inches high. A height of 18-24 inches is preferred if the beds are placed on pavement, but remember that a deeper bed will require more soil. Raised beds on the soil do not need a bottom, but those placed on pavement might need a bottom and can be raised an inch or two to allow for good drainage. On pavement you should line the bottom of the beds with landscape fabric (available at any garden store) to allow water drainage, but to retain the soil. There is no limitation on the length of the beds, but 8-foot lengths are common. Synthetic materials sold for raised beds are quite expensive compared to natural wood. Pressure treated wood sold today does not contain the arsenic used decades ago, but you may wish to avoid it for a garden used by children to grow food. Cinder blocks can also be used to make raised beds.

Many of the materials listed in the "Resources" chapter of this manual contain information on raised beds. Here are some useful web sites:

- http://www.kidsgardening.org/designing-a-school-garden-raised-beds-101
- http://www.csgn.org/soils-and-garden-bed-preparation

LAYOUT

Once you have selected the site and chosen either raised beds or in-ground planting (or a combination), you can begin developing the layout of your garden. Determine if you will limit your garden to vegetables, or if you want to include other types of plants (see below). You may want your garden to have areas that relate to various aspects of environmental education. Decide which areas you will use right away and which will be set aside for future expansion. Don't necessarily restrict your design to straight lines and rectangles; curving paths, round beds, etc. can add interest to the garden. You can get advice about garden design from other garden leaders, master gardeners, or a professional landscape designer.

Here are some resources to help you with the garden design process:

- https://kidsgardening.org/designing-a-school-garden-designing-and-placing-the-garden/
- http://www.schoolgardenwizard.org/wizard/create/designing.php
- http://www.csgn.org/designing-your-garden

Experienced school and community gardeners recommend that you use the design process as a way to engage people. A meeting with everyone involved is a great way to begin this process. You could have groups identify what they'd like in the garden and come up with their own drawings. Arrange for people to visit other gardens in the area, and show photos or diagrams you can find in the materials listed in the "Resources" chapter. Keep coming back to your stakeholders as the design is developed. As a way to build enthusiasm and collect feedback, banners showing the proposed design can be displayed during events attended by parents.

Above all, get the children actively participating in this process. Teachers can include their input in lessons, such as a math lesson about calculating area or a social studies lesson about plants used in different cultures.

Here are some components that are essential in any vegetable garden.

- Planting beds
- Paths between beds: these should be wide enough to accommodate wheelchairs. If you are planting in the ground, it's important to demarcate paths so children are less likely to walk across the crops. Decide what material to use for the paths, again considering wheelchair access.
- Instructional area large enough to accommodate the classes that will use the garden.
- Tables or benches (which may or may not be part of the instructional area)
- Shed(s) that can be locked
- Compost area; area for garbage cans
- Water supply
- Washing station for cleaning up after work and for washing harvested crops
- Fencing: Small animals such as rabbits or groundhogs are a problem nearly everywhere. Do you also need to keep deer out? You want to keep children from wandering out during their gardening time, and from wandering in at any time.

Among the optional components (or to be added later) are the following. See the section below on "Special Gardens" for more detail and resource material.

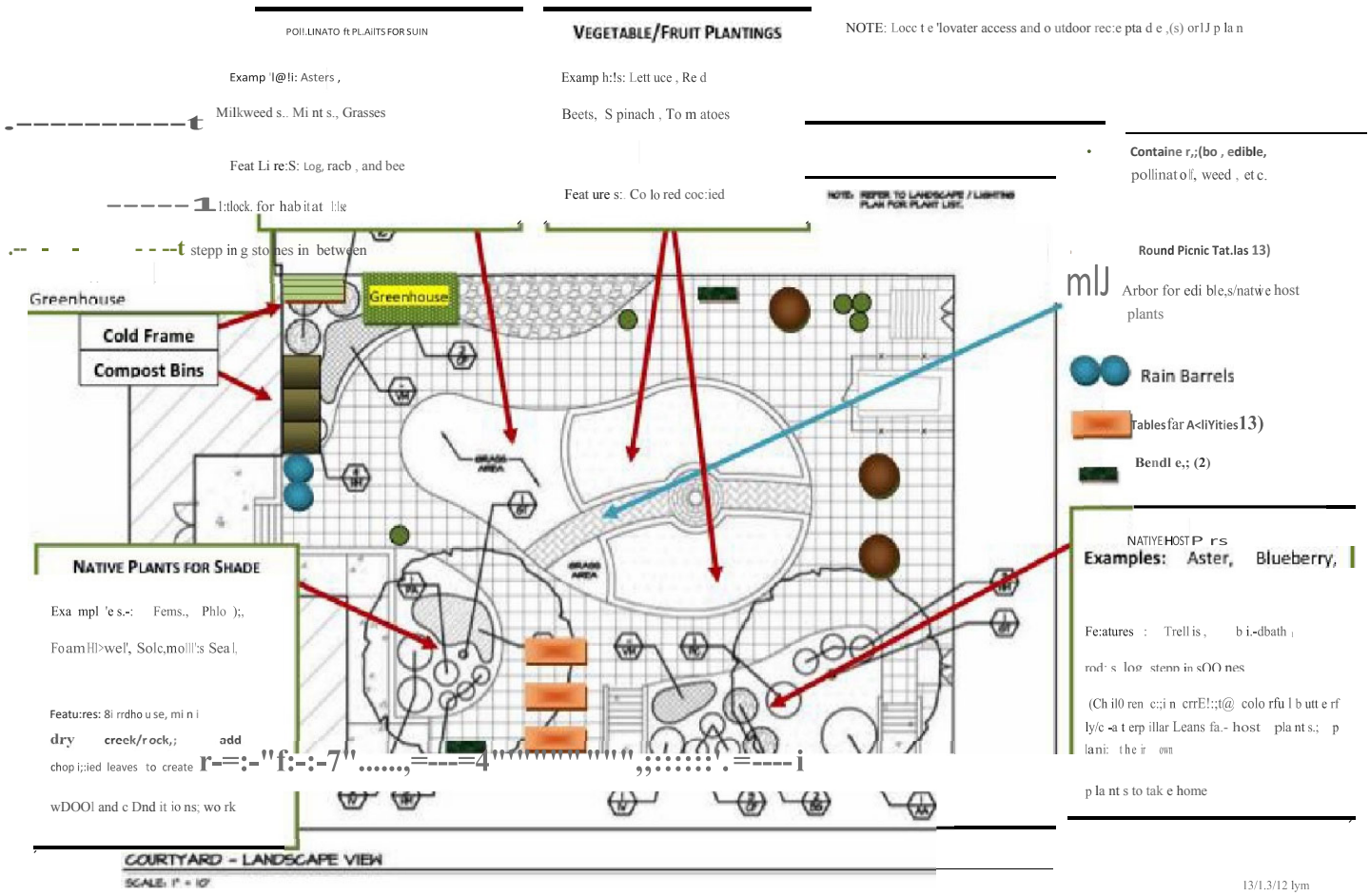
- Pollinator garden
- Flower garden
- Fruit garden
- Butterfly garden
- Trees: shade is pleasant, but remember in choosing the location that vegetables need lots of sun. Trees on the north side will not be a problem.
- Birdbath and bird feeder
- Greenhouses or growing tunnels

Providing some space for a pollinator garden should be a high priority. The vital role of bees and other pollinators in nature is an important lesson for children. There are a

great many easily grown annual and perennial plants whose flowers are attractive to bees. Provide a wide range of plants so there is always something in bloom.

LAYOUT EXAMPLE

Washington School: The garden at Washington Elementary School (Lancaster) is a little unusual in that it is in an interior courtyard. It is designed for environmental education, so it includes not only vegetables but also pollinator plants, butterfly plants, etc.



BUDGET

The garden budget will include items needed for initial construction and operation (such as material for raised beds, a shed, tables, tools, signs, etc.), items needed yearly (such as seeds and plants), and items needed occasionally for repair and replacement. Some items are essential, while others could be deferred until later years, as your program develops. So your planning and budgeting processes should include a phased implementation plan. Every garden budget will be different.

Many garden resources include sample budgets and lists of materials needed. Here are some examples:

- Green Education Foundation Budget Calculator
  http://www.greeneducationfoundation.org/greenthumbchallengesub/start-up-kit/budgeting-resources.html

  This site contains a fillable spreadsheet that uses estimated prices for various items and allows you to calculate a budget. Note that this spreadsheet does not include the cost of materials for raised beds.

- Massachusetts Agriculture in the Classroom
  http://www.aginclassroom.org/ag-curriculum "Garden Start Up Guide"
  Appendix C has a basic budget for a garden with two raised beds.

- Collective School Gardening Network
  http://www.csgn.org/sites/csgn.org/files/garden_budget_1.pdf
  Very detailed list of options. Prices are from several years ago.

Include funds for outreach and communication. You will want signs or banners. Perhaps you will send home announcements or newsletters. For internet and social media communication, you may find someone to volunteer to do that work, or you could hire a high school student.

Enhancing the expertise of the school staff and parent volunteers is important to a successful program. Find out about workshops and classes offered by local or regional organizations. Perhaps someone will want to take the Master Gardener course offered by the Penn State Agricultural Extension Office. Your budget should include funds for such training activities, and travel/living expenses if they are elsewhere. The return on this investment can be great. Consider adding some books and other materials about gardens to the school media center and to the teachers' resource center. The school or district may be able to help with these expenses.

On the following pages you will find a detailed budget from a local school. They did not have to build raised beds, since permanent concrete beds were installed as part of a construction project. This budget is a preliminary, "work in progress" budget that is presented to give you an idea of what one school was considering. Budget and planning go hand in hand, so they include ideas on phasing.

Costs & Phasing

Item	Phase	Season	Year	Labor Source	Material Needed	Material Source	Funding Source(s)
Soil Preparation	I	Summer	2012		Compost/ Leaves	Manheim Township	Free
Compost Bins	I	Summer	2012				
Water Access Plumbing	I	Summer	2012	School			
Stones/Rocks	I	Fall	2012				
Plantings (trees/shrubs)	I	Fall	2012				
Rain Barrels	II	Spring	2013				
Water Feature (optional)	II	Spring	2013				
Garden Sculpture	II	Spring	2013	Students			
Benches	II	Spring	2013	School Vendor			
Picnic Tables	II	Spring	2013	School Vendor			
Permanent Containers	II	Spring	2013	School			
Containers for Students & Parents (Topsy Turvy)							
Container Plantings & Soil	II	Spring	2013				
Plantings (natives / pollinators / vegetables)	II	Spring/ Summer	2013	Volunteers			Incorporate into grant
Electrical Access to Courtyard	III	Spring/ Summer	2014	School Vendor	Receps		Build into future grant to expand educational activities
Cold Frame	III	Spring/ Summer	2014				Build into future grant to expand educational activities
Trellis or Tutuer (1-3)- vertical gardening options	III	Spring/ Summer	2014				
Mini Greenhouse	III	Spring/ Summer	2014				Build into future grant to expand educational activities

SAMPLE BUDGET

ITEM	PRICE	QTY	COMMENTS
Soil and Compost (amendments for vegetable/fruit gardens and leaves for native plants in woodland conditions)	unknown		Township Public Works - Compost Facility; calculate the amount of compost needed for beds
Garden Shed for Storage	unknown		Utilize the existing closet inside the building for storage; consider use of the basement storage area outside in the courtyard - check with Maintenance Staff for use (consider painting or decorating the stainless doors to basement due to extreme reflective light/glaring)
Potting Station (include potting/weather station?)	unknown	1	Design with individual who will donate labor and materials; ensure handicap accessible
Tables for Activities	$200.00	3	Use heavy duty plastic tables that handle weather for durable use and ease of use
Tools & Supplies	$300.00		Trowels, rakes, hoes, gloves, wheelbarrow, watering wands, hose, dandelion fork, buckets (FREE) and/or watering cans; currently have 2 pitch forks, brooms & shovels
Garden Education Materials	$200.00		Clipboards, water gauge, magnifying glasses, journals, etc.; costs for ongoing materials? Topsy turvy gardens, etc.; take an inventory of materials on-hand
Signage (depends on custom or student creations)	$500.00		Low End $500 - High End $3,000; Plant markers, permanent educational signage, sign to thank contributors, etc.; name of garden & branding; invite children and adults to participate in brainstorming ideas for the garden including a name for the garden - it will help them stay connected and promote bonding to the garden (signage is a huge part of identifying with a garden)
Marketing/PR (Connections with Lancaster New Era - Ad Crable, Pennysaver, etc.)	$100.00		Costs associated with promoting the garden? Newsletters, flyers, mailings, etc. (manage as much via digital methods and other social media connections - Facebook, Twitter, Blogs, etc.; create a student garden newsletter
Rain Barrels with Connection	$320.00	2	2 55-gallon barrels plus the connection; will also need a section of hose to run to drainage basin as overflow (NOTE: unable to filter into

			rain garden design due to proximity to building and problems with water in basement)
Garden Sculpture (materials)	$100.00	1	3-dimensional art works designed by students - use of recycled art (clay, etc) that decomposes into landscape; start up budget only - included funds for future projects?
Benches	$2,100.00	3	approx. $700 each; 5' benches for seating areas
Round Picnic Tables (for adults/children sitting; functional for in school and afterschool activities where parents/teachers/children can enjoy mealtimes)	$750.00	3	select exterior picnic table in earth tones with an umbrella hole; recommend use of earth tones for umbrellas
Umbrellas for (3) Round Picnic Tables	$200.00	3	Shop around for pricing; use of school vendors to compare pricing.
Containers (consider scale and use	$500.00	5	$100 each - excludes potting soil; 1. wetland container, 2. shade container, 3. full sun container, 4. herb container, 5. annuals; create hypertufa pots as student project and showcase pots in groupings **(NOTE: two separate types of containers)**
Compost Bins	unknown	3	Create out of wood pallets (FREE from local businesses); recycle leaves, garden clippings, food wastes (no cheese/meats), etc.
Potting Soil (# of bags per container - pending size) - for topsy turvy project and permanent containers in garden	$300.00		For containers (may include peat moss for acidic conditions, vermiculite, etc); purchase by scoop from supplier and/or create own soil mix; 1-year topsy turvy 90 pots - calculate amount needed for this project
Arbor Design (creation of a tunnel effect - plant beans, native vines, etc.) - optional	$500.00	1	Custom - Cedar or Pressure Treated? Optional arbor could be a phase II or phase III; another option for an in-house student design project or possible Boy Scout project?
Trellis or Tutuer (1-3)- vertical gardening options	$250.00	3	Custom or Standard Design - Cedar or Pressure Treated? Expand education areas with vertical gardening projects; flexibility in design options (FREE - use of bamboo or custom design)
Bee Block (s) & Birdhouse Materials	unknown	2-3	Seek non pressure treated wood donations; student workshops to create and install; attract wildlife for study & observation
Water Access	$1,300.00	1	Water access in courtyard essential for watering landscape/hand washing - define location

Outdoor Receptacle (s)	$500.00	2	Any current receps? Is there any need for outdoor receptacle use during evening events???; low end $500 to high end $1,000; locate on each end of the courtyard for easy access
Cold frame	$375.00	1	Expand learning opportunity/growing season for food crops with cold frame; use of tampered glass for safety if using recycled materials such as a patio door
Mini Greenhouse	$500.00	1	
Natural Log/Rocks	unknown		Include a log (or logs) in design to discuss decomposition; local rocks/logs add natural elements among the plantings to re-create conditions in nature for observation and study (seek from park/preserve) Excludes price for pickup and installation
Trees & Shrubs & Herbaceous (Local Vendors)	$1,000.00		Seeds/plants to grow vegetables/fruits/herbs & flowers for food and study and trees/shrubs/herbaceous plant material
General Maintenance	unknown		Funds set aside for ongoing maintenance from school district if support staff time needed?
Preliminary Budget for Garden	**$9,995.00**		**Comments:** Volunteer labor to prepare garden and install plantings; offer parent/child workshops during phase implementations

TOOLS AND OTHER MATERIALS

Following is a basic list of tools and materials to start your project. (Not included are construction materials for raised beds, fencing, etc.) Some will be used by adults only, whereas others are for the children. Make sure that tools for the children are appropriately sized. Quantities of tools needed will depend on your particular program. You may need different types of these items for different tasks, such as various types of shovels or hoes. If you are doing composting or if you are doing some indoor gardening, you will need the appropriate materials. You should have a collection of basic household tools: hammer, screwdriver, drill, pliers, saw, etc. Not included are special items you may only occasionally need (such as a tiller when you are first establishing your garden).

Make sure to buy sturdy, durable tools. You may be able to find tools at yard sales, but be sure they are in excellent condition and suitable for the children. You will need to plan on a certain amount of annual replacement.

Safety is an important consideration for anyone using tools. Make sure that the tools you select are designed and constructed with safety in mind. Children (and adults) should be trained in the safe use of tools at the outset, with reminders as necessary. Children should understand that using tools is a privilege.

For The Garden

Shovels
Hand trowels
Pitchforks
Hand cultivators
Hoes
Rakes
Pruners
Buckets – 5 gallon
Wheelbarrow
Permanent markers (waterproof)
Irrigation system, including timer materials
Poles and trellises for tall plants
Fertilizers
Row markers and string
Plant labels
Scissors (for harvesting)
Baskets
Watering hose and spray nozzle
Watering cans
Gloves
Trash containers
Cart
Measuring cups
Pest Control
First aid kit (including materials for insect stings / bites)

"Pest control materials" include a wide range of options (not just "pesticides"). As discussed below, you might use fencing to keep out rabbits, special lightweight fabrics to keep out flying insects, etc. ***Note on pesticides and fertilizers:*** See the section below on materials that are safer and more compatible with sustainable practices.

FOR TEACHING

Hand lenses
White boards
Clipboards for students
Pens and pencils
Notebooks/journals

FOR STARTING SEEDLINGS INDOORS

Plant trays and pots
Potting mixes
Row markers and plant labels
Lighting system
Watering system

FOR PREPARING FOOD FROM THE GARDEN PRODUCE

Microwave
Toaster oven
Cooking utensils
Eating utensils
Basic food items such as cooking oil, salt, etc.
Herbs and spices (but hopefully you will grow some of those!)

WHAT TO DO IN THE SUMMER

A problem faced by school gardeners, though not by community or workplace gardeners, is the upkeep and harvesting during the summer. To most people, a garden

means fresh tomatoes, peppers, squash, beans, and melons. But summer is when there is a great need for weeding, watering, and harvesting, and school isn't in session! Your garden may be in a location (such as an interior courtyard) that is inaccessible to the community in the summer or you may be concerned about finding people to do the work during the summer.

Many schools have developed summer programs that keep students and families engaged. You could partner with organizations that provide summer day camps or child care, or with neighbors in the community.

Here are some suggestions for the summer from the detailed "Summer Garden Care" guide[1] at http://www.aginclassroom.org/ag-curriculum

- Enlist the **aid of parent volunteers** to share the work. Create a summer schedule in spring and ask families to sign up to adopt the garden for one week during the summer. Reward them with the chance to harvest during their assigned week.
- Develop a **garden apprenticeship program** for the school garden and mentor students from a local high school or youth group.
- Hire **student interns** to take care of the garden in summer. Write a job description and conduct interviews.
- Schedule a **work day in the garden** one day each week during the summer. Invite students, parents, teachers and community groups to join you in caring for the garden. A teacher at Conestoga Elementary School (Penn Manor) organizes a weekly story hour in the garden as part of a program to bring families to the garden.
- Invite **a local summer camp** to utilize the garden as an outdoor educational classroom, or organize your own summer garden camp.
- Plant a **moveable garden** in containers and send the garden home with students for the summer. Washington Elementary School (Lancaster) gives families tomato plants in planters to take home.
- Make the garden as low-maintenance as possible. **Mulch heavily** to reduce weed competition and hold moisture in the soil so less watering is needed.
- Install **drip irrigation** under mulch and engage school staff or volunteers to turn water on a few hours a week, as necessary.
- Plant **drought-tolerant plants** that can survive without watering.
- Schedule your garden to match the school season. Use primarily fall and spring maturing crops. Harvest early crops such as peas, radish, lettuce and strawberries in the spring; and long season crops such as pumpkins, corn and collards when school is back in session in the fall. Potatoes can also fit this schedule of spring planting and fall harvesting. The "Healthy Foods for Healthy Kids" program in Delaware uses fast-growing cool-season crops in spring and fall (http://www.healthyfoodsforhealthykids.org). The garden is "on vacation" in

the summer. See also https://kidsgardening.org/gardening-basics-maintaining-a-school-garden-in-summer.

SUMMER PROGRAM AT CONESTOGA ELEMENTARY SCHOOL (by Beth Horst)

At the end of the school year, the Garden Coordinators send out a request for families to tend the garden for one designated week over the summer. We first invited families on the garden committee, as they already have shown interest in helping. Then additional families that express interest may sign up. The families must visit the garden at least once during their given week, but they may visit as often as they'd like. We post a list of expected tasks in the shed. We also ask that they write a brief journal entry to document any happenings in the garden. We do have a drip irrigation system that takes care of watering.

As an additional outreach this summer, we instituted Story Time and Tea in the Garden on three days from 9:30 to 11:30 AM. Any interested families can join us to listen to garden-related stories, walk around and observe the garden, and enjoy some cold Meadow Tea. The Garden Coordinators and any willing teachers lead the activities. For example, one day we focused on insects in the garden; the read aloud stories and other activities related to that theme.

SUMMER PROGRAM AT BLUE BALL ELEMENTARY SCHOOL (by Lori Noyes)

Here is the descriptive letter/permission form Mrs. Noyes sends to the families of her third grade students at the end of the school year. When students attend, they may complete a journal entry for the classroom web site. If necessary, Mrs. Noyes or the school custodian takes care of any additional garden chores at other times.

Dear Parents and Students,
We expect to have a great time preparing, planting, and learning in our garden this spring. We have planted some lettuce and spinach, and look forward to harvesting some before the end of school. The other crops will be growing and maturing over the summer and into the fall. I would like to offer your students the opportunity to continue to observe and take care of the garden over the summer months. Some tentative dates are Wed. June 26, Wed. July 10, Wed. July 24, and Wed. August 7. These dates may need to change due to weather conditions and accessibility (building cleaning schedule has not yet been set).

If this is something that interests you and your student, please fill out and return the bottom of this paper by Friday May 24. Depending on the amount of interest, I may need to assign students to a certain date to keep the group a manageable size. Watch your email for further information and confirmation of dates (if you do not have email, I will contact you by phone).

If your child participates, you are welcome to stay for the hour, or come back to pick up your child at 10 A.M. (please be prompt). I will be at the front entrance by 8:45 to meet students, and we will go to the garden together. At 10:00 we will return to the front of the building for parent pick-up.
In case of inclement weather or inaccessible hallways, please check your email the night before and/or that morning by 8 A.M. for information on the possible cancellation/postponement of the day's activity.

If you cannot make it to school, but are interested in the progress of the garden over the summer, please check the classroom website every week or so to see updates.

Thank you,
Mrs. Noyes

I am interested in bringing my child to school on Wednesday mornings to participate in gardening activities from 9-10 A.M.

Student name _____ Grade 3 homeroom _____

Parent Name (printed) _____

Parent name (signed) _____

Parent email _____ Parent phone (daytime) _____

We are interested in the following dates (choose as many as you would like):

_____ Wednesday June 26, 9-10 A.M.
_____ Wednesday July 10, 9-10 A.M.
_____ Wednesday July 24, 9-10 A.M.
_____ Wednesday August 7, 9-10 A.M.
_____ My schedule is flexible as far as dates
_____ My schedule is inflexible; if the dates are changed we will not be able to participate

SUSTAINING THE GARDEN

See the "Assessment" chapter of this manual for information on evaluating all aspects of the program. The key to evaluating and sustaining the garden is careful record keeping. Keep careful notes on what you did and when: the crops planted, the yield obtained, the weather, pest problems and solutions, the garden events, volunteer hours, etc. This information will not only guide your work in subsequent years but will also be useful in publicizing your work in the community, in applying for grants, and in encouraging volunteers. Document activities with photos and videos, but make sure to follow your school's policy on photography students. Keep copies of all your communications to the community.

You will, over time, develop your own manual of procedures, policies, etc. Although some parents and school staff may continue for years, there are always new parents and new teachers involved. Passing on the leadership of a garden is so much easier if there is good information.

If you've built the garden into the curriculum, there can be activities that will maintain student interest and engagement throughout the year, even in the dreariest days of winter. Make a hearty soup with some of your stored produce. Have the students review the previous year's harvest and brainstorm what they would like to do in the upcoming season. If you're fortunate enough to have a greenhouse, hoop house, or classroom plant growth units, you can continue garden activities through much of the school year and get a jump on planting in the spring.

The most important thing for sustaining the garden itself is to continually build the soil. The procedures described in the manual for adding compost and mulching are essential tasks. Make sure you remove any plant material that might harbor diseases or pests. Retest the soil every few years. Crop rotation is strongly recommended.

As you've learned in your first year, the growing season is busy. Use the "down time" in the winter to do as much advance preparation as possible. You may not be able to work in the garden, but you can determine what you will grow, order seeds, organize volunteers, do fundraising, and plan special events.

For more information, see:

- https://kidsgardening.org/create-sustain-a-program-sustaining-your-program
- http://www.schoolgardenwizard.org/wizard/keep
- https://www.gardening.cals.cornell.edu/program-tools/planning-organizing/sustaining-the-garden/

Garden-Policy, Garden Safety, Food Safety

POLICY, GARDEN SAFETY, AND FOOD SAFETY

Many regulations or policies (at the federal, state, local, and district levels) that apply to the garden are probably already part of your school's procedures. The principal, district administrators, and experienced garden leaders elsewhere can provide advice on policies and regulations. Many of the materials listed in the "Resources" section contain information on the following and other issues.

- Screening volunteers
- Accessibility for all students
- Waste handling and recycling
- Accepting donations
- Liability for volunteers
- Authorization to use part of the school land
- Restrictions on pesticide application
- Taking photographs of students
- Food safety
- Nutritional content of school meals
- Food allergies or allergies to insect stings
- Composting safety
- Administering surveys or questionnaires to students

If you intend to donate food to a food bank or other organization, you may wonder about your liability. "Donations of food and grocery items to non-profits to feed needy individuals are covered by the Good Samaritan Food Donation Act (Public Law 104-210). Unless there is gross negligence or misconduct on behalf of the donor, individuals and groups are not liable"[2].

Here is a summary of food safety matters you may need to address, adapting these general ideas to your specific garden.

Fresh, Healthy, and Safe Food: Best Practices for Using Produce from School Gardens (source "Grow, Cook, Teach!", Massachusetts Farm to School Project) http://www.hungerfreecommunities.org/resource-library/grow-cook-teach-a-resource-guide-for-farm-to-school-activities/

School Gardens serve as exciting living laboratories and are an important component of Farm to School efforts. The bounty from school gardens can contribute to the school cafeteria, students/families, or be used in classroom and afterschool taste-testing activities.

The following practices are intended to provide basic food safety guidelines for those involved with school gardens. They include principles from Good Agricultural Practices and safe food handling procedures and are intended to serve as a framework that may easily be adapted to meet individual school settings and regional requirements. The safety benefits of fresh food grown on site include the avoidance of potential

contamination that accompanies long-distance travel (where products frequently change hands) and control over the supply chain direct from garden to table.

Safe handling information should be provided to students, teachers, and others involved in growing, harvesting, and preparing. In addition to the many benefits of fresh food, healthy activity, and learning, your school garden can be an educational tool that helps teach students about food safety procedures.

Growing Practices

All organic matter should be fully composted in aerobic conditions and at high temperatures prior to application. Avoid raw manure and limit composted manure to what can be purchased from a commercial outlet to ensure traceability.

When using water for irrigation make sure it is potable and from a tested source. Check with your state cooperative extension or state health offices for simple testing kits. [Do not use water from rain barrels, recycled water, gray water, etc.]

If soil used for growing is coming from school property, test for contaminants before planting. Testing kits are usually available through your state, as for water testing above.

There are many places to purchase seeds for your school garden, so be conscious of where your seeds come from and consider source and quality. Look for those that are preferably non-genetically modified, and come from companies that have taken a “safe seed pledge.”

No synthetic pesticides or herbicides should be used, preventing toxic residue on food and avoiding human and environmental exposure to pesticides.

Materials used for garden beds, containers, stakes or trellises should be constructed of non-toxic, non-leaching material (no pressure treated wood or used tires).

Harvesting and Handling

Students, staff, parents or volunteers involved in harvesting should wash hands thoroughly in warm soapy water for at least 20 seconds prior to harvesting. Anyone with open cuts or wounds on their extremities should not participate in harvest until they have healed.

All harvesting tools--scissors, bowls, tubs--should be food-grade and/or food service approved and designated solely for harvest and food handling. The tools should be cleaned regularly with hot water and soap, then dried.

School Garden produce delivered for use in a school cafeteria should be received and inspected by food service personnel upon delivery with the same system used to receive and inspect all other incoming products.

If storage is necessary, produce should be cooled and refrigerated promptly after harvest. Temperatures vary depending on type of produce being harvested; specific post-harvest storage and transportation temperatures can be found at: http://postharvest.ucdavis.edu/commodity_resources/storage_recommendations/

School Garden produce should be washed according to the same standards that the cafeteria has in place for conventionally received produce. A person with ServSafe or comparable food-safety certification should supervise students, parents, or staff who participate in any food preparation--i.e., taste-testings or special cafeteria events.

Other Considerations and Recommendations

Those planning and planting the school garden should review your school's rules and regulations. Some plants that can cause serious allergic reactions may be prohibited.

If the garden is near parking areas or other high-traffic zones, consider testing for contaminants before growing fruits and vegetables. Many states have agriculture extension services that can help with this. If building a raised-bed garden, consider purchasing soil meant for food production from an established retail entity to ensure soil safety and traceability.

If your school has a composting program for cafeteria waste, use the resulting compost for flowers, ornamental plants, and trees rather than garden beds where food is grown. Compost that comes from garden waste can be applied to food-growing beds if deemed appropriate by the school garden supervisor and/or compost coordinator.

Be sure to coordinate with school grounds-keeping or custodial staff about your garden's goals, protocols, and maintenance plan. If you are concerned about the presence of pesticides on or near your garden, be sure to communicate that, too. Consider using your school garden as an educational tool that can teach students about food safety procedures and incorporate curricula that teach to these issues in your garden educational plan.

Be sure that your school garden program is aligned with any relevant school district policies including, but not limited to, wellness policies, school procedures for receiving gifts and donations, working with parent and community volunteers, and liability policies.

RESOURCES ON POLICIES AND SAFETY

The following resources have information on garden-related policies and all aspects of safety. Some include related matters such as administrative procedures for connecting the garden to the food service program.

- USDA Food Safety Tips for School Gardens.
  www.nfsmi.org/documentlibraryfiles/PDF/20110822025700.pdf

- Garden Safety Checklist
  http://www.aginclassroom.org/ag-curriculum

- Safe Gardening Guidelines
  https://kidsgardening.org/gardening-basics-safe-gardening-guidelines/

- Safe Harvesting Guidelines
  https://kidsgardening.org/gardening-basics-safe-harvesting/

- Garden to Cafeteria – A Step by Step Guide
  http://www.canr.msu.edu/resources/garden_to_cafeteria
  Detailed information for educators and stakeholders, both newcomer and experienced

- Alaska School Garden Safety Guidelines
  http://dnr.alaska.gov/ag/FarmToSchool/SGfoodsafetyguide.pdf
  Includes checklists for routine monitoring of your garden

- Policy and Protocols for Schools Gardens and Garden to Cafeteria
  http://www.lifelab.org/for-educators/schoolgardens/garden-to-cafeteria/
  Extensive list of sample policies and protocols from schools and government agencies

- Serving School Garden Produce in the Cafeteria
  https://www.changelabsolutions.org/publications/school-garden-produce
  Addresses federal policies (such as School Lunch Program) and other regulations

- Toolkit: Food Safety in School Gardens
  https://www.farmtotablenm.org/wp-content/uploads/2013/01/Toolkit-Food-Safety-in-School-Gardens-FINAL.pdf
  Very practical guide to administrative and safety issues. Includes some of the misperceptions about garden-to-cafeteria programs.

SOIL

Above all, the quality of your soil will determine the success of your garden. Evaluating and improving the soil at the outset and during each growing season is an important task. Soil is complex and dynamic. **Its components are minerals, organic matter, water, air, and organisms.** All interact in myriad ways, many of which are poorly understood. Your goal is to create optimal conditions for your plants, balancing all these components.

Minerals are needed by plants and other soil organisms for their life processes. Plants require over 15 different chemical elements, some in large quantities (such as potassium and nitrogen) and others in trace quantities (such as zinc and molybdenum). The minerals are ultimately derived from the soil's parent rock material, along with inputs from fertilizer, compost, etc.

Organic matter, often referred to as humus, consists of dead and decaying organisms: leaves, worms, bacteria, etc. The decay process (carried out by innumerable microorganisms) is critical to the recycling of the minerals that were part of those organisms. Humus helps provide the proper structure of the soil, allowing the penetration of air and water.

Air, specifically oxygen, is vital for the soil organisms. Roots need oxygen, as do earthworms and many other soil organisms. So a good soil will be loose, with large and small air spaces. Earthworms and other organisms help keep these air spaces open as they burrow through the soil

The need for **water** is obvious, but too much water can be just as bad as too little. Excess water will fill the air spaces, reducing the supply of oxygen and harming the organisms. So whether you are gardening directly in the ground or in raised beds or in containers, you need to make sure your soil drains well (and amend it if necessary) and avoid overwatering.

The **organisms** in your garden soil include the obvious ones such as plant roots, earthworms, and many insects. There are a vast number of microorganisms (fungi, bacteria, etc.), only some of which have been identified and their roles determined. Many of these soil organisms are vital in natural decay and recycling. Curricula often include study of these processes (part of the ecosystem's biogeochemical cycles), so the garden provides a great opportunity to make this learning real. A gardener's task is to provide the conditions that will enhance the activities of these soil organisms.

Occasionally there will be soil organisms that can harm your garden, and you will need to develop ways to minimize their impact. Moles and other burrowing animals can be

devastating. Some soil microorganisms can damage the roots; information is provided below in the section on pests.

An ideal soil has good structure; it is made of small particles (referred to as clay) collected together in clumps and mixed with larger particles such as sand, with lots of space within and between the clumps. A soil made up of mostly sand will not hold water. A soil made up mostly of clay is too "heavy"; roots and worms may not penetrate it easily, and water will not drain well and it can become waterlogged. Observe what happens after a heavy rain. A poorly draining soil can be amended by adding sand, peat moss, or compost. If you are using raised beds, you can specify an ideal mixture when you purchase the soil. Soil mixtures for containers are specifically formulated to allow good drainage. The addition of compost can improve many aspects of your soil. Compost, decayed organic matter, contains some of the minerals the plants need. It greatly improves the soil structure.

Analyzing the mineral composition of your soil is important at the start and subsequently every few years. Soil test kits ($9 each for the basic analysis) can be obtained from the Penn State Agricultural Extension Office at the Farm and Home Center, 1383 Arcadia Rd., Lancaster PA 17601 (717-299-5361). The kit contains simple directions for taking the samples and mailing. For a large garden, you may want to submit several test kits. In about a week, you'll receive by mail an analysis of soil pH (acid or alkaline) and mineral content. The report will include recommendations for improving the soil to optimal values, such as how much fertilizer may need to be added and whether the soil pH needs to be altered. There are simple ways to adjust the soil pH. Soil pH can be a particular concern for certain shrubs and trees. Blueberries, azaleas, oaks, and pines are examples of plants that have a strict requirement for acidic soil. In the earlier section on “Site Selection”, there is information on testing for and dealing with contaminants in the soil.

If your garden area had once been paved, you will face some problems with returning it to a healthy condition. But many school and community gardens have successfully dealt with this problem, so information is available on how to proceed.

Too much foot traffic can compact and damage the soil structure, reducing the air supply and water penetration. Think about what a well- trodden path in a lawn or the woods looks like - no plants! Be particularly careful in the early spring and any time after rain; wet soils are very easily compacted. Be careful not to overwork the soil when you prepare it each year. Some gardeners and farmers have adopted reduced or no tillage methods, partly to preserve the soil structure. Information on this idea is presented in the "Weed Control and Mulching" section.

In the "Fertilizer" section there is information on using cover crops to enhance soil structure, drainage, as well as fertility.

Good resources on soil are:

- http://www.aginclassroom.org
- https://www.kidsgardening.org/gardening-basics-all-the-dirt-on-soil/

BUILDING THE SOIL - COMPOSTING

Farmers, gardeners, homeowners, and schools are recycling food and yard wastes at the source, reducing the waste flow, protecting the environment, and utilizing this valuable soil amendment. Adding a composting program to your school garden is also a way to teach first-hand about soil science, decomposition, and environmental sustainability. You will find information about composting in many of the general materials in the "Resources" chapter of this manual. This section provides an introduction to the science, how-to and options for school composting. Much of the information in this section is excerpted from the guide “Composting” or: http://www.aginclassroom.org/ag-curriculum

If you aren't ready to start your own composting program, various types of compost can be purchased commercially from garden centers or bulk suppliers. Check with your municipality for the availability of compost or mulch. The Manheim Township Compost Park sells both mulch and compost to anyone; see their web site for details http://manheimtownship.org/index.aspx?NID=1009

An excellent place to find information and curriculum materials about composting is the website of the Cornell University Waste Management Institute. The website (http://cwmi.css.cornell.edu) includes information not only for small-scale composting (school and home) but also for industrial-scale composting and other waste management programs. The latter may be interesting for teachers developing lessons on environmental issues at the community and regional level. Another main composting page is http://compost.css.cornell.edu/ ; there are sections on the science and engineering of composting and on composting for school and other small-scale gardens. Lists of resources (electronic, print, and video) on composting and waste management in general are at http://cwmi.css.cornell.edu/composting.htm and http://cwmi.css.cornell.edu/resources.htm. Materials in Spanish can be found at http://cwmi.css.cornell.edu/spanish.htm

An extensive composting K-12 curriculum is at http://cwmi.css.cornell.edu/solidwastecurriculum.htm. The publication "Composting in the Classroom: Scientific Inquiry for High School Students" (download at http://compost.css.cornell.edu/compostingintheclassroom.pdf) contains very extensive background information and ideas for investigative projects. Even if you are working with younger children, you involved will find the information very helpful. The project ideas could be modified for other age groups. A comprehensive Power Point slide

show suitable for elementary age children is at http://aggie-horticulture.tamu.edu/kindergarden/kidscompost/cover.html

Another resource on composting is:

- www.howtocompost.org

COMPOSTING BASICS

Decomposition is a natural biochemical process in which bacteria, fungi and other microscopic organisms convert organic material into nutrients that can be used by plants and animals. "Organic" means anything that was once alive. Composting manages the natural recycling systems of decomposition. Composting provides an opportunity for children to observe nature at work and see interconnections. Classroom discussion can center on soil science, waste reduction and management, decomposition, watershed protection, pollution prevention, bio-diversity, nutrition and more. There is valuable background information and an environmental inquiry, authentic scientific research program for high school students in the book "Decay and Renewal", published by the National Science Teachers Association. It (print or e-book) can be purchased at http://www.nsta.org/store. There are online resources to accompany the book at http://ei.cornell.edu/pubs/dr.html

Adding compost to your garden will:

- enrich the soil with nutrients and hold them until the plant roots can use them,
- increase moisture retention,
- improve soil structure by loosening and aerating the soil, and
- provide a good environment for beneficial soil organisms.

Composting also helps protect the environment. The Environmental Protection Agency estimates that 25% of the solid wastes that Americans generate are food scraps and yard wastes that could be recycled through composting. These useful materials are too often sent to landfills and incinerators or go down the drain through the sink garbage disposal. Landfill wastes can cause water pollution and production of methane gas from anaerobic decomposition. The use of home garbage disposals for food wastes places unnecessary burdens on the water supply, requiring about eight gallons of water per pound of wastes. Wastewater treatment plants then must process the increased volumes of water.[3]

Successful composting occurs when the decomposers are provided with the optimal conditions to flourish. They need food, air, water, space and an appropriate temperature. All organic material (the "food") contains both carbon and nitrogen in varying amounts. The microorganisms need carbon for energy and nitrogen to grow and reproduce. They are most productive when the ratio of carbon to nitrogen is about 30:1. This exact proportion is not critical, and the microbes will function well at somewhat higher or lower ratios. Since most organic materials do not fit the 30:1 ratio

exactly, different materials should be mixed. Detailed instructions are given below in the section on "Starting the Composting".

"Brown" material is high in carbon. It is mixed or layered with damp "green" material which is high in nitrogen. If possible, break up the materials to speed up decomposition. For example, run over piles of autumn leaves with a lawn mower. Keep a pile of brown materials (especially autumn leaves) so you will have them when needed.

Some types of mulching also provide compost and can help build the soil. In particular, sheet mulching can be a good first step for a garden that is covered in grass or weeds. Sheet mulching is described in the “In the Ground or in Raised Beds?” section above.

BUILDING THE COMPOST BIN

Select a bin that is appropriate for your setting. There are many commercial containers available, but you can build your own fairly inexpensively from easy-to-find materials. Bin designs include one, two, and three bin systems made out of wood or bricks, and barrel turners. In an urban setting, choose a rodent-proof bin with a floor, tight fitting lid and no openings wider than½ inch. Each bin should be a minimum of one cubic yard (3' by 3' by 3'). Piles wider or taller than 5 feet do not allow enough air to reach the microorganisms at the center. Piles smaller than one cubic yard will freeze in the

winter, although the organisms will revive in the spring and composting will resume. Plans and detailed construction instructions for many different kinds of composting bins can be found at https://ecommons.cornell.edu/bitstream/handle/1813/11729/Designs_for_Composting_Systems_Revised.pdf?sequence=18. For each type information is provided on how to add wastes and maintain the composting process. The book "Joy of Gardening" has instructions for a simple, easy-to-build compost bin.

Choose a location for the bin. It should be easy to reach in summer and winter. A shady location is preferable. In the sun, it will tend to dry out quickly, requiring more water.

The three-bin design allows for adjacent turning piles. These turning piles are appropriate if there is a large volume of material available to compost and the desire to make high-quality compost in a short period of time. The first bin holds compost that is being actively worked. The middle unit holds compost close to completion, and the third bin is used to finish and store the compost before it is applied to the garden.

STARTING THE COMPOSTING

No matter what kind of bin you use, the basic process is roughly the same. Prepare the bin by placing alternating layers (about a foot thick) of "green" and "brown" materials. Sprinkle a few shovelfuls of soil between the layers to get the microorganisms started. Moisten the pile, so the materials feel like a "wet sponge." Shape the pile with a depression in the top to catch rainwater.

Anything that was once alive is organic and will decompose. Do not compost meat, bones, fat, grease, oils, peanut butter, dairy products, foods cooked with butter or sauce, or animal manure. Other things that are not good for a typical school compost pile include weeds gone to seed; weeds that spread by roots and runners; banana skins; and beech, birch, and shiny leaves (such as magnolia and holly) which are slow to decompose. Avoid composting any plant material that might harbor diseases or insects. Although a hot compost pile should kill them, you don't want to take the chance of carrying over pests into your next crop. Tomatoes are particularly likely to have some diseases.

The following table illustrates the carbon/nitrogen ratio for some of the readily available materials[4]. Although manures are listed here, school gardeners should avoid using such materials for health and safety reasons.

Materials with high nitrogen levels (green)	
Fruit and vegetable waste	12-20:1
Grass clippings	20:1
Cow manure	12-25:1
Horse manure	25:1
Poultry manure	10:1
Pig manure	5-7:1

Other green materials: coffee grounds, tea bags, crushed egg shells, fresh garden cuttings, weeds without seeds

Materials with high carbon levels (brown)	
Dead (mature) leaves	30-80:1
Corn stalks	60:1
Straw	40-100:1
Tree bark	100-130:1
Paper	150-200:1
Wood chips & sawdust	100-500:1

Other brown materials: coffee filters, used potting soil, pine needles, chipped brush

Rather than precisely calculating the ratio for your composted materials, you can start with a rough rule of thumb: three parts "brown" materials to one part "green" material will result in an overall carbon to nitrogen ratio of about 30:1. Adjust the ratio depending on the type of materials you have, according to the table. As discussed below and in resources on composting, the behavior of your compost pile will give you important clues if the compost pile is working well or if you have too much brown or green material.

The microorganisms in the compost pile thrive in damp but not soggy conditions. If material is not damp enough, the composting process will stop. If leaves rustle, they're too dry. Particularly in hot, dry weather you may need to add water to the pile, so try to locate it near your water supply. If the material is too wet, the air spaces will fill with water resulting in anaerobic conditions and odor.

Heat is essential for successful composting. The pile should be large enough to maintain heat; decomposition will be very slow in a small pile. The decomposers give off metabolic heat. As populations increase, more heat is produced and trapped in the center of the pile causing the temperature to rise. A properly managed compost pile will get hot enough to kill most weed seeds and disease-causing bacteria and fungi.

MAINTAINING THE COMPOST PILE

Once the bin is set up, you can begin to add fresh materials regularly. Combine green and brown materials as described above. A compost mix too high in carbon will take longer to decompose. A compost mix too high in nitrogen can get sloppy and smelly. If in doubt, it is better to err on the carbon-rich side, which reduces the likelihood of odors. A healthy compost pile does not smell!

Compost microorganisms are aerobic -they need oxygen. Turn the material in the bin occasionally (weekly during the first month) with a pitchfork to introduce more air and speed up the decomposition process. Another way to provide a good air supply is to insert into the pile large-diameter PVC pipes with many holes drilled in them. Two piles will permit you to add fresh material to one, while you turn and finish the compost in

the other bin. A compost pile should never be turned immediately if at any time there is a strong ammonia or other offensive odor. This indicates anaerobic decomposition; the compost pile is not functioning properly because of excess moisture or lack of oxygen.

With frequent turning, compost can be ready in about three months. Once the compost stops heating up and the original ingredients have transformed into dark, rich, crumbly, sweet-smelling humus, the compost is finished. Compost started in the fall could be ready for use in the spring. If there are some undecomposed materials in your finished compost, you can sift it. Make a sifter using half-inch hardware cloth (wire mesh) stapled onto a wooden frame that will fit over your wheelbarrow or cart. Shovel compost directly through the screen into your cart.

A well-designed and maintained compost system will not attract unwanted insects and animals. Line the bottom and sides inside your bin with brown materials. Always cover green materials with at least several inches of brown material. Wire mesh or a lining of bricks will help keep out rodents. Keep burrowing animals out by attaching mesh to the bottom of your bin. Have a secure lid.

USING THE COMPOST

There are many ways to use finished compost in the school garden.

- For amending the soil before planting, add compost up to four inches deep to beds and dig in.
- Make your own seed-starting mix by combining compost, peat moss, top soil, and perlite. A potting mix for older plants can be made with equal parts compost and top soil.
- Compost tea is a nutrient-rich fertilizer. Soak a burlap sack full of compost in a bucket of water for several days. When the "tea" is a light brown color, apply the liquid fertilizer to your plants.
- Compost can be used to mulch plants, shrubs and trees.

DEVELOPING YOUR COMPOSTING PROGRAM

You may begin by composting just your garden and schoolyard materials. But if you want to develop composting as a part of your school's overall waste management and recycling program, you will need to assess what is best for your school. Start with a basic program and then, if it succeeds, you can expand it. The steps in developing a program are described in "Composting" at http://www.aginclassroom.org/ag-curriculum

There is considerable interest in Lancaster County in developing food waste composting for institutional food services. As of early 2018 Franklin and Marshall College and Millersville University have begun such programs. The goal is to expand the efforts to schools. So encourage your food service department to get involved. Brenda's photo with children

VERMICOMPOSTING - COMPOSTING WITH EARTHWORMS

Earthworms speed up the composting process and aerate the organic material. Their wastes improve the compost. Red worms (red wigglers, Eisenia foetida), typically used for fishing, are best suited for worm composting. They eat many of the same foods as humans. Hungry red worms can eat and expel an amount of waste equal to their own weight every day. Red worms adapt well to changes in temperature, although they prefer a range between 40 and 80 degrees Fahrenheit. They are also extremely prolific. Red worms start reproducing in as little as three months. In nature red worms are an indicator of fertile soil with high organic matter content. There are many commercial sources of worms. A pound of worms is enough to start a large bin.[5]

Vermicomposting can be done outdoors or indoors. Many teachers have used small bins in classroom activities, especially during the colder months when outdoor gardening activities are limited. Consult the Cornell vermicomposting website (http://compost.css.cornell.edu/worms/basics.html) for information; there is a video at http://www.cwmi.css.cornell.edu/vermicompost.htm.

If you are new to vermicomposting, contact others with experience for suggestions and tips.

COMPOSTING WITH EARTHWORMS STEP-BY-STEP

1. Building or buying the bin

2. Preparing the bedding

3. Adding the worms

4. Adding the food waste

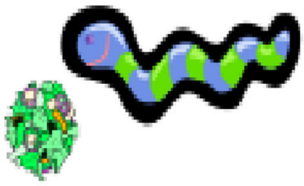
5. Harvesting the castings

6.Fertilizing the garden

7. Growing vegetables

8. Eating the vegetables

9. Feeding vegetable waste to the worms



Worm Lesson: Second Grade, Conestoga Elementary School

Who likes worms? Are worms our friends? What do worms do for us?

- Eat their way through the soil – food from decaying plants and animals. This makes the soil a better place for plants to grow. The tunnels let air into the ground and keep the soil loose.
- After they eat – they excrete worm poop called castings – show castings. Ask students from now on to refer to the worm poop as castings to get them familiar with the terminology.
- Castings are like natural fertilizer to plants to help them grow.
- In doing their job, worms become important recyclers.

You live in a house, and so today we are going to put the worms in their own house. (Show the worm bin. Ask why there are holes drilled all over it.)

When you go to bed at night, you have sheets and blankets. The worms need suitable material, too, so they will be sleeping in shredded newspaper.

And of course, they need food. You will be feeding them food scraps that you collect one time a week and giving them a little spray of water to keep their environment damp.

Now it's time to get started in creating our worm bin.

Break students into three groups: Bin Prep, Observation, Vermicomposting Cycle

Bin Prep Station

- Students tear newspaper into tiny pieces or strips to put in the bin.

Observation Station

- Each student or pair is given a worm to observe and measure using the Worm Observation Sheet as a guide. They can put the worm on a paper towel.
- Prep them before they are given the worm. Teach them to respect the worm. Not a lot of touching unless necessary for measuring.
- When they finish, they can put the worm back with the other worms, and new worms can be given to the next group.

Vermicomposting Cycle

- Using the prepared poster explain how the Vermicomposting Cycle works.
- Then give pairs of students the cycle in its individual components and see if they can arrange it in the proper order and explain it to the Station leader.

Later, students will harvest the castings by emptying the contents of the bin a little at a time over a screen which allows the castings to fall through. The worms are placed back into the bin with newly prepared bedding.

BUILDING THE SOIL - COVER CROPS

Cover crops, also called green manures, are plants that grown and then turned under when mature. As they decompose, the minerals and organic matter they contain are returned to the soil. The soil structure and drainage improved. Part of the garden may be kept out of production for a year while a cover crop is grown instead. Sometimes gardeners grow cover crops in the off-season. Cover crops decrease soil erosion during the winter. Winter cover crops can be planted as early as August 1 but no later than October 1 so they can make some growth before hard frost. The following are some cover crops suitable for winter use: alfalfa, barley, buckwheat, crimson clover, oats, winter rye, hairy vetch, annual ryegrass, and winter wheat. The book "Joy of Gardening" is an excellent resource about cover crops. See “Using Cover Crops” at http://www.aginclassroom/ag-curriculum

Cover crops can provide benefits in addition to improving soil fertility. Lentils can be planted as a living mulch beneath taller plants during the growing season.

Do you want to grow plants that actually increase the fertility of the soil? Legumes (such as alfalfa, clover, soybeans, beans, peas, lentils, etc.) have the unique ability to capture nitrogen from the air (nitrogen fixation) and utilize it to make their own nitrogen-containing molecules. Thus, they need less (or, in theory, no) nitrogen from the soil. Farmers all over the world have, for millennia, grown legumes and then plowed them under so that the next season's corn or wheat or other crop will have an enhanced supply of nitrogen, a critically important mineral. Lancaster County farmers may grow alfalfa or clover or vetch for this purpose. You can do the same thing! Grow a legume "cover crop" one year, turn it into the soil at the end of the growing season, and you'll have a head start on supplying nitrogen for next year. Depending on your growing calendar, you might be able to grow a rapid-growing legume cover crop for the first part of the year and then replant with another crop, or plant the cover crop in the late summer (after harvesting the vegetables) and then turn it under in the spring. An important side benefit of some legume cover crops is that they are valuable sources of food for bees. You may be able to grow a legume together with another crop. That is part of the ancient logic of growing beans along with corn.

The nitrogen fixation process is actually the result of a cooperation (symbiosis) between the plant and certain soil bacteria. Many farmers and gardeners try to help the process along by adding the bacteria when they plant the legume seeds. The bacteria are commercially available in packets from local farm and garden stores or from seed companies. The bacteria are rather fussy about which plant they will work with, so make sure you get the right bacteria for your particular crops.

If you are starting your garden and have areas that are particularly weedy, the use of cover crops over several growing seasons can also reduce weed problems. This method requires leaving that part of the garden uncultivated, thus reducing gardening space. Cover crops must also be mowed or harvested regularly, which can be time-consuming and difficult without the proper tools.

Garden-What To Plant And When

There is a bumper crop of information on how and what to grow in your garden. So use the materials listed in the "Resources" section of the manual. See:

- "Selecting Plants for the School Garden" https://www.slideshare.net/pd81xz/xwc126
- "School Garden Start-Up Budget and Plant List" https://wwwslideshare.net/pd81xz/ma5wq
- "Vegetable Growing Guides" https://www.gardening.cornell.edu/homegardening/scene0391.html
- Detailed information on over 50 crops, including growing instructions, site and soil requirements, varieties, pests, etc.
- "Growing Guides" https://kidsgardening.org/plant-of-the-month/
- "Vegetable Gardening: Recommendations for Home Gardeners in Pennsylvania" Penn State Extension https://extension.psu.edu/vegetable-gardening

EASY TO GROW CROPS

There are many crops that are easily grown in a school garden. Let the children decide on their favorites, but use the garden as a way to introduce them to new foods. Plant crops that that are characteristic of the students' own cultures and that represent the different cultures the students will study. See below for examples of plants for other special gardens.

Here are examples of "easy to grow" plants. Keep in mind that some children find certain vegetables (such as radishes, broccoli, some greens, etc.) bitter, so you may have to gradually overcome that.

Vegetables: lettuce, Swiss chard, spinach, many kinds of Asian greens, arugula, radishes, carrots, beets, peas (sugar, snap, and hull), broccoli, cauliflower, Brussels sprouts, collards, kale, tomatoes, corn, peppers, summer squash, pumpkins, beans (green, yellow, and lima), onions (both for greens and bulbs), potatoes, cucumbers

Annual herbs: parsley, cilantro, dill, basil (many different types)

Perennial herbs (though some may not survive a harsh winter): thyme, sage, mint, rosemary, chives, oregano

Others: sunflowers (varieties range from 1-2 feet tall to 8 feet or more), marigolds, nasturtium, many other flowers

Good record keeping about what you planted, where, how and when is essential. Then keep notes about the plants through the growing season up to harvest time. See the section on "Sustaining the Garden" in the manual. With this information you will benefit

from your experiences in the future years and can share your observations with others. Taking photos is a great way to supplement your notes.
Children will be particularly fascinated to grow potatoes. In class they can learn that a potato tuber is a specialized underground stem. The "eyes" are buds of new stems; this is easy to see on a potato that has sprouted. Potatoes are started using small tubers that are buried under several inches of soil. These tubers are called "seed potatoes", but of course they are not seeds. Purchase certified disease-free seed potatoes from garden centers; don't use potatoes from the supermarket. There is an incredible diversity of potato types (used for baking, potato chips, etc.), and a lesson on the peoples of the Andes (where potatoes were first farmed) can complement growing potatoes of all sorts of colors and shapes. Harvesting potatoes in the fall is like a treasure hunt for children. Because potatoes can be stored for considerable time, you could plan to donate part of your crop to a food bank.

In developing the layout for your garden, you should make some preliminary decisions about what will be planted where. You need to know how much space a particular plant requires and how many of that plant you will grow. But you can change things from year to year: if you had too many tomatoes and too few beans, you can change what you grow. Whether you are planting in raised beds or directly in the ground, you will generally be planting in rows, so seed packets and other guidelines will tell you about spacing in the row and between rows.

It is important to use crop rotation: don't plant the same crop in the same location year after year. Crop rotation can improve the soil and reduce the chance that diseases or pests of a particular crop will build up in one spot. There is detailed information on crop rotation later in this section.

Ample sunlight is important for your garden. Arrange the planting so that the taller plants do not shade the smaller ones. If there are some areas that are shaded for part of the day, certain crops
will do well there. See the box for information on hours of sunlight recommended for various crops. You can find additional information on many resources and on seed packets.

How Much Sun for Vegetable Garden?[6]

Light is one of the most important elements in growing vegetables and is probably the one that we have least control over. No vegetable will grow in full, dense shade. Also, although your vegetables may get enough light when planted near a tree, they may not get enough nutrients and water. They can't compete with an established tree for essential nutrients and moisture.

General Recommendations
Fruiting Vegetables - 8 hours of sun
Includes tomatoes, peppers, eggplants, cucumbers, melons, and squashes.

Root Vegetables - 6 hours of sun
Includes carrots, beets and radishes.

Leafy Vegetables - 4 hours of sun
Includes lettuce, spinach, kale and collards.

These are minimums; increasing the amount of sunlight your vegetables receive will increase the yield and quality of your crop.

Vegetables And Herbs That Are More Tolerant Of Less Sun
The following crops will do well with about 6 hours of sunlight per day.

- beets
- borage
- carrots
- chamomile
- chives
- cilantro
- dill
- mint
- oregano
- parsley
- peas
- radishes
- sage
- spinach
- strawberries
- swiss chard
- thyme

The following crops will produce with 3 to 6 hours of sun.

- salad greens, such as leaf lettuce, arugula, endive, cress.
- broccoli
- brussels sprouts
- cauliflower
- radishes
- peas
- swiss chard
- beets
- beans
- leafy greens, such as collards, mustard greens, spinach, kale

In some ways, growing in a site with part shade is easier than growing everything in full sun. You won't have to water as often, and crops that are quick to bolt in hot weather, such as lettuce and spinach, will grow quite a bit longer given some shade.

Make use of the space you have, in both sun and partial shade, and you can increase the amount of vegetables you would usually get. You can use the sunny space to grow the sun-lovers: the crops that do well with some shade can be placed elsewhere.

Your own experience over the years in your particular garden can help guide your decisions on which crops will do well in various areas.

The major consideration of when to plant particular crops is temperature, primarily low temperature in the spring and fall. Planting guides will indicate the optimal growing season for each crop. Some plants are quite tolerant to low temperature ("hardy") and seeds can be sown as early in the spring as the soil can be worked; examples are

spinach and radish. They will survive spring or fall frosts or even freezes. Seeds of peas and lettuce, among others, should be sown a few weeks later. Many of these plants flourish in cool weather and do not survive the heat of summer. Many cool season plants can also be sown in the late summer and early fall. This is an excellent way to start the school year. The garden program of "Healthy Foods for Healthy Kids" is specifically designed for school gardens growing cool season crops only (http://www.healthyfoodsforhealthykids.org).

GET AN EARLY START!

Children want to plant the garden, take care of the plants, and also enjoy the harvest. By planting as early in the spring as possible, you can be sure that there will be some crops for them to enjoy before the end of the school year. In a typical year in Lancaster County, some types of seeds and seedlings can be planted in mid- to-late March, producing a harvest by early May. For other plants you'll have to wait until May for planting, with harvest in the summer. If you are growing your own seedlings (for either early or late planting), you will start them indoors several weeks earlier. Seed packets and gardening resources will indicate how long before the planting-out date the seeds should be started. So you can have several "Planting Days" in the spring where children and adults share the joy of getting the garden started.

At the other end of the scale are plants that are damaged or killed by cool temperatures ("tender") and that can only be grown after all danger of spring frost has passed. Examples are tomatoes, green peppers, squashes and corn. Learn about the differences in cold-sensitivity of these crops. The growth of many favorite garden crops (tomatoes, melons, beans, squashes, etc.) can be impaired or stopped completely by cold temperatures, so there is no point planting them until it's consistently warm. Memorial Day is the traditional guide in Lancaster, but usually a week earlier is safe. The average last frost date in Lancaster is around May 10, but there can be substantial localized and year-to-year differences.

There are many variations on these categories of "hardy" and "tender". For example, some types of sweet corn and squash are a bit less tender than the extremely tender lima beans and eggplant. Among the cool-season crops, lettuce and Swiss chard are sometimes referred to as semi-hardy.

Often, planting guides for garden crops refer to "hardiness zones", based on long-term average minimum winter temperatures. Those temperatures are then generally reflected in other climate parameters, such as last frost date in the spring and first frost date in the fall, so planting guides will often indicate suggested planting times relative to those dates. See the box for a description. Lancaster County is generally considered to be in hardiness zone 6b. But remember nothing is guaranteed when it comes to the weather! If the spring is mild, you might be tempted to push your luck and plant tender

crops a little early; sometimes you'll win, sometimes you'll be fooled by a late cold snap and have to rush out and cover your tender seedlings.

The first frost date in the fall will determine the end of the season for the summer crops such as tomatoes and peppers. You might be able to save those plants from an early frost be covering them overnight. The average first frost date in Lancaster is around the last week in October, though it may be a little later to the south and east.

USDA HARDINESS ZONES

In resources about plants you'll find mention of "USDA Plant Hardiness Zones". These zones are primarily important for perennials, as they are based on the average annual minimum temperature. That temperature is a key determinant of the survival of plants, though of course other factors are important, such as average annual maximum temperature, rainfall, etc. So it's warm enough in the summer for palm trees in Lancaster, but they won't survive the winter. The hardiness zones range from 1 (interior Alaska) to 11 (the Florida Keys). Lancaster is in zone 6b: long-term average annual minimum between -5 and 0 degrees. If your garden is right along the Susquehanna, as of 2012 you're now classified in zone 7a (long-term average annual minimum between 0 and +5 degrees). After many years with temperatures not approaching zero, that changed in 2014! Hardiness zone information for a particular species is only a rough guideline; different varieties of a species may have slightly different low temperature tolerances. Also, the site for a particular individual plant can influence survival. There are known "cold pockets", such as low-lying areas, and warm spots such as a protected area in the city (these points apply to annuals as well). So you need to take hardiness information into account if you are planting perennials, such as shrubs in a pollinator garden or fruit trees (apples yes, papayas no). A zone map is at http://www.planthardiness.ars.usda.gov/PHZMWeb

Some fall-planted cool season vegetables (such as spinach, Swiss chard, and lettuce) will survive over the winter, particularly if the winter is mild or if the plants are covered with mulch or a plastic sheet tent. Then you may get an extra-early crop for the students the following spring (by mid-April).

Crops take a certain amount of time to reach maturity; that information is found on seed packets, pot labels of commercial seedlings, and in garden resource materials. Of course these are only averages, and weather and other conditions can make a difference. So your schedule of planting and harvesting needs to take time-to-maturity into account. There will be different times to maturity depending on whether you start with seeds in the ground or transplants. In the case of warm-season transplants such

as tomatoes, the pot label or catalog will indicate days to maturity from setting out the plants. Lettuce grown from seed may take a month and half, but if you start with a good-sized lettuce plant from a nursery or your indoor garden you might be able to begin harvesting within a few weeks. You should plan to extend the harvest by making successive plantings: for example, sow radishes or beans every week or two during their planting seasons. It's important to know that for many vegetables (such as tomatoes) there is a great range among different varieties in days to maturity, so you can use different varieties to provide a longer harvest time (use early-, mid-, and late-season types). Some vegetables, such as lettuce and Swiss chard, can be harvested over a long period of time, whereas others, such as peas, have a fairly short harvest period.

When selecting varieties, there are several factors you might want to consider. Time to maturity was mentioned in the previous paragraph. What size tomatoes do you want - some may weigh a pound or more, while cherry tomatoes may appeal to children as a pick and eat (after washing!) snack. There are many other crops for which various sizes are available: do you want to try for a giant pumpkin, or tiny ones? If you are growing beans, pole beans will require less space than bush beans for a comparable yield, so think about how much space you have. Likewise, there are more compact bush type and more wide-spreading vining-type squashes and melons. A mixture of red and green lettuces makes an appealing salad. There may be varieties of a crop with somewhat better tolerance to low or high temperatures.

Another factor to consider when selecting plant varieties is disease and pest resistance. Many varieties of tomatoes, for example, have been bred to resist the major fungal diseases and pests. Such resistance may not be complete, and other diseases or pests may still threaten your crop (many tomatoes were severely damaged by late blight a few years ago). There is more information below on dealing with diseases and pests.

New varieties of vegetables are constantly being introduced, so you will have many choices when you browse through seed catalogs or in the garden store. You may find the interactive web site http://vegvariety.cce.cornell.edu useful to see descriptions of varieties and the opinions of other gardeners. The site also has a program to engage young people in collaborative investigations about vegetable varieties. Extensive lists of varieties are at the following (although they may not include the most recent additions):

http://www.blogs.cornell.edu/gblblog/files/2017/12/vegetable-varieties-list-2018-1:56ta9.pdf
(This list is revised every year.)
http://njaes.rutgers.edu/pubs/publication.asp?pid=FS681

There is much interest in heirloom varieties of vegetables and fruits. There are many local sources of heirloom seeds and plants. The Landis Valley Farm Museum (in Manheim Township) has an heirloom seed project as part of their educational program about Lancaster County farming http://www.landisvalleymuseum.org/index.php/programs/heirloom-seed-project/. Seeds can be ordered, and plants are sold at the annual Herb and Garden Fair in May. In some cases heirloom varieties may be less disease or pest resistant than modern varieties.

Do you start vegetables from seed or from transplants? In our area, some warm-season plants with a long time to maturity are only started from transplants (either purchased commercially or grown in your school): tomatoes, peppers, and eggplant are examples. Some warm-season plants are usually started by direct seeding: corn and beans are examples. Don't start them too early; if the soil isn't warm enough, the seeds will not germinate. And some warm-season plants can be started either way, though take into account your planting schedule and the days to maturity for the particular variety: cucumbers and melons are example. Among the cool-season crops, root crops such as beets, carrots, and radishes, are always started by direct seeding, as are peas. Lettuce and spinach can be started either be direct seeding or as transplants. You could do both, to spread out the maturity time. Broccoli, cabbage, and cauliflower are example of cool-season plants that are usually started as transplants.

Helpful resources on starting seeds (either indoors or outdoors) are:

- "Seeding Plants for the School Garden" https://www.aginclassroom.org/ag-curriculum "Seeding"
- There are several guides on indoor and outdoor seed starting at https://kidsgardening.org/gardening-basics

For starting seeds indoors, there are many commercially-available products that include lights, trays, watering systems, etc. These can be expensive, and you can assemble your own. Use a standard 4-foot fluorescent fixture (preferably accommodating 4 type T-5 bulbs). The kind of light bulb you use is critical. Regular fluorescent bulbs are not appropriate. Instead, you should use bulbs that provide a full spectrum of colors, as described in the resources listed above. Although the light from such bulbs may look bright, it is nowhere near as bright as the sun. Indoor-grown plants that receive insufficient light will be spindly and not very sturdy. You should

place the tops of the young plants within about 4-6 inches of the bulbs. Don't let the upper leaves touch the bulbs, as the heat may damage the leaves. It's important to be able adjust the lights as the plants grow. You could hang the fixture with chains and raise the fixture; if the fixture height is not adjustable, then devise some way to put the plants on a bench or other support that can be progressively lowered as the plants grow. You should use a timer (available at any hardware store) for the lights; generally 12-16 hours of light every day is recommended.

You may be able to start seedlings on a sunny windowsill. You'll need to be careful that the plants don't dry out over the weekend. The plants will tend to grow toward the light, so you should turn them every few days to promote straight growth.

Seedlings grown indoors must be gradually acclimated ("hardened off") before they are transplanted outdoors; failure to do so can harm or kill the plants. The outdoor environment is windier, has more intense sunlight, and may have greater swings of temperature than the indoor environment. When you buy transplants, ask the grower about the recommended hardening procedure, depending on the conditions at the source. Acclimation usually involves gradually (over a week or so) exposing the plants to the outdoors, starting with an hour or two and gradually extending to the full day. During this time and in the first weeks in the ground, be particularly careful to water the plants, as they may use much more water than in the relatively mild conditions indoors. Shading and sheltering the plants from the wind might also be necessary in hot, dry, or windy conditions. The act of transplanting may lead to some root damage. It takes a while for the root system to recover and adjust to the new soil conditions.

Information on transplanting can be found at:

- https://kidsgardening.org/gardening-basics-transplanting-and-direct-seeding
- http://www.aginclassromm.org/ag-curriculum "Transplanting"

When children transplant seedlings into the garden or do other tasks, in their enthusiasm they may damage a plant. Don't worry about this and don't be critical; just be sure you've started with more plants than you need. There will also be losses due to pests, heavy rain, etc. With raised beds the children should always work from the outside. You can design in-ground beds so that they are narrow enough to allow work from the outside. Have clear rules to discourage "short-cuts" across the planting area. Plants started from seeds (in the ground or indoors) need to be thinned as they grow so that the plants have ample room above and below ground. You'll always sow more seeds than you need, since not every seed will germinate and some seedlings will be damaged or die. Follow the suggestions on seed packets or in other resources on the final plant spacing. In the case of lettuce and other greens, you can use the plants removed: your own "microgreens".

The charts on the following pages have a detailed planting guide for nearby Maryland (whose climate is more typical of ours than is that of much of Pennsylvania). For

Lancaster County, we suggest you use approximately the middle of the spring planting date range (or a week or two after the earliest given date). A brief planting guide is at https://extension.psu.edu/vegetable-planting-and-transplanting-guide

Very detailed information on planting, care, and harvesting of common crops for Pennsylvania is found in the publication "Vegetable Gardening" (cost $10) https://extension.psu.edu/vegetable-gardening

Crops	Spring Planting Dates[1]	Fall Planting Dates[1]	Feet of Row per Person	Seed or Plants per 100 ft of Row	Depth to Plant (Inches) [2]	Planting Distances Between Rows (Inches) [3]	Planting Distances in Rows (Inches)
Asparagus*	Mar 20-Apr 15		20	100 crowns	6-8	36-60	12-18
Beans, Lima	May 10-June 10	June 20-July 10	20	3/4 lb.	1-1 1/2	30-36	3-4
Beans, Snap	May 5-June 30	July 1-Aug 5	20	3/4 lb.	1-1 1/2	24-30	1-2
Beets	Apr 1-June 15	June 20-Aug 1	10	2 oz.	1/2	15-24	2-3
Broccoli*	Apr 1-May 1	July 20-Aug 20	20	67 plants	1/2	24-36	18-24
Brussels sprouts*	Apr 1-May 1	July 1-Aug 1	10	67 plants	1/2	24-36	18-24
Cabbage*	Mar 15-Apr 10	July 10-Aug 20	15	100 plants	1/2	24-36	12-18
Cabbage, Chinese	Mar 15-May 1	July 1-Aug 5	10	1 packet	1/2	18-30	8-12
Cantaloupes	May 15-June 15		25	1/2 oz.	1	60-72	24
Carrots	Apr 10-June 1	June 15-Aug 1	20	1/2 oz	1/4	15-30	2-3
Cauliflower*	Apr 1-May 1	July 1-Aug 1	15	67 plants	1/2	24-36	18-24
Celery*	Apr 15-May 1	June 1-July 20	10	300 plants	1/8	18-36	4-6
Chard, Swiss	Apr 15-June 15	June 15-July 25	5	2 oz	1/2	18-36	12-18
Chives	Mar 20-Apr 20			1 packet	1/2	15-24	2-4
Collards*	Apr 1-June 1	July 10-Aug 10	15	67 plants	1/2	24-36	18-24
Cress, Upland	Apr 10-May 10	Sept 1-Oct 1		1 packet	1/4	15-30	2-3
Cucumbers	May 10-June 1	June 15-July 10	15	1/2 oz	1	48-60	18
Eggplants*	May 15-June 10		6	67 plants	1/4	30-42	24
Endive	Apr 1-May 1	July 10-Aug 20	10	1/4 oz	1/4	18-36	12

*Asterisks indicate dates for setting out transplants

Lettuce, Leaf	Mar 15-June 1	July 15-Sept 1	15	1 packet	1/4	12-18	8-12
Lettuce, Romaine, Butterhead	April 1-May 15	July 20-Sept 1	15	1 packet	1/4	18-24	18-24
Mustard	Apr 1-May 10	July 20-Aug 20	15	1/4 oz	1/4	18-24	12
Okra	May 10-June 1		10	2 oz	1	36-48	12-18
Onions*	Apr 1-May 1		12	400 plants		15-24	3-4
Onion, Seed	Mar 15-Apr 15		12	1/2 oz	1/2	15-24	3-4
Onion, Sets	Mar 15-Apr 15		12	2 lb	1-2	15-24	3-4
Onion, Multiplier (potato onion)	Oct 15-Nov 15		10	2 lb	1-2	15-24	6-8
Parsley	Apr 1-May 1		1	1 packet	1/4	15-24	6-8
Parsnips	Apr 1-May 1		10	1 packet	1/2	18-24	3-4
Peas	Mar 15-May 1	July 25-Aug 5	20	1/2 lb	1-2	8-24	2-3
Peas, Black-eye	May 15-June 1	June 1-July 1	20	1/2 lb	1	36	4
Peppers*	May 15-June 10		6	67 plants	1/4	30-42	18-24
Potatoes	Mar 20-May 10	June 15-July 10	20	8 lbs	4	30-36	12
Pumpkins	May 20-June 10		10	1 oz	1	60-96	48-72
Radishes	Mar 20-May 10	July 20-Sept 15	10	1 oz	1/2	12-24	1
Rhubarb*	Mar 20-Apr 15	Oct 15-Nov 15	10	33 roots		36-48	36-48
Rutabagas		July 1-Aug 1	10	1/2 oz	1/4	18-30	3-4
Salsify	Apr 1-May 15	June 1-July 1	10	1 oz	1/2	18-30	2-3
Shallots	Apr 1-May 1	Oct 15-Nov 15		1 lb	1-2	12-30	2-3
Soybeans	May 15-June 15	June 15-July 1	20	1 lb	1-2	24-30	2
Spinach	Mar 10 -Apr 20	Aug 1-Sept 5	10	1 oz	1/3	12-24	2-4
Spinach, New Zealand	May 1-June 15	June 15-July 20	5	1 oz	1	30-42	15-18
Squash, Summer	May 1-May 30	June 1-June 15	6	1 oz	1-2	48-60	18-24
Squash, Winter	May 15-June 15		15	1 oz	1-2	60-84	36-48
Sweet Corn	May 1-June 15	June 15-July 10	50	1 oz	1-2	30-36	10-12
Sweet Potatoes*	May 20-June 10		20	100 plants		30-42	12-15
Tomatoes*	May 1-June 15	June 15-July 5	10	67 plants		30-42	18-30
Turnips	Mar 20-May 1	July 10-Sept 1	15	1/2 oz	1/4	18-30	2-3
Watercress	Mar 20-May 1			300 plants		18-24	46
Watermelon	May 15-June 15		20	1 oz	1-2	60-96	48-60

http://extension.umd.edu/hgic/plants/vegetables

[1] Dates are for Central Maryland. Advance or delay planting dates accordingly for other areas of the state.

[2] A good rule of thumb is to plant seeds to a depth 2x their diameter. Seeds can be planted deeper in sandy soils and shallower in heavy clay soils.
[3] Distance between rows can be reduced if rows are planted on a raised bed.
[4] Garlic planted in the fall will out produce garlic planted in the spring.

Order Factsheet #HG70 Recommended Vegetable Cultivars for Maryland Home Gardens

Author: Jon Traunfeld, Regional Specialist, Maryland Cooperative Extension, University of Maryland

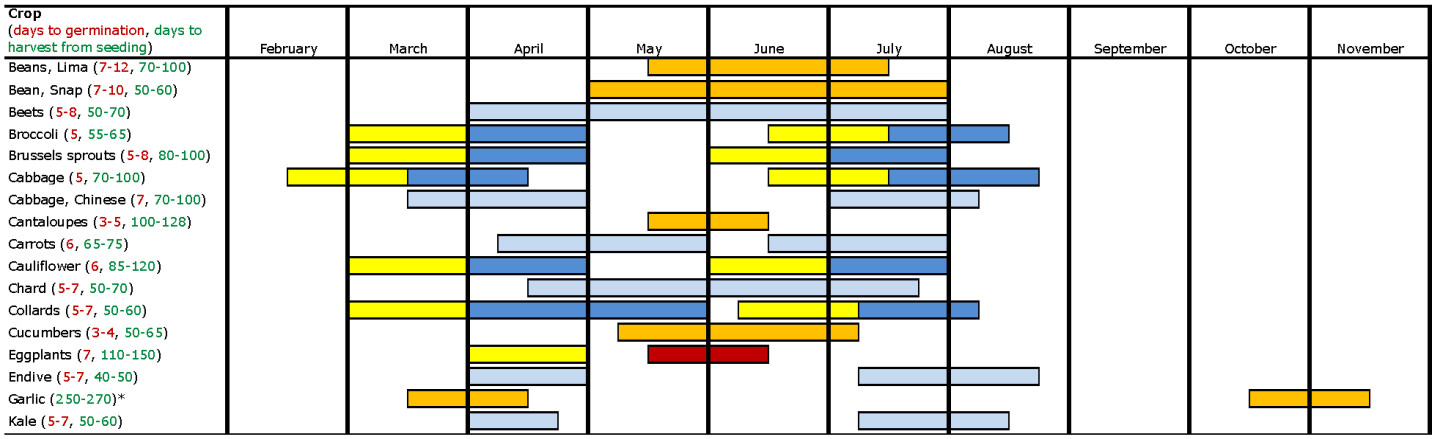
Vegetable Planting Calendar for Central Maryland

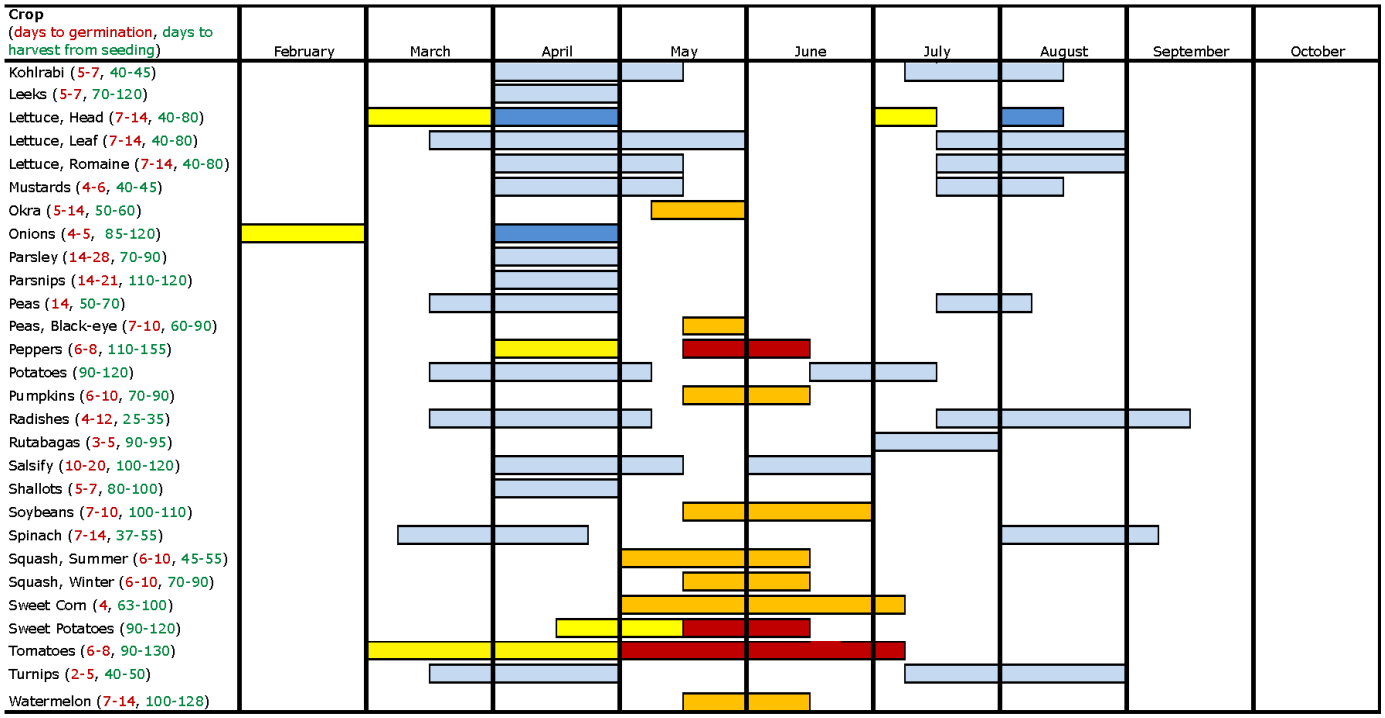
= start seeds inside to grow seedlings (transplants)
= plant seeds for cold hardy crops directly in the ground
= plant cold hardy seedlings outside
= plant seeds for warm weather crops directly in ground
= plant warm weather seedlings outside

STOP: Read this first!:
The range of dates given is the time periods during which you can plant each vegetable and expect success.
For a sustained harvest, plant a little bit of that vegetable every two weeks (known as succession planting)
Color coding tells you whether you transplant or direct seed. Crops that are typically direct seeded can be started indoors and transplanted to increase garden productivity
Cool weather crops are ones that are planted and harvested twice: once in the fall, once in the spring. Warm season crops grow during the summer, but you can plant in successions across the range of dates given.

Dates are approximate. Some plants may be propagated by methods other than what is listed here. Consult gardening books to explore whether direct seeding or transplanting is recommended.

For more detailed information on these crops, see the Vegetable Profiles section of the Grow It Eat It web site.





* Garlic planted in the spring for fall harvest does not produce as well as garlic planted in the fall for spring harvest. Fall planting should happen between October 15 and November 15

Based on information from University of Maryland Cooperative Extension. This publication replaces HG 16, Planting Dates for Vegetable Crops in Maryland

Author: Chrissa Carlson, former Nutrition and Garden Educator, FSNE Program, UME
Reviewer: Jon Traunfeld, Extension Specialist, UME

March, 2010

Can you save seeds from one year to the next? Yes, with a little bit of care. The best conditions for seed storage are cold and dry, so just put them in the refrigerator. There are differences in long-term viability for different species, but you can usually store seeds successfully in the refrigerator for several years. You can use a jar with a tight-fitting lid or a zippered plastic bag if you wish.

It's easy to test the germination of stored seed, so students can help. Count out some seeds and wrap them in a moist paper towel. The towel needs to be kept moist, so put it in a plastic bag or a small air-tight container (such as a yogurt cup tightly covered with plastic wrap). Put the seeds in a warm place, especially if you are testing warm-season seeds such as tomatoes or peppers. Use the seed packet information about germination temperature as a guide. The paper needs to stay moist, but not soggy, so check it every day. The seed packet will indicate the expected number of days for germination. At that point (or a few days later), check for germination. If half or more are germinating, you can use the seeds, perhaps planting some extras to be on the safe side if the percent is on the low side. If fewer than half the seeds have germinated, buy a new packet.

The Lancaster County Conservation District (offices at the Farm and Home Center) has a yearly sale of tree seedlings, perennial flowers, groundcovers, and shrubs. Typically some fruit trees and berries are available. Orders are taken in late winter, with distribution in mid-April. Information is available at http://www.lancasterconservation.org.

Companion Planting

The concept of "companion planting" refers to growing certain plants together. See the box for the various aspects of companion planting. In some cases one plant my create soil conditions that enhance the growth of another. In addition, there are plants that can repel certain pests; these can be very helpful in your garden. In contrast, avoid those combinations of plants that have antagonistic effects. Keep track of what works in your garden. Here are some resources that provide general discussion of the topic as well as details on possible companions and antagonists:

- http://www.chemung.cce.cornell.edu/resources/companion-planting-information on companion plants and pest-repelling plants
- https://attra.ncat.org/attra-pub/viewhtml.php?id=72 – a very comprehensive resource on companion planting and botanical pesticides. Detailed information on the Three Sisters Garden

The following is a summary of the various mechanisms underlying companion planting.[7]

THE SCIENTIFIC FOUNDATION FOR COMPANION PLANTING[7]

Several mechanisms that create beneficial plant associations:

Trap cropping. Sometimes, a neighboring crop may be selected because it is more attractive to pests and serves to distract them from the main crop. An excellent example of this is the use of collards to draw the diamond back moth away from cabbage.

Symbiotic nitrogen fixation. Legumes— such as peas, beans, and clover—have the ability to fix atmospheric nitrogen for their own use and for the benefit of neighboring plants via symbiotic relationship with Rhizobium bacteria. Forage legumes, for example, are commonly seeded with grasses to reduce the need for nitrogen fertilizer. Likewise, beans are sometimes interplanted with corn.

Biochemical pest suppression. Some plants exude chemicals from roots or aerial parts that suppress or repel pests and protect neighboring plants. The African marigold, for example, releases thiopene—a nematode repellent—making it a good companion for a number of garden crops. The manufacture and release of certain biochemicals is also a factor in plant antagonism. Allelochemicals such as juglone— found in black walnut— suppress the growth of a wide range of other plants, which often creates a problem in home horticulture. A positive use of plant allelopathy is the use of mow-killed grain rye as a mulch. The allelochemicals that leach from rye residue prevent weed germination but do not harm transplanted tomatoes, broccoli, or many other vegetables.

Physical spatial interactions. For example, tall-growing, sun-loving plants may share space with lower-growing, shade-tolerant species, resulting in higher total yields from the land. Spatial interaction can also yield pest control benefits. The diverse canopy resulting when corn is companion-planted with squash or pumpkins is believed to disorient the adult squash vine borer and protect the vining crop from this damaging pest. In turn, the presence of the prickly vines is said to discourage raccoons from ravaging the sweet corn.
Nurse cropping. Tall or dense-canopied plants may protect more vulnerable species through shading or by providing a windbreak. Nurse crops such as oats have long been used to help establish alfalfa and other forages by supplanting the more competitive weeds that would otherwise grow in their place. In many instances, nurse cropping is simply another form of physical-spatial interaction.

Beneficial habitats. Beneficial habitats— sometimes called refugia—are another type of companion plant interaction that has drawn considerable attention in recent years. The benefit is derived when companion plants provide a desirable environment for beneficial insects and other arthropods— especially those predatory and parasitic species which help to keep pest populations in check.
Predators include ladybird beetles, lacewings, hover flies, mantids, robber flies, and non-insects such as spiders and predatory mites. Parasites include a wide range of fly and wasp species including tachinid flies, and Trichogramma and ichneumonid wasps. Agroecologists believe that by developing systems to include habitats that draw and sustain beneficial insects, the twin objectives of reducing both pest damage and pesticide use can be attained. For detailed information on establishing beneficial habitats, request the ATTRA publication Farmscaping to Enhance Biological Control.

Security through diversity. A more general mixing of various crops and varieties provides a degree of security to the grower. If pests or adverse conditions reduce or destroy a single crop or cultivar, others remain to pro- duce some level of yield. Furthermore, the simple mixing of cultivars, as demonstrated with broccoli in University of California research, can reduce aphid infestation in a crop.

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Companion Planting

	Grows Well With	Protected by	Inhibited By
Asparagus	Parsley, Basil	Tomato (Asparagus Beetles	
Basil	(Repels flies & mosquitoes)		
Bay	(Eliminates Weevils in stored grains)		
Beans, Bush	Carrots, Cauliflower, Potato, Strawberry, Celery, Cucumbers	Marigolds, Summer Savory (Mexican Bean Beetle)	Onion Family
	Note: Bush beans planted with potatoes protect them from Colorado Potato bug and potatoes protect beans from Mexican Bean beetle.		
Pole Beans	Corn, Radishes	Summer Savory	Onion, Beets, Kohlrabi, Sunflower
Beets	Cabbage, Lettuce, Onions, Kohlrabi	Mustard	Pole Beans
Broccoli	Potato, Beets, Onion, Aromatic Plants , Sage, Rosemary,	Oregano (Cabbage Butterfly)	Tomato, Pole Beans, Strawberries
Cabbage	Celery, Dill, Onions, Potatoes, Bush and Broad Beans, Garlic	Mint, Hyssop, Thyme, Wormwood (repels White Cabbage Butterfly)	Tomato, Pole Beans Strawberries
Caraway	Peas	*(helps loosen compacted soils)*	Fennel
Carrots*	Lettuce, Tomatoes, Chives, Radishes	Onion, Leeks, Rosemary, Sage *(repels Carrot Fly)*	Dill
Cauliflower	Celery	(see Cabbage)	Tomato, Strawberry, Dill
Celery	Leek, Tomato, Cauliflower, Cabbage, Bush Beans	Nasturtium *(repels whiteflies)*	
Corn	Potato, Peas, Beans, Cucumber, Pumpkin, Squash	Sunflowers in alternating strips *(reduces Fall Armyworm)*	Tomato
Cucumber	Beans, Peas, Radishes, Sunflowers, Corn	2 or 3 radish seeds in hill *(cucumber beetles)*	Potato Aromatic Herbs
Dill	Cabbage		Carrots
Eggplant	Beans, Marigold	*(Green Beans repel Colorado Potato bug)*	
Fennel	*(Inhibits most plants including Bush Beans Caraway, Kohlrabi & Tomatoes)*		Wormwood
Kohlrabi	Onions, Beets, Cucumbers		Tomato, Pole Beans, Strawberry, Dill
Leek	Celery, Onions, Carrots		
Lettuce	Cucumbers, Carrots, Radishes Strawberries	Onions *(repel rabbits)*	
Mint		*(repels ants)*	
Onions	Cabbage, Beets, Strawberries, Tomato, Lettuce	Summer Savory	Peas, Beans
Parsley	Tomato, Asparagus		

	Grows Well With	Protected By	Inhibited By
Peas	Carrots, Turnip, Radish, Corn, Cucumber, Beans		Onions, Garlic, Shallots, Potato, Leek, Gladiolus
Potatoes	Beans, Corn, Cabbage, Peas, Horseradish (in corners of patch)	Marigold *(repels nematodes)*	Pumpkin, Tomato, Squash, Raspberry, Cucumber, Sunflowers
Pumpkin	Corn, Marigold		Potato
Radish*	Beans, Lettuce, Cucumber, Beets, Carrots, Spinach, Parsnips	Nasturtium *(repels insects)*	Hyssop, Cabbage, Cauliflower, Kohlrabi, Brussels sprouts, Turnips
Tomato	Chives, Onions, Parsley, Asparagus, Marigold, Carrots , Cucumber	Basil *(repels insects & disease)*	Corn, Potato, Fennel, Cabbage, Cauliflowers

**Note: Mix tea leaves with radish and carrot seeds to prevent maggots*

Prepared by: Kenneth Derenthal, Master Gardener of Suffolk County.
Reference: Carrots Love Tomatoes, Louise Riotte.

Slightly Revised by: Susan K. Beebe, Association Issue Leader, CCE of Saratoga County, 2013
Reference: ATTRA Publication – Companion Planting Basic Concepts and Resources

SPECIAL GARDENS

There are many types of special-interest gardens containing particular groups of plants. For most of these, lessons can include related stories or other reading materials. Here is an extensive list of special gardens and gardens for different cultures (including connections to the curriculum and to children's literature) https://www.schoolgardenwizard.org/wizard/learn/teach_themes.html

Given the diverse cultures of students in many Lancaster County schools, grow the crops typically used by their families, and then invite community members to help cook typical dishes. The Native American Three Sisters garden is very popular: beans, corn, and squash. Here are web sites on the Iroquois legend, on how to grow the garden and lessons and activities: http://gardening.cals.cornell.edu/lessons/curricula/the-three-sisters-exploring-an-iroquois-garden

http://blogs.cornell.edu/gblblog/files/2016/07/newlogoThree-Sisters-Exploring-an-Iroquois-Garden1-199h8hj-xupent.pdf

Other special gardens include: salsa, pizza, children's stories, herbs, bees and other pollinators, butterflies, flowers for cutting, native plants, and sensory gardens (visit the Five Senses Garden at Lancaster County Central Park http://co.lancaster.pa.us/343/garden-of-five-senses

Crop Rotation

One of the easiest and most effective ways to enhance soil fertility and reduce insect and disease problems is through crop rotation. This is an ancient practice and fundamental to organic gardening. It simply means not growing the same type of plant year after year in the same place, but moving plants around in successive years. Here's how it works.

The pests or diseases of a certain crop may overwinter in the soil. If the same crop is planted in that spot the next year, the pests or diseases will be right there to attack the new plants. But if a different crop is there, since some pests and diseases are very host-specific, they won't be able to attack the plants right away. Of course this may not help for flying insects or highly mobile plant diseases, but crop rotation does give you an advantage, in conjunction with other strategies.

Here is one example of a rotation pattern. "Beds" could refer to raised beds or different parts of an in-ground garden. You'll find many other examples of rotation patterns in gardening resources, depending on the number of beds you have, the crops you grow, etc. Following an exact pattern is not as important as doing some kind of rotation.

Crop Groups

Tomato/Potato Group – Tomato, Pepper, Eggplant, Potato
Greens/Brassica Group – Cauliflower, Broccoli, Cabbage, Kale, Brussels Sprouts, Lettuce
Legume Group – Peas, Beans
Squash/Corn Group – Cucumber, Squash, Melon, Pumpkin, Corn

YEAR	BED 1	BED 2	BED 3	BED 4
1	Tomato/ Potato	Greens/ Brassica	Legume	Squash/ Corn
2.	Squash/ Corn	Tomato/ Potato	Greens/ Brassica	Legume
3	Legume	Squash/ Corn	Tomato/ Potato	Greens/ Brassica
4	Greens/ Brassica	Legume	Squash/ Corn	Tomato/ Potato

Onions, beets, carrots, and radishes can be planted with any group, and the members of that group can be replanted after an early crop is harvested.

Different crops have somewhat different needs for mineral nutrients. By growing different crops in an area, you can lessen the chance that you'll deplete particular minerals, especially if the crop is a "heavy feeder" such as tomatoes or corn. Also, plants in the legume group (beans and peas, as well as cover crops such as lentils) can actually increase the soil's nitrogen content by taking nitrogen from the air (nitrogen fixation). So any crop rotation pattern should include a legume crop. You'll get the most benefit from a legume cover crop that you don't harvest but dig into the soil. With a crop such as beans or peas that you harvest, you remove some of the added nitrogen; but there's still a positive effect.

Cover crops can be worked into the rotation as desired. In addition to the other benefits, crop rotation with a cover crop can suppress weeds by choking them out; there's less bare ground for the weeds to get started and the established cover crop can deprive the weeds of water and mineral nutrients.

The problem for those with a very small garden is that there isn't enough space to move one group of plants very far away, but do whatever you can. With even a few raised beds or a modest sized garden, crop rotation is easy to do and highly recommended.

EXTENDING THE GROWING SEASON - TUNNELS, GREENHOUSES, AND INDOOR PLANTING

The limited growing season in Lancaster presents challenges for a school garden, but there are ways to expand the time frame for your garden. Many of these are quite inexpensive. The "Resources" section contains additional information on these ideas, which have been implemented by some established school gardens in our area. Lots of people in our area are familiar with these structures.

Black plastic mulch can warm the soil in the late winter and spring, thus allowing you to plant somewhat earlier. See the "Weed Control and Mulching" section below for further information.

Temporary structures can be installed over your garden or raised beds. These may allow you to harvest crops much longer into the fall (by protecting against early frost) and to sow seeds or transplant seedlings much earlier in the spring (by warming the soil and protecting against cold nights. Some fall-sown crops, such as spinach or Swiss chard, may overwinter and resume growth early in the following spring. Our winters are variable, so there's no predicting!

A low hoop tunnel is easily constructed at minimal cost to cover either a raised bed or part of a soil garden. Lightweight non-woven polyethylene row coverings (sold under various trade names) are very effective, although clear plastic is preferable in the winter. There are various types of row covers depending on the extent of cold protection desired. Some of these covers allow air and water to pass through, so you

can leave them in place until the weather has settled. Some types are used in the summer for shading and cooling of lettuce and other crops, or for keeping some pests off.

Install hoops in the soil every few feet; flexible plastic pipe or electrical conduit (1/2 inch diameter and 6 foot lengths are suggested) is an inexpensive but sturdy material. Or you can purchase hoops commercially. Then lay the covering material over the hoops. Allow extra sheeting so you can anchor it on the ground with rocks or bricks to withstand the wind. Provide a small opening for ventilation to reduce excessive humidity. You'll have to brush off heavy snow.

Floating row covers are so light that they can simply be placed over the plants (or the seeded area) and anchored with soil or pegs. They are permeable to air and water. A traditional cold frame can be made for a small area, using an old window sash.

The photo below shows a plastic covering over a 4 X 4 foot raised bed. The hoops are ½ inch diameter plastic pipe, anchored to the inside of the wood with pipe clamps. For a 4 X 8 foot raised bed you could install two such structures or make a hoop tunnel.

A cross between a low hoop tunnel and a permanent glass greenhouse is a high hoop house, allowing several feet of height for plants. You can purchase a kit or assemble on your own. Some school gardens have purchased small portable plastic greenhouses. Information on these ideas is at: https://kidsgardening.org/gardening-basics-extend-the-season-with-plant-cover-ups/

Some schools may have a permanent greenhouse with heat, ventilation, water, etc. Or you may have access to a greenhouse operated by a partner organization or at your high school. If you have your own greenhouse or a window-mounted unit, then you may be able to raise some plants throughout the year. More importantly, with a greenhouse you'll be able to start your garden seedlings well ahead of time, for transplanting into the garden.

An alternative to a greenhouse is an indoor growing unit with artificial lights; these range from a single light on a countertop to large mobile units with many shelves. Many such units are commercially available. A lower-cost alternative would be to make your own or to seek the collaboration of a high school or college class to construct the units. You'll need to get some information on how to use these units, such as the type of lights to use and the light intensity needed. Regular fluorescent bulbs will not support good plant growth; special broad-spectrum high intensity plant growth bulbs are necessary. The benefits can be great, as the students can watch their plants grow day by day. You can build lesson plans around the project. An automatic watering system is highly recommended, because the classroom environment can be quite dry; make sure you have plans for watering over weekends and vacations. There's nothing sadder than returning on Monday to wilted and dead plants. With any plants grown indoors, remember to gradually acclimate the seedlings to the outdoors ("hardening off"), and resist the urge to transplant too early.

SPECIAL DAYS IN THE GARDEN

As you plan your garden activities, identify days when you can celebrate special events and when you will need lots of helpers (both adults and children). Use your publicity and media systems to inform the community (see the "Cultivating Support" chapter for further details). Make sure to highlight the involvement of the children. Plan these events carefully so you have all the materials ready and clearly defined tasks for the participants; volunteers don't want to stand around doing nothing. Have people ready to take photos to post on your web site and social media.

At the beginning of your project, there will be much work to do. Organize construction days, perhaps along with an official groundbreaking ceremony.

Whether it is your first year or a subsequent year, there are many tasks to get ready for the spring planting. So a spring preparation day is an opportunity to check that the tools are in good condition, to have your participants help decide what will be planted where, to do any repairs or new construction (such as additional raised beds), etc. In their classrooms the students should already have had lessons related to planning the garden activities and what their jobs will be. They may already have started some seedlings for later transplanting.

Planting will occur on many days throughout the spring, since some plants can be started as soon as the ground can be worked (mid-to-late March), some a bit later, and others must wait until after the last frost (mid-May). Some of these days can be times for celebrations, involving parents and the community, while other plantings may occur as routine parts of the school day. Given the uncertainties of spring weather, you'll probably want to do the early plantings whenever you can, and schedule the big events a little later when you can be sure it will be warm enough.

Once the garden has been started, the children can do many of the tasks such as thinning, weeding, and harvesting early crops. The garden leaders will have to arrange for volunteer helpers as needed. You might want to have a spring harvest celebration for the early maturing crops, but many of these crops (lettuce, spinach, radishes, etc.) will be continually maturing. At any harvest event you could include preparation of dishes made from the crops.

If your garden will be continuing over the summer, then arranging for summer care and harvesting is essential (see above for information on summer gardening). When the first tomatoes and other crops are ready, a celebration might be a good opportunity to bring people together for a picnic with homemade salsa from garden tomatoes.

Fall brings more opportunities for harvest events. A celebration soon after school starts can help build interest and enthusiasm, especially among children and families new to the school. You might also do some fall plantings. If you've grown pumpkins, then surely arrange a pre-Halloween event.

As the gardening season draws to a close, you'll need to arrange work days to prepare the garden for winter and to begin preparation for the next growing season (spreading compost, for example). These days may not have quite the excitement of planting or harvest celebrations, but they are a way to bring everyone together to mark the end of a successful year.

Garden-Caring For The Garden

Once your garden has been planted, you will need to pay attention to watering, fertilizing, weed control, and pest control. Each of these activities is discussed below, with particular emphasis on how you can engage the children. Teachers often notice

that children are eager to do tasks that adults may find "boring", so you can create enthusiasm and a learning opportunity even for routine jobs. As you maintain your garden, make sure to keep careful records, so that you will benefit from your experiences in future years and can share your observations with others.

WATERING

Of all the factors involved in a successful garden, rainfall is probably the most variable. Remember the summer of 2013: nearly constant rain in the early part of the season and then hardly any rain in August and September. When young plants are just getting established, careful attention to watering is crucial. Even a day or two without watering can severely damage your plants. But once they are well established, they can easily tolerate a week or more without water. If there is an inch or so of rain per week, you will probably not need to water; but always look at the plants for any signs of lack of water. A simple rain gauge is a good investment of a few dollars. Consider setting up a basic weather station in your garden. Children could monitor and record rainfall, along with other environmental conditions. Don't rely on newspaper or 1V reports, since (especially with summer storms) rainfall amounts can vary greatly over short distances.

Many materials listed in the "Resources" section have information on watering. Information on all aspects of water (why plants need water, how they obtain and transport water, and how and when to water) is available in: “Garden Watering” at https://www.aginclassroom.org/ag-curriculum

In your planning process, make sure to consider the need for a convenient water supply so you don't have to carry buckets of water long distances day after day during a summer dry spell. Try to locate your garden close to an outside water source, such as a faucet on the building wall or a faucet used for nearby athletic fields. Otherwise, consider how much garden hose you will need to get water from a distant source. It is expensive to run a dedicated underground water line for your garden, but you may need to include that in your planning and budget. Remember that any outside water source will need to be drained before freezing temperatures occur.

For health and safety reasons, you should use only potable water from your school’s approved water supply for watering your garden and for handwashing. Do not get drinking water from garden hoses. Do not use water collected in rain barrels for watering food crops, for handwashing, or for drinking.

Children enjoy watering, so give them this task, even at the risk of some wet shoes. Children can use small watering cans or cups that they fill from a bucket or a faucet. A "dripper", made from a small container with holes punched in the bottom, enables children to water plants gently and carefully. Use yogurt containers for young children, or milk or juice jugs (with the tops cut off for older children. Experienced school gardeners advise that young children should not use hoses; you'll certainly end up with dripping wet students. Hoses can be a tripping hazard, hoses can damage plants as

they are dragged through the garden, and it is hard for children to avoid damaging plants with a strong spray.

An irrigation system might be useful during the summer. Rather than an overhead spray system, consider using pipes with perforations or "emitters" to deliver the water directly to the soil at the base of the plants. The system controller can be pre-set to water on certain days, or you can simply turn it on as needed. You can construct a basic system fairly inexpensively using readily available components obtained at a hardware or garden store. Such a drip irrigation system can be used for either raised beds or a garden in the ground.

So when should you water? Different plants, at different stages, and in different soils will have different needs. A key step of managing the water in your garden occurs at the beginning. When you first develop your garden, find out if the soil drains properly and, if not, what amendments you should add. A garden soil with too much clay will not drain properly; adding compost or sand can help. If the soil has too much sand (not usually a problem in our area), it will drain and dry out too quickly; again, compost can help. If you are bringing in soil for raised beds, make sure you discuss with the supplier the proper mixture for your intended use.

Too much water can be just as much a problem as too little. There's not much you can do if there is excessive rain, but if your soil is well-draining and does not have low spots, even heavy and prolonged downpours will not cause problems. You need to be careful with certain seeds planted early in the spring, as wet soil and cool temperatures can lead to rotting of the seeds (particularly corn and beans). If seeds haven't sprouted in the expected time, then replant. Excessively wet conditions can lead to mold and other diseases on leaves, so avoid planting very densely; good air circulation is one way to lessen such problems.

The soil covering newly-planted seeds should be kept moist but not excessively wet until they germinate. Young seedlings have only a tiny root, so on a warm, sunny day they can lose water quickly and may be unable to replace it from a dry soil. Children have to be careful when they water their young seedlings.

If you are growing or purchasing plants for transplanting, you should gradually acclimate them ("hardening") to the potentially harsher outdoor conditions. It's quite likely that you will inadvertently damage some roots during transplanting, and

(especially for greenhouse-grown plants) the root system may be inadequate for the size of the plant. If you can, transplant on a cloudy day or late in the day, so the plants don't immediately face a water stress situation. Monitor the young plants every day and keep the soil moist.

Once the plants are established, they will have developed a good root system (provided your soil is sufficiently loose - that's one of the benefits of applying compost). Several days or a week without rain will not be a problem. Learn to observe the plants: drooping tomato leaves in the heat of the day are a signal for watering, but the children will be amazed at how quickly the plant recovers. A useful guideline for watering is that once the soil starts to dry out you should water thoroughly and deeply. Then let the soil dry somewhat before watering again. Avoid frequent light sprinkling. Deep watering promotes a deep root system, thus enabling the plant to tap water from deep in the soil.

But there are some plants that are inherently shallow-rooted and more susceptible to damage from a dry spell.

Mulching around the plants is a good way to conserve the soil's water content. This can be especially helpful during the summer if there will be long intervals when no one can visit the garden to water. See the section on mulching below.

FERTILIZING

As you think about providing the essential nutrients that plants need, start with background information to help students learn about soil and how to maintain ideal conditions for your garden. Strive to nourish all the soil bacteria, worms, and other organisms so they provide a good habitat for the plants. Here are good resources: http://aginclassroom.org

https://www.kidsgardening.org/gardening-basics-all-the-dirt-on-soil/

Before each growing season, you may want to get the soil analyzed for the mineral content (see the "Soil" section). The report you receive will include recommendations for necessary amendments for optimal growth of the plants.

Adding compost to your garden is important for many reasons. Compost improves the soil structure. Compost adds minerals and keeps them in a form that is readily available to the roots. However, you do not know the mineral content of your compost, so you can't determine if the addition has met the needs of your crops.

This discussion does not distinguish between "chemical" and "organic" fertilizers. Both supply the specified minerals, although some organic fertilizers may also supply other materials beneficial for the soil structure. All commercial fertilizers are labeled as to their mineral composition. Certain chemical fertilizers are approved for commercial

organic crop production, according to the national standards. Fish emulsion is a commonly used liquid organic fertilizer. Information on making compost tea, a do-it-yourself organic fertilizer, is given in the section on composting. Other organic fertilizers are bone meal, dried blood, rock powders, etc.

Commercial fertilizers are labeled with their "NPK" content to indicate their contents of three critical minerals, nitrogen (N), phosphorus (P), and potassium (K). Some fertilizers contain only those minerals, while some contain other minerals as well; your soil analysis report will indicate specific needs in your soil.

The report will also indicate if you need to adjust the pH (acidity or alkalinity). The pH is important in influencing how readily the minerals can be absorbed by the roots. Improper pH can impair the growth of some plants.

In gardens with a variety of vegetable crops, you can follow the general recommendations in the soil analysis report for such a garden. You should also determine any particular fertilizer needs for the plants you are growing. Certain crops (corn, for example) are known to be "heavy feeders", referring to their requirement for greater amounts of nitrogen in particular. Tomatoes should receive a high-phosphorus fertilizer and less nitrogen to encourage good fruit development. For information on fertilizer and other requirements of particular crops, see:

- “Vegetable Gardening” Penn State Extension
- “Vegetable Growing Guides” https://www.gardening.cornell.edu/homegardening/scene0391.html
- “Growing Guides” https://kidsgardening.org/plant-of-the-month

Two traditional practices involving the crops you plant can contribute to soil fertility. In the section on “Building the Soil” you’ll find information on cover crops, plants that are grown in the off-season and then turned under to improve soil fertility and soil structure. Crop rotation described in the “What to Plant and When” section, can also help maintain soil fertility.

As you prepare your garden in the early spring, you should add compost and whatever fertilizer is recommended. Some additional fertilizer may be needed during the year, especially if you are growing multiple crops in the same area. When you harvest and remove the plants, the minerals are removed as well. That's why adding compost is a

way to replenish the minerals, to some extent. Work the fertilizer into the soil, but be careful that foot traffic on the moist soil does not lead to compaction, which can damage the soil structure and greatly impair plant growth. Stand away from the planting rows and stand outside the raised beds.

Fertilizer can be added during the growing season in various ways; information on particular crops will indicate if that is advisable. Dry fertilizers can be added around individual plants or beside the rows ("side dressing") and gently cultivated into the soil; do not cultivate deeply as you may damage the roots. Liquid fertilizers (either commercial or home-made compost tea) can be applied to the soil.

If you have used compost and followed the recommendations of the soil analysis, you will have taken major steps. The condition of the plants can give you an indication of the need for fertilizer. Shortages of certain minerals lead to noticeable symptoms. If you see that the lower leaves are yellowing on tomatoes, for example, that is probably a sign of a nitrogen deficiency and you should add a high-nitrogen fertilizer as recommended on the package. There may be particular recommendations for certain crops or conditions. For example, high-nitrogen fertilizers are good for leaf/vegetative growth, while high- phosphorus fertilizers encourage root growth and flowering. Plants grown in containers, with only a limited amount of soil, are more likely to have mineral shortages.

Be careful not to over-fertilize. An excess of certain minerals can harm plants. Also, excess fertilizer that is not taken up by the plants can run off into streams, rivers, and the Chesapeake Bay. You need not worry about the impact of your small plot compared to that of a big corn or dairy farm. But this is a "teachable moment" to help students understand the water pollution problems that citizens of Lancaster County need to address in urban, suburban, and rural areas.

PEST CONTROL

This section examines problems you may encounter with insects and related animals such as mites, plant diseases (caused by bacteria, fungi, and viruses), mammals (such as rabbits, deer, and groundhogs), and others such as slugs. The organisms that may attack and damage garden plants are all part of the web of nature. Plants are the "primary producers" in the ecosystem, and many other organisms obtain their energy and materials from the plants. These herbivores (plant-eaters) are often themselves fed upon by other animals, the carnivores. So discussing garden "pests" with children is a way to teach about the natural food web, a topic that is at the heart of curricula at all levels of education.

In most cases the animals that feed on garden crops do not do significant damage and can be left alone. Your tomato plants may be covered with white flies, but you will still get a bumper crop. The same may be true of certain plant diseases. But gardeners do need to be alert for a potentially devastating situation. But even those situations can

provide the opportunity for learning, and it is usually possible to recover after such an incident. You're not trying to produce picture-perfect plants, so don't worry about a few holes in the leaves. But do worry if slugs or rabbits are demolishing every seedling in the row.

Prevention is your first line of defense. Many plant varieties have built-in genetic resistance to certain diseases or pests, so find out which varieties are best for your garden. Cultural practices, such as companion planting and crop rotation (discussed elsewhere in this manual) and encouraging natural enemies, can lessen the disease and insect problems. At the end of a crop's growth, remove all plant material, which could provide an overwintering reservoir of disease or insects. Diseased material should not be composted. If your compost pile does not reach a high enough temperature, disease organisms may survive. See this list of prevention strategies and the pest control information: https://kidsgardening.org/gardening-basics-dealing-with-garden-pests-and-diseases/

Your first task is to identify the pest or disease. In some cases it will be obvious; if the fence has been knocked down and everything trampled, it's probably deer. Or you may see the insects eagerly chewing away on the leaves. If you're not sure what the problem is, there are many resources that describe the typical pests of crops. Experts at garden stores or the Penn State Extension Office can help if you bring a sample of the affected plant.

PLANT DISEASES

Most people have heard about the potato blight that devastated Ireland in the 1840s, with about a million people dying and a like number migrating to the U.S. and elsewhere. This is a great lesson to link the garden to history; see:

- http://www.apsnet.org/edcenter/K-12/NewsViews/Pages/2001_12.aspx - an introduction to the history
- http://www.apsnet.org/edcenter/intropp/lessons/fungi/Oomycetes/Pages/LateBlight.aspx - a detailed technical discussion on the disease
- https://kidsgardening.org/gardening-basics-potato-world-history/ -an introduction to the fascinating history of the potato, which originated in South America

The disease-causing organism is routinely found in the soil, so if you are growing potatoes make sure you start with certified disease-resistant material. Since similar diseases also affect tomatoes (a close relative of potatoes), choose resistant varieties. In general choosing disease-resistant types (if available) of any crop is the gardener's first step.

Reference materials on particular crops provide guidance on diseases, including identifying symptoms. Various treatments, including organic materials, are available.

MAMMALS

Animals such deer, moles, rabbits, or groundhogs can cause serious damage. Fencing is the most effective approach, although the one-time cost (in money and labor) may be considerable. If you fence your garden, make sure the gate is secured after people leave the garden!

Repellant sprays containing garlic or hot pepper are reasonably effective and can be purchased in garden stores or homemade. Recipes can be found in garden resources. Repeated applications may be necessary following heavy rain.

Deer are a problem in suburban and rural areas, and even in urban areas where there are nearby woodlands. A deer fence needs to be sturdy and at least 6 feet high. To keep out rabbits, a poultry-wire fence 2 feet high is sufficient. Groundhogs are powerful diggers, so in addition to a strong above-ground fence you should have sturdy material (such as hardware cloth) buried several inches below ground.

SLUGS AND NEMATODES

Slugs can decimate a row of young seedlings as well as mature plants of many crops. There are some non-chemical ways to trap slugs, which are usually active at night.

Beer is a favorite of many gardeners; non-alcoholic works just as well as alcoholic, since it's the yeast that attracts them! Bury small containers (such as yogurt containers) nearly to the rim and fill about half-way with beer. Slugs will be attracted to the beer and the next morning you can remove them. You'll need to replace the beer after a few days.

Diatomaceous earth (only use a type specifically for gardens) can be sprinkled through the garden; its sharp granules will kill the slugs. You will need to replenish it after rainfall.

You can hand-pick the slugs from the garden early in the morning or in the evening. Slugs will seek shelter under boards or similar objects placed in the garden, and then you can remove them the next day.

Nematodes are microscopic worm-like organisms. They can occasionally be a problem on certain crops. Many varieties of tomatoes, for example, have been bred to be nematode resistant.

INSECTS AND MITES

People may lump these organisms under the heading of "bugs". Insects and mites (related to spiders) belong to the huge group of animals called arthropods (along with crustaceans such as lobsters and shrimp). Some of these organisms are rather particular in their feeding habits, favoring just one or a few (often related) crops, such as cabbage loopers that consume cruciferous vegetables; others can affect many different crops. Very few insects are potentially problems in a garden; most are either harmless or actually beneficial (such as pollinators). Take advantage of the many learning opportunities about the insects and their roles in nature. There are lesson plans in the materials in the "Resources" section.

Children may be familiar with some garden insects, such as caterpillars, butterflies, ants, and ladybird beetles. You can grow plants that will attract particular insects, such as milkweed, which is the sole food plant for monarch butterfly caterpillars. The beautiful caterpillars of the black swallowtail butterfly will probably find and eat your parsley plants. You may be able to rear caterpillars (the larval stage) in the classroom. Science supply companies provide kits and instructions.

As you decide what crops you will grow, you should learn about potential insect problems so that you have a response plan ready. Some of your strategies may involve prevention, the use of natural enemies, or the use of pesticides that are safe for food plants. Here is a web resource with illustrations of common insect pests: https://idl.entomology.cornell.edu/factsheets/

There are several strategies for prevention. Some crop varieties that have been bred to be more resistant to particular insects. Some companion plantings (described previously in this manual) are designed for pest control. Some herbs (and other plants) can deter particular insects, so including such plants can protect the potential target, and you'll also get some great herbs to harvest! Some gardeners grow "trap crops", which will attract the pest away from the plant you are trying to protect. Lightweight fabric floating row covers can provide some protection from flying insects.

Beneficial organisms, including many types of insects, can be a valuable part of your insect control strategy. Gardeners seek to encourage populations of these organisms because they can attack and kill certain pests. The most familiar example is the ladybird beetle (colloquially, "ladybugs"), which can help control pests such as aphids and scales. The Asian ladybird beetle, though a valuable biological control agent, is an introduced (non-native) species that has actually become an annoying (though harmless) home pest. See https://idl.entomology.cornell.edu/files/2013/11/beneficial-insects-1sdvhbp.pdf for information about beneficial insects, and http://migarden.msu.edu/uploads/files/e2719.pdf for more detailed information.

In addition to relying on natural populations of beneficial insects and other pest-attacking beneficial organisms, you can purchase some of them commercially to

release into your garden. Of course insects can fly or crawl away, so not all of them will stay in your garden!

One of your best weapons against insect pests is the children. With so many eager hands, they can make quick work of removing an infestation of insects or slugs. There are lessons here, so be sure to have some hand lenses so they can examine them. Just be sure they know to leave the beneficial insects or other desirable insects, such as monarch caterpillars.

You may be able to dislodge insects with a stream of water from a hose (do this carefully to avoid damaging the plants). They may come back later, but the treatment is usually harmless and you've also watered the plants at the same time.

There are situations in which you might want to use an insecticide, although this is generally unlikely. There are some products that are quite safe and are approved for use in organic production. Some of these can be applied to food crops as close as one day before harvest. These should be used by adults, and make sure you adhere to your district's policies on such products. Examples include insecticidal soaps and pyrethrin-based products. Read the label carefully: choose a product that is appropriate for the pest and the plant, note the guidelines for repeated applications (many of these products kill on contact but have no residual effect), and observe the required time between application and harvest for particular crops. The pesticide Bt (an abbreviation for Bacillus thuringiensis) is an approved and widely-used organic material that consists of a naturally- occurring soil bacterium. Bt is quite effective against certain insect pests, such as caterpillars.

There is much concern about the impact of pesticides on pollinators, such as bees. The neonicotinoid insecticides, widely used commercially, are a likely contributor to the decline of honeybees.

You can make your own insecticidal soap with a half tablespoon of liquid soap (not detergent) in a quart of water. If permissible, older students could apply this spray. There are other home-made material that you can use, such as garlic spray as an insecticide and fungicide.

INTEGRATED PEST MANAGEMENT (IPM)

Integrated pest management, as applied to either a huge farm or a backyard garden, refers to a combination of approaches to lessen the impact of pests and diseases with attention to human health and the health of the environment. The term connotes a diminished use of or, where possible, elimination of chemical pesticides. It is a knowledge-intensive process. Rather than just spraying at the first sight of a pest, the farmer or gardener identifies the pest, assesses the extent of damage and (for the farmer) the economic impact, and then, if necessary, applies various control strategies, beginning with those least likely to cause environmental problems. The farming or gardening practices have been designed beforehand to lessen the risk of significant pest problems.

Learn about the biology of the pest. For example, if a particular pest appears late in the growing season, that crop may be planted and harvested early, thus avoiding the problem. Knowledge of the pest's or disease's habitat, life cycle, preferred host plants, and behavior is important to the 1PM user. There are many resources about the theory and practice of 1PM, and this topic could be an important part of the garden curriculum.

For an introduction to integrated pest management, see:
https://extension.psu.edu/introduction-to-creating-healthy-landscapes

Here is a detailed web publication on integrated pest management:
https://croplandpestguides.cce.cornell.edu/Guidelines/HomePestCultural/
(chapter 12 is about vegetable gardens)

WEED CONTROL AND MULCHING

Weeds are plants that grow where you do not want them. They compete with desired plants for water, nutrients, and sunlight. They may also harbor plant diseases and pests. They can spread by seeds or by underground stems called rhizomes.

On the plus side, however, some weeds provide a habitat for certain insects, some of which are beneficial to the garden. They provide shelter, pollen, and nectar for pollinators such as bees and for predators of garden pests, such as praying mantis. If weeds are removed before flowering, they can be added to your compost pile.8 (see the "Composting "section). There are several ways to rid the garden of most problem plants. Don't spend the time to remove every single weed, but do remove the large and aggressive ones.

Initial soil preparation

You can reduce weed infestations by preparing the soil well when you first establish your garden and before each growing season. Do your best to remove weeds and weed roots before you plant. If you are establishing a new garden where there is

already a lot of vegetation, sheet mulching (described previously in this manual) several months in advance is a very effective way to suppress most of the unwanted plants.

Tilling- pros and cons

In the past, it was assumed that garden soil should be thoroughly turned over yearly, mostly for weed and pest control. Current practices include turning the soil when a garden is first being prepared for planting. Rototilling yearly (though not too deeply) is an acceptable action, as long as there is not too much residual plant accumulation. Shallow rototilling mixes the upper layers of the soil rather than turning the soil over completely. Gardens with raised beds may be tilled entirely by hand if the area is small enough. Whenever you till, but particularly in the early spring when the soil is still wet, be careful to loosen any areas of soil that have been compacted as you work.

Turning the soil deeply may be detrimental, causing soil compaction, upsetting the balance of organisms, and often causing layers of coarse organic material to be buried below the influence of insects and microbes that otherwise would break down the material.

Working the soil in the fall has several advantages over the traditional spring tilling. It allows for earlier spring planting, since the basic soil preparation has been done when spring arrives. The turning under of large amounts of organic matter is likely to result in better decomposition when done in the fall, since autumn soil temperatures are higher than those of early spring and there is more time for decomposition to take place.

Farmers in our area and gardeners are increasingly using "no-till" or "low-till" methods as part of their efforts to reduce energy use (to run tractors) and to preserve the soil structure. Typically, the remains of the crop are left in the soil over winter. These systems often use appropriate cover crops, which are turned under before the main crop is planted. Planting the main crop involves making a hole in the soil just big enough to drop in a seedling or seed. Without the tilling under of weeds, however, more attention to weed control may be necessary.

Cultivation

Since mature weeds extract large amounts of moisture and nutrients from the soil and may shade your crop plants, it's best and easiest to remove weeds when they are young. Hand-pull weeds before they flower and produce seeds. Hand-pulling and digging are fine for small gardens and raised beds. Hand-pulling or careful hoeing are the best ways to remove weeds near vegetable plants. Make sure to remove the entire root system, otherwise the weeds may regrow from underground parts of the plant. Avoid deep cultivation with any tool, which is likely to damage the roots or stems of crop plants. Turning under weeds before they flower provides organic matter to the soil.

Cultivation is best done when the soil is somewhat moist but not wet. Working wet soil can damage the structure. When the soil is too dry, weeds are difficult to remove. Probably the best time to cultivate is a day or two after a rain or irrigation.

Children may find weeding less onerous than you imagine, especially if you can make a game of it. Weeding is just one of the many tasks in a garden, and children should learn about all of them. Of course, pulling weeds and cultivating the soil should only be entrusted to students responsible enough to distinguish weeds from crops. But as mentioned elsewhere, have some extra plants in the garden in case of an "accident"; don't be critical of students who are just starting what is hopefully a long-term love of gardening.

Mulching

Mulching can lessen the need for weeding and provide other benefits. As you plan your garden, try to locate a reliable source of mulching materials. Thick layers of organic mulch will suppress most annual weeds, and those that do appear are easily pulled. After planting, apply a 3-inch layer of organic mulch to prevent new weeds from growing. Keep the mulch away from the stems of the plants.

Grass clippings (no more than 3 inches thick) make a great mulch. Make sure the clippings were not from a lawn treated with weed killer or insecticide. Stockpiled and shredded tree leaves from the previous fall are also good. These materials add nutrients and organic matter.

Laying down black plastic mulch helps you have a healthy, low-maintenance garden. In addition to reducing weed problems, black plastic will substantially accelerate the warming of the soil in the spring allowing earlier planting and reducing the time to harvest for many plants. The sheets of black plastic are anchored with pegs or rocks. If you are planting seeds, leave the row uncovered. If you are transplanting seedlings, make holes in the plastic to accommodate them.

Special weed-blocking fabrics provide some advantages over black plastic. They are permeable to water and air.

For paths in your garden or between the raised beds, newspaper, old carpeting, and similar materials, covered with sawdust or straw, will provide excellent weed suppression. Small stones, obtained from a gravel and stone supply company, can also be used for paths, although some weeds may grow through. However, sawdust is not recommended as a mulch around the base of plants, since it has a tendency to crust and impairs the nitrogen supply in the soil.

Check with your municipality for the availability of mulch. The Manheim Township Compost Park sells both mulch and compost to anyone; see their web site for details http://manheimtownship.org/index.aspx?NID=1009

Close spacing
Once vegetable plants are established, if they have been planted close enough, but not too close to each other, they will shade the soil and prevent the growth of many weed seedlings.
Arrange the spacing so that at maturity the foliage of adjacent plants touches and forms a closed canopy.

Drip Irrigation
By supplying water directly at the roots, weeds in other areas have less access to water.

Boiling water
Pour boiling water onto the weeds; they will die in a few hours.

Vinegar
Vinegar kills the visible part of the weed. The leaves will wrinkle and die the next day, although the root will not be killed and the plant will resume growing.

Crop rotation
Rotating crops with ones that suppress weeds by choking them out can be a very effective method of weed control (in addition to the other benefits of crop rotation).

Living mulch
Low-growing cover crops such as lentils are grown along with the main crop and can then be turned under at the end of the season.

Herbicides
Some tenacious and persistent weeds (such as Canada thistle) may require judicious use of herbicides. You may need to use herbicides if you are starting a garden in a weed-infested area and other practices have not been successful. There are some herbicides that are compatible with organic practices. Some herbicides kill certain weeds selectively without harming desired plants. Others kill all plants either by contact with the foliage (foliar) or through the root system (systemic). If you are considering using an herbicide, make sure you adhere to your district's policy on the use of chemicals in the landscape and obtain appropriate permissions. Select a product that is intended for the weeds that you want to control. Carefully read and follow all label directions.

Garden-Harvesting, Storing, and Using The Garden Produce

The day that everyone has been awaiting has arrived - the first crops are ready to be picked. At first, you may have just a few radishes or spinach leaves, but soon you'll have an abundance of fresh, nutritious vegetables. The students can do the harvesting, with some guidance. They will want to taste things right away, but you must first have robust safety protocols in place. See this manual's section on "Policy, Garden Safety, and Food Safety".

Information on when to harvest vegetables for best taste and nutrition can be found on the web sites of many state extension services, such as http://www.extension.umn.edu/garden/yard-garden/vegetables/harvesting-and-storing-home-garden-vegetables

Sometimes you will do a small harvest casually, or you may arrange for scheduled harvest days when your class or even the entire school community gathers. No matter what, you'll need to plan carefully. Flexibility is important, since you may not know exactly when a crop will be ready, and rain is always a possibility. The students should have learned in advance what to harvest and what tools to use, such as child-safe scissors for leafy greens or a small trowel for root vegetables (if they can't be pulled easily). Potatoes may require digging; be careful not to damage them. Children can carefully pick some crops by hand, such as peas, beans, tomatoes, and leafy greens. Have clearly defined tasks and procedures (how many radishes should each student pick, how many leaves to cut and where to cut), and give your adult volunteers specific roles in supervising the children. If you are using the harvest as part of instruction, have your lesson plans and materials ready.

Harvesting and preparing a salad is perhaps the easiest activity and gives children an immediate reward for their efforts. And the taste and nutrition are outstanding. If you have a washing area, tables, and benches or chairs in the garden area, the salad can be enjoyed right in the garden. Greens grow rapidly, and new leaves continue to be produced after removal of the older ones (make sure some leaves remain after harvest to support continued growth). Be cautious in introducing some vegetables that children may find too pungent, such as radishes, broccoli and other crucifers, and some greens.

Although some gardens may have cooking facilities on site, most likely cooking will be done in the classroom or, in collaboration with the food service staff, in the school kitchen. The teachers at Conestoga Elementary School have a shared cooking cart, equipped with the necessary equipment (including a small oven, a microwave, and a two- burner electric hotplate) and supplies.

Cooking is an excellent way to involve your school food service staff, who will be eager to help your class to cook a dish from scratch. If you have an abundant harvest, work with the food service staff to use your crops in meal preparation. The "Curriculum and Other School Programs" section of this manual has information on using your produce in the school food program, including recipes for a small group or an entire school. Parents or other community members may volunteer to cook, and there is great opportunity for children to learn about the dishes of different cultures. Ideally, you have a composting program (either outdoor bins or a classroom vermicompost system), so there is a "teachable moment" when the children place the food scraps into the compost.

As part of your program to involve the students' families in the garden, arrange to send produce home with the children. Provide a simple recipe that the family can use.
Such efforts can be an important part of your school's community-building efforts.

Many school and community gardens donate some of their produce to food banks and other programs for the hungry. Local food banks include the Lancaster County Council of Churches (http://www.lcchurches.org/food-hub), which also coordinates community meals prepared and served daily at various locations, and the Central Pennsylvania Food Bank (http://www.centralpafoodbank.org).

An excellent way for children to learn about helping others is to make such donations a part of the garden program right from the outset. The Plant a Row for the Hungry program http://www.gardenwriters.org/Par can connect your garden to the community; there are many other similar programs. The web site provides information on how to find partners, how to publicize your efforts, and how to engage other gardeners in contributing produce to add to what you have grown. Talk to the agencies you are working with to decide on the best crops to grow; some crops may be too perishable for their distribution system.

How can you store garden produce? Sometimes you have more harvest than you can use at the moment, or you may need to harvest a crop (such as beans) over several days to get enough for a recipe.

Although many gardeners in Lancaster grow and store large quantities of certain crops by canning, freezing, pickling, or drying, many of these methods are beyond the scope

of a school or community garden. So our discussion of storage is limited to the basics about how to keep vegetables for a short time and about freezing. The web sites of state extension services have lots of information. A good place to start is the site of the National Center for Food Preservation (http://nchfp.uga.edu/index.html).

In thinking about storage, you want, above all, to consider food safety. See the section on “Garden and Food Safety”. Storage should keep the food appealing, preserve taste, and retain nutrients. Your school food service staff is the first place to go for advice and information. The school kitchen may have carefully monitored storage facilities that you can use. You will find some storage guidelines that require facilities that may be beyond what you have available. Before people had refrigeration, special storage areas such as root cellars were used, with crops packed in various materials to maintain proper moisture levels. If you read about or visit a historic site, such as the Landis Valley Farm Museum, students can learn about these techniques.

The two factors that are important for food storage are temperature and humidity. While we may think that the refrigerator is the best place, some produce is actually damaged by the cold temperature of a refrigerator. Moist conditions may keep many vegetables at their best, but others are best kept somewhat dry and are susceptible to rotting if it is too moist.

Refrigerator temperature is typically between 32 and 40 degrees, so those vegetables that require cold can be stored in the refrigerator. (Those crops that are best stored at slightly higher, "cool" temperatures are problematic for the home gardener.) In any refrigerator there are areas that are colder or warmer. Use a thermometer to find out. In modern refrigerators the air is actually rather dry. Vegetable crispers are designed to maintain higher humidity. Plastic bags will keep produce moist, but excessive moisture should be avoided for some crops. That's why you'll see some fruits and vegetables sold in bags with holes. Note guidelines about preparation (such as washing) before storage.

This helpful chart provides basic information on storage conditions for many fruits and vegetables:
http://www.ucanr.edu/sites/Postharvest_Technology_Center_/files/230110.pdf

The length of time produce can be stored is quite variable. For example, if low temperature is required, storage at a higher temperature can substantially reduce the recommended storage time. So any guidelines are only approximate.

The following resources include information on harvesting and storage:

- National Center for Home Food Preservation http://nchfp.uga.edu/index.html
- University of Minnesota Extension http://www.extension.umn.edu/garden/yard-garden/vegetables/harvesting-and-storing-home-garden-vegetables

- University of Vermont Extension
  http://www.uvm.edu/sites/default/files/storagecharthomeproduce.pdf
- University of Missouri Extension
  http://extension.missouri.edu/explorepdf/agguides/hort/g06226.pdf

You may want to freeze some of your produce if there is a freezer in your school. Some crops, such as leafy vegetables, cannot be satisfactorily frozen. In general, fruits and vegetables for freezing are blanched (briefly boiled) before freezing. Some crops should be cut into pieces before blanching and freezing. The freezing process should occur as quickly as possible. You can spread out the food on a tray and then place it in the freezer, and after it is frozen put it into freezer bags or plastic containers. General information on freezing and specific guidelines for many fruits and vegetables can be found at the web site of the National Center for Home Food Preservation (http://nchfp.uga.edu/index.html).

After your garden is well-established, you may want to consider developing activities that allow the students to gain real-world experience operating a farmer's market or making and selling various products from the garden. Such efforts would add to the students' skills and would help connect the garden to the community. There are lots of ideas for these programs at
https://kidsgardening.org/create-sustain-a-program-school-farmers-markets-helping-kids-and-communities-grow/
https://kidsgardening.org/create-sustain-a-program-strategies-for-a-growing-business/

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Cultivating Support

A school garden is a big commitment, with even bigger potential benefits to the school and community. You want to engage many people and groups to help and to create win-win situations for all. Below is a chart summarizing ways to create a support network. Making more connections between members strengthens communities. This is a principle of the science of ecology that applies to human communities as well. In a successful garden people will meet and collaborate with others whom they might never have met otherwise. New initiatives and ideas will naturally arise from these contacts; seek ways to encourage them.

Building a Support System[1]

Who can be a resource for your garden program?

- Parents
- Teachers
- Principals
- Cafeteria Managers/ Food Service Directors
- Grounds & Maintenance
- School Nurses
- Office Support Staff
- Students
- Neighbors
- Businesses
- Farmers
- Youth groups and service organizations
- City and County agencies
- Garden groups, organizations

How can you involve these people to build a team?

- Back to school night
- First PTA/PTO meeting
- Meet with teachers
- Request time at teachers' staff meeting
- Talk to grounds people often
- Email lists, phone trees
- Flyers
- Notice in school bulletins
- Other publicity/media
- Give garden plots for after school use
- Garden with them
- Organize: communication, newsletter, extra credit, face-to-face, tine in to school events, personal invitations.

How can you keep people involved?

- Hold regular meetings
- Put notices in school bulletins
- Write a garden newsletter (or garden corner in school newsletter)
- Involve everyone in decision – making (especially students)
- Create visible signage around the school
- Have kids make art for the garden
- Hold events – social events; work parties; seasonal festivities; events for school community; events for larger community
- Develop a system that volunteers can plug into easily

- Post tasks to make working in garden easy
- Field trips for the garden team (e.g. farmer's markets, other gardens)
- Make room for participants' input
- Establish a clear, easy plan for on-going maintenance
- Find ways to integrate garden with curriculum
- Solicit media attention
- Solicit help from local businesses
- Research and write grants
- Hold plant sales
- Extend gratitude / acknowledgments
- Pay the coordinators
- Make a school garden website
- Have a teacher in-service day in the garden
- Have a regular garden work parties
- Remember to eat food from the garden

According to school garden leaders, the adults should remember that the garden belongs to the children. It is important that the school garden volunteers are there as a support but not doing all of the work. Look at "Hart's Ladder of Participation" in the "Planning" section. The children need to plan, plant, weed, water, harvest, clean, decorate, trim, compost, etc. They will benefit and learn more from the work and occasional failure in the garden. Children who "own" the garden will learn responsibility, skill development, long-term investment of effort, consequences of their actions (cause and effect), etc. Of course the adults may have to take responsibility when there are safety concerns, such as the operation of a tiller.

Make sure that you clearly communicate the garden's mission, purpose, and needs to potential volunteers and donors so that distractions are minimized. If the garden is solely for vegetable, you may have to politely decline a gift of rose bushes, while encouraging the donor to find more appropriate ways to support your efforts.

Engaging the School and Community

Gardens can bring together many people in your community. There are roles for everyone, from the youngest children in your school (or pre-school programs) to school staff, parents, participants in neighborhood senior programs, members of partner organizations already involved in your school or who could be asked to join, etc. Find as many ways as possible to involve the students, in age-appropriate ways. Some people will want to get their hands dirty in the soil, some will want to do public relations and create your web site and social media sites, and others will want to help children and families make delicious meals with the garden's produce.

To get buy-in, participation, and support, make sure you have a clear and convincing message about what you hope to accomplish with your garden. You should craft a story that will appeal to people you contact. Different aspects of the garden may appeal to different people and organizations, so be prepared to tailor your requests for support appropriately. Experienced school garden leaders report that, while there may

be considerable initial excitement about your project, over time only a few people will stay involved. To maintain engagement, it's helpful to give people explicit tasks and responsibilities and deadlines rather making than open-ended requests for help. Try to minimize the fall-off, and put your energies on engaging the truly dedicated participants. Assess the level of long-term commitment before you decide to proceed.

Having an experienced gardener in your group can be a great asset right from the start. In addition, there are many ways to tap the resources of the community for such help. Fortunately, there are already many schools in Lancaster County with gardens, and people there can help you. The Master Gardeners of the Penn State Agricultural Extension Office are expert volunteers; their office is at the Farm and Home Center, 1383 Arcadia Rd., Lancaster PA 17601 717-394-6851. The Extension Office is a great source for information. We suggest that you make contact with this organization very early in your planning. The role of Master Gardeners is to be consultants and educators; they do not generally do the garden work for you.

When you look for volunteers, you might think first about people and organizations in your school's area. A local group will have a natural connection to your school. People in your area will appreciate the support of a local business that supports your garden. Residents of a local retirement community could establish a meaningful connection with your students. Religious organizations may have community volunteer groups.

There are many individuals and organizations working to improve the health and nutrition of your community, such as Lighten Up Lancaster County (www.lightenuplancaster.org), which brings together people from all over the county to share ideas and create networks on the issue of healthy weight. Likewise, explore collaborations with organizations that work with youth and families. Boy Scouts and Girl Scouts can be involved, either as groups or as individuals completing projects for advancement (Eagle Scout or Gold Award). Landscape designers and garden stores might be able to help in the development and operation of your garden. Chefs could help teach children and families about preparing meals with the garden produce; Hamilton Elementary School in Lancaster had a successful event with a chef from a partner organization. The organization Chefs Move (part of Michelle Obama's child health initiative) works to develop such partnerships (www.chefsmovetoschools.org). The United Way Day of Caring could provide volunteers for a one-day effort.

Crucial support comes from the parents and other family members of your own school community. Some may have experience with gardening, but for others this may be new. Children can bring home information and ideas to help strengthen the family's health; working in a garden can enhance a family's cohesion.

Make sure you continually recognize the contributions of volunteers and supporters. Highlight their work in your communications to the school and general communities. Post signs at the garden acknowledging the support. As appropriate, work with the firm's or organization's public relations department.

Many school districts have a required community service project as a high school graduation requirement. Talk to your high school about having students work on garden-related projects to fulfill that requirement.

Colleges in the Area to Use as Resources:

- Millersville University
- Franklin and Marshall College
- Harrisburg Area Community College
- Thaddeus Stevens College of Technology
- Elizabethtown College
- York Technical Institute
- Lancaster County Career and Technology Center (both high school and adult education)
- Pennsylvania College of Art and Design
- Pennsylvania College of Health Sciences

Your own school district may have classes (especially in the middle and high schools) whose students could do projects to help your garden. An art class could help make posters or other displays. A technical education class could help build raised beds or a shed. Media and graphic design classes could help with publicity, social networking, web sites, etc. Environmental science or biology classes could study and document the growth of the plants, the presence of insects (both beneficial and damaging), etc. All districts and some private schools participate in the Lancaster County Career and Technology Center program (Brownstown, Willow Street, and Mount Joy campuses), which includes many areas relevant to a garden, such as horticulture, culinary arts, visual communication, carpentry, etc. The LCCTC also has adult programs. LCCTC teachers might be interested in a partnership.

School clubs, such as those focused on environmental issues and on community service, could help in the garden. Some schools have agriculture programs and Future Farmers of America or 4-H groups.

Local colleges and universities can be valuable resources. Most institutions have internship programs for their students, and an intern could provide valuable assistance. These institutions have courses in relevant areas, such as environmental studies, horticulture, nutrition, childhood development, public health, carpentry and other trades, etc. Students in these programs might be interested in volunteering. Some colleges have service learning programs, in which part of a course involves working on a community project. College students pursuing their certification for elementary or

secondary education who are practice teaching in your school could also assist in your garden. Student organizations (fraternities, sororities, department clubs, athletic teams, etc.) often participate in community service on an on-going basis or for a single day. The Agatston Urban Nutrition Institute at the University of Pennsylvania is a good example of a partnership. The institute "engages, educates, and empowers youth, university students, and community members to promote healthy lifestyles and build a just and sustainable food system" [2]

Hamilton Elementary School

The program at Hamilton Elementary School illustrates the combination of instruction, after school programs, and parent engagement. The school developed a School Garden Club as a way to address several issues that arose in the past, such as limited time during the regular school day, engaging families, and maintaining the garden over the summer. There is a direct link between the garden and the classroom instruction.

The garden is operated as a co-op for families. Parents who join the co-op commit to six hours of work per month in the garden. In return, they receive a share of the harvest. Rather than giving each family its own plot, the garden committee allocates particular plots to particular crops, thus encouraging a sense of cooperation. However, other gardens have used the assigned family plot idea. During the summer, garden mentors will be on site at specified times to provide advice and to unlock the tool shed.

The club meets for an hour after school three times a week; children can attend as often as they wish. School staff (principal, teachers, paraprofessionals, etc.) and parents have volunteered to help. Parents must pick up their children at the end. This enhances parent engagement with the garden and provides an immediate link to their children's excitement about what they did that day.

Governance

Successful planning, implementation, and assessment require effective leadership. An important early decision is who will develop and manage the garden: the school itself, a group related to the school such as the PTO, or a separate community group with strong ties to the school. Following are statements from local garden leaders about each of these models.

1. Garden run by the school (by Katie Reiff, Community School Director)
   Hamilton Elementary School's principal leads the efforts of providing nutrition and garden education in the classroom. This top-down approach helps hold teachers accountable for completing certain tasks such as hands-on garden experiences; adoption of a plant that students grow from seeds in their classroom and then transplant to the garden; and an overall appreciation for healthy choices (even if they don't know the specifics of gardening). The principal prepares and distributes to the teachers any necessary lessons and/or materials needed to meet expectations. This approach truly conveys an all-school learning process for the teachers, staff, students, and families.

2. Garden run by a school-related organization (by Beth Horst, garden co-founder and committee co-chair)
   The Conestoga Diggers Discovery Garden is governed by a committee of the Conestoga Elementary Parent Teacher Organization (PTO). The project was initiated and led by parents, so it made the most sense to work with the PTO in promoting the garden to school and community. Also, having a larger organization with an existing treasurer seemed a logical way to appropriately handle funds for the project. Finally, since the PTO is instrumental in securing committee chair people every year and keeping the school and community well-informed about school-related projects, the chance of sustainability of the garden increases.

3. Garden run by a community organization (by Jay Butterfield, school principal)
   The governance structure of the Wheatland Middle School/Lancaster Community Garden is a loosely coupled association of Meetup/Community Garden members. All members of the community garden are expected to contribute through service, goods or knowledge. The garden occupies about 1/3 of an acre. The school uses several plots; for example, a science teacher uses a plot for instructional purposes. We hold cleanup, planting days, and meetings as needed. During our meetings volunteer leaders of the group prepare an agenda and present topics for discussion and action. The group acts by simple majority. The School Board approved the initial garden proposal. School staff, including

the principal and a science teacher, are involved in all meetings and decisions; the middle school principal and a science teacher are involved.

Following recommendations of the American Heart Association's Teaching Gardens Program, you should consider appointing a Garden Leader, preferably from the school staff, and a Garden Management Committee, composed of school staff, parents, and community members; the makeup of the committee will, to some extent, depend on the nature of your program.

Here are some suggestions about responsibilities, as described by the American Heart Association. The Garden Leader coordinates the garden activities and also coordinates the work of the Management Committee and its subcommittees. "The Committee collaborates to identify concerns, set priorities, and design solutions in regard to the health environment and opportunities to offer experiential, project-based learning. The committee will act collectively to establish, maintain, and integrate the garden into the school community"[3]

The Leader and Management Committee will probably recognize the need for various ongoing subcommittees or short-term task forces. Issues such as securing funding and in-kind contributions, soliciting volunteers, organizing special events such as planting days and harvest days, developing a public relations plan, developing web resources, creating social media resources, developing curricula and assessments, etc. might be assigned to such groups.

Funding Sources

You can look for funds from sources within your school or district, in your community, or through state or national granting organizations -- both governmental and private (for-profit and non-profit). There is a large and ever-changing list of possible sources of financial support. Your colleagues in Lancaster have had considerable success with a variety of funding sources.

In the local community, there are possible sources of grants for your project, such as foundations that direct their efforts to particular areas. In particular, most school districts have an educational foundation that awards mini-grants to teachers for

specific projects. Some gardens have relied on crowd funding through Kickstarter or other websites.

At the end of this section are samples of letters to local businesses, to parents, and to your local community for support. The most effective strategy is the follow up your letter with a personal visit to prospective donors.

If your school is a federal Title I school, then it is possible to use that funding for the garden by tying the gardening activities to curricular standards. Title I funding can also be used for garden-related parent and family involvement activities.

INFORMATION ON GRANTS

Consult the following web sites for information on grants and other fundraising opportunities for garden projects. You will also find tips on grant writing; your local colleagues can also provide such advice.

Collective School Gardening Network
http://www.csgn.org/funding-school-garden

Kids' Gardening
http://kidsgardening.org/grants-and-programs

Community Groundworks
http://www.communitygroundworks.org/content/grants-opportunities-school-gardens

America in Bloom
http://www.americainbloom.org/resources/Grant-Opportunities.aspx

Public Relations

The chart ("Building a Support Network") at the beginning of this section contains many suggestions for outreach to your school and wider community. See the *"Resources"* section for information and materials you can use for your outreach efforts. There are examples of handouts and posters in the California School Garden Network site (csgn.org/csysg-trainer). Ask your partner organizations to include publicity about the garden in their newsletters and web site.

Design a logo for your garden and use it on all the materials you produce. Use social media to communicate with parents and other participants. Create a section about the school garden on your school and district web sites and also on your municipality's web site (townships, boroughs, or city that include your school). Include information

about the garden in school newsletters or emails. Put up displays about the garden in the school lobby, and have an information table at key events such as Back-to-School night, concerts, PTO meetings, etc. Provide information about ways that families can become involved.

Districts (or individual schools, in some cases) have staff involved with public relations and community outreach. They can help you spread the word.

School and District Policy

Does your school or district have a policy supporting gardens? Such policies can help assure success and continuation of your garden. The policy should make the garden an integral part of the broad curriculum and should emphasize the hands-on aspects.

By federal law, all districts operating a school lunch program are required to have a wellness policy; find out about your district's policy and if it encompasses the goals you've set for your garden. Work with your district to expand the policy. A district-wide in-service day can be effective in bringing the wellness message to everyone. The district should have a wellness committee in charge of developing and implementing the policy. Here's an example from a Pennsylvania district: "The mission of the Upper Moreland School District's Wellness Committee is to promote lifelong health, well-being, and the ability to learn by supporting the whole child; physically, emotionally, intellectually, and socially in a healthy school environment"[4].

There are many policies, regulations, and laws that regulate to gardens, about matters such as food safety, accessibility, student privacy, liability, pesticides, etc. These topics are addressed in the "Garden" section.

Featured Below Are Sample Documents from Established School Gardens

Conestoga Elementary School
100 Hill Street
Conestoga, PA 17516
717-872-9535
conestogadiggers@gmail.com
Hannah Thomas, Beth Horst: Co-Founders
Lori Adelman, PTO Treasurer

January 26, 2012
Dear Sponsor:

We are very excited to announce the start of new project called _____ Diggers Discovery Garden benefitting students of _____: a school garden and outdoor classroom. The goal of this project is to expose students to hands-on environmental education through the use of the garden as an outdoor learning lab. In addition, we foresee the garden as a place where meaningful connections can be made between school and community through volunteerism and environmental stewardship.

Because your business is a vital part of our community, we are asking you to consider how you can help support this project through the donation of money and/or goods or services. To recognize your gift, names of donors will be displayed prominently in the garden.

In addition, your business would be invited to our groundbreaking event tentatively planned for May 2012 which most likely will include coverage from various media outlets. For additional information, you can contact one of our garden coordinators. Thank you for taking time to consider supporting our project.

Sincerely,

Hannah Thomas, Co-Founder
Discovery Garden
Conestoga Elementary School
717-872-9535
conestogadiggers@gmail.com

Donate Money or Supplies

Supplies We Need

- 99(1”x8’x8’) cedar boards
- 22 (2”x4’x8’) Topchoice KD Whitewood stud
- 12 boxes 2” Deckmate screws (75 pieces per box)
- Topsoil for 11 beds
- Landscape Fabric 4’x100’ roll
- Gravel (for bottom of raised beds)
- Soil amendments
  - 2 galvanized metal troughs (2’ x3’x6’)
  - 1 galvanized metal trough (1’x3’x6’)
  - 3 20”Wooden Barrel Tub
  - Topsoil and amendments
  - Gravel
  - Seeds/Plants /Bulbs
  - 30 Ergo hand trowels
  - 2 Neverkink 5/8” x 100’garden hose
  - 36”Hose wand w/7ADJ patterns
  - Garden utility cart
  - 2 Trug tubs
  - True Temper dig shovel

If you are interested in contributing our project, please complete the following information:

Name: _____

Organization:_____

Phone Number: _____ e-mail:_____

I am interested in making a monetary donation to the _____ Diggers Discovery Garden in the amount of:

_____$50 _____$100 _____$200 _____$300

_____ $400 _____ $500 _____ Other: amount $_____

Cash or checks accepted made payable to _____(garden).

I would like to donate goods and/or services. Briefly describe below the goods or services being offered:

_____

_____

_____

***Please call/email to share when we can pick up donated items

Please return in envelope provided to:

Conestoga Elementary School
Attention: Garden Fund
100 Hill Street
Conestoga, PA 17516

Founding Families Garden Fundraiser

Dear Parents,
By now most of you are aware of the PTO/Donor sponsored School Garden and Outdoor Classroom project. The plans are well underway, and we are excited by the interest and support that many of you have expressed.
Now it is time to get busy! In order to bring this project into realization, we need funds! We have already secured one grant from the Chestnut Grove Foundation, and we are in the process of seeking funds from additional grants as well as local and outside businesses. We want to extend this opportunity to YOU to support this project as one of our Founding Families. Be sure to share this exciting news with your extended family, as well. Our goal is to raise $8,000 dollars for Phase 1 of the project. Donations will be used toward the costs of the following:

- 11 raised-bed boxes
- Potting table
- Tool Shed
- 3 compost bins
- 5 round container planters, 3 oblong containers
- Tools and supplies for student, teacher and volunteer use

Would you please consider donating to this project? No donation is too small! To recognize your gift, names of the Founding Families will be displayed in the garden. We are looking into a number of creative ways to do this, and will provide details as they become available. Look for the following in the near future: a garden newsletter blog which can be accessed from our school website and a bulletin board in the lobby entitled "As the Garden Grows."

Thank you in advance for your support!
The Garden Team

Complete the following information and return form and donation in a sealed envelope labeled "Garden Fund" to the office.

Name of donor:
_____
Phone number _____
E-mail _____

Amount:
____ $5.00
____ $10.00
____ $25.00
____ $50.00
____ Other: Amount _____

Cash or checks made payable to _____.

Fundraising Team

Goal: Develop a plan to attain monetary donations or goods and services for the garden (both short term and long term) that would involve the following groups:

1. School and community members
2. Local Businesses
3. Outside businesses and organizations

School and community

- Brainstorm and create a fundraising campaign at _____ Elementary: Letter that goes home to parents to gain monetary donations that can be tracked visually in the school by a bulletin board or something similar. Check websites for ideas- Google "school garden fundraising ideas"
- Coordinate with the event planning committee to create fun garden-related events: First priority would be a Spring event – most likely a groundbreaking event w/ invites to garden supporters/donors and all members of school who are interested- could coordinate with end of year picnic
- T-shirts w/ garden logo or saying, i.e. "We dig our garden." Or reusable tote bags w/ _____ School Garden and logo

Local Businesses

- Try to locate a list of all of the local businesses in _____. Develop a form letter describing our project and asking for monetary contributions: Have a place to ask for one time donations or annual support.
- Create a form letter asking for the donation of specific goods or services (Garden Coordinators will provide the specifics). Letter with follow up face to face or phone call.

Outside businesses and organizations

- Create a list of organizations and businesses that might be willing to support the garden such as Kiwanis Clubs, Rotary Clubs and Lowe's, Home Depot, etc.
- Create a form letter asking for the donation of specific goods or services (Garden Coordinators will provide the specifics). Letter with follow up face to face or phone call.

Other duties:

- Record keeping of specific donations
- Follow-up thank you notes to donors

School Garden Volunteer Skills Inventory

Name_____

What skills can you contribute to the garden?
Please check all that apply.

_____General Labor
_____Construction
_____Graphic Design
_____Landscaping
_____ Grant Writing
_____Fundraising
_____Event planning
_____Garden Knowledge
_____ Advertising
_____Donating goods/services
_____Other: Please explain below

_____
_____
_____

References

[1] Planning Your School Garden Program. Creating and Sustaining Your School Garden. Collective School Garden Network. 2012. [Retrieved January 2, 2018] http://www.csgn.org/sites/csgn.org/files/GFL_10.pdf

[2] Agatston Urban Nutrition Initiative. 2013. [Retrieved February 24, 2018] http://www.urbannutrition.org

[3] American Heart Association Teaching Gardens Manual

[4] "Upper Moreland School District Food Services." Upper Moreland School District. 2012. [Retrieved January 2, 2018] http://www.umtsd.org/page/129

Curriculum, Food Service and Other School Programs

As mentioned earlier, a key reason to develop a school garden is to enhance student learning in a wide range of disciplines. While a garden can contribute to content learning, even more important is the development of investigative, critical thinking, problem solving, and creative skills. Elementary and secondary education is increasingly tied to standards or common core content, so teachers want their lesson plans to be tied to those standards in all subjects.

As you develop the garden's educational aspects, think as broadly as you can. The instructional program can address many different learning styles. Students with different academic strengths can flourish, given the varied activities in the garden program. The garden program can promote awareness of a wide range of careers. Remember that every person in your school community is an educator and a learner, so be inclusive. You'll be pleased at the contributions that different people can make, and the more people involved, the better the outcome.

We have included sample curricular materials and a list of sources for additional materials. Be sure to look at the list of web and print materials listed in the "Resources" section, as many of them have detailed standards-linked lesson plans and other ideas for the classroom.

On the following pages are examples of a garden-based curriculum for grades K – 5 linked to instruction in several subjects; this "Curriculum to Plate" guide exemplifies the comprehensive role of a garden. As suggested elsewhere, other subjects ought to be included, such as health, art, music, etc.[1]

Grade	Subject	Concept	Lesson Ideas	Recipe Ideas
Kindergarten	Science	K.1 Humans have five senses that they use to observe their environment. A specific sense organ is associated with each sense.	Sensory Test/ Sorting (Appearance, Taste, Smell, Touch, Sound)	Taste Test Plate: Oranges, Carrots, Cheddar Crackers, Dark Chocolate, Lemons, Banana, Raisins
		K.2 Living things can be classified as plants or animals. Plants have characteristics (such as roots, stems, leaves and flowers) that animals do not have.	Build a Plant Out of Vegetables Roots=Carrots Stem=Celery Leaves= Collards Flower=Broccoli Fruit= Cucumber Seeds= Sunflower seed butter for dipping	Carrots, Celery, Lettuce, Broccoli, Cucumber, Sunflower Seed Butter
		K.3 Weather conditions vary daily and seasonally	Build Garden Weather Instruments (Rain Gauge/ Pin Wheels)	Rice Cake and Pretzel Suns Fruit and Vegetable Rainbows
	Language Arts	Reading: Literature	Books: A Very Hungry Caterpillar Gregory the Terrible Eater	Apple, Pear, Plums, Strawberries, Oranges Spaghetti Squash, Currants, Kale
		Reading: Informational	Eating the Alphabet, The Carrot Seed, Apple and Pumpkins	Apple, Pumpkin, Carrots, Avocado, Zucchini, Okra, Pomegranate
		Compose Opinion Pieces	My favorite fruit is….. My favorite vegetable is… My favorite season is…	Any Fruit or Vegetable
	Mathematics	Measurement	Starting Seedlings (seed depth, seedling height, seedling spacing)	Edible Seeds: Sunflower, Pumpkin, Corn Nuts, Edamame
		Counting	Classroom Cooking *A Seed is Sleepy* Extension: Count Seeds	Any recipe using measuring cups/spoons Edible Seeds (Sunflower, Pumpkin, Corn Nuts, Edamame)

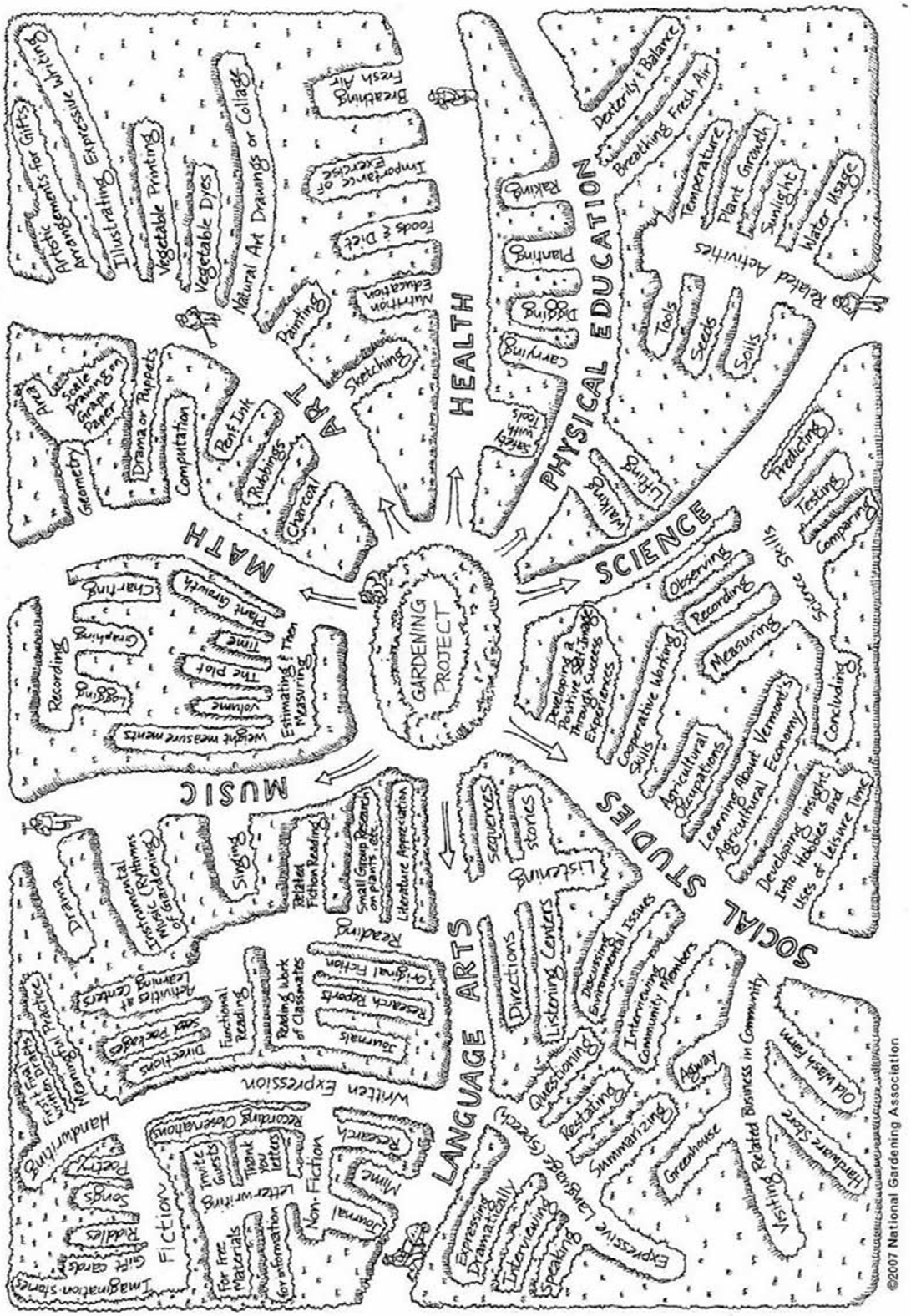
Grade	Subject	Concept	Lesson Ideas	Recipe Ideas
First	Science	1.1 The sun appears to move across the sky in the same way every day, but its path changes gradually over the seasons.	Build a shadow tool to track position of the sun throughout the year.	Rice Cake and Pretzel Suns
		1.2 Living things have different structures and behaviors that allow them to meet their basic needs.	Build a Plant Out of Vegetables Roots=Carrots Stem=Celery Leaves= Collards Flower=Broccoli Fruit= Cucumber Seeds= Sunflower seed butter for dipping	Carrots, Celery, Lettuce, Broccoli, Cucumber, Sunflower Seed Butter
	Language Arts	Reading: Literature	Books: A Very Hungry Caterpillar Gregory the Terrible Eater	Apple, Pear, Plums, Strawberries, Oranges Spaghetti Squash, Currants, Kale
		Reading: Informational	Eating the Alphabet, The Carrot Seed, Apple and Pumpkins	Apple, Pumpkin, Carrots, Avocado, Zucchini, Okra, Pomegranate
		Compose Opinion Pieces	My favorite fruit is….. My favorite vegetable is… My favorite season is…	Any Fruit or Vegetable
	Mathematics	Measurement: Order objects by height	Starting seedlings: compare seedling height	Edible Seeds (Sunflower, Pumpkin, Corn Nuts, Edamame)
		Counting	Classroom Cooking	Any recipe using measuring cups/spoons

Grade	Subject	Concept	Lesson Ideas	Recipe Ideas
Second	Science	2.2 Life Cycle of Plant/ Plant Part	*A Seed is Sleepy*/ A Seed is Tasty Build a Plant Out of Vegetables Roots (Carrots), Stem (Celery) Leaves (Collards), Flower (Broccoli), Fruit (Cucumber) Seeds (Sunflower seed butter for dipping)	Edible Seeds: (Sunflower, Pumpkin, Corn Nuts, Edamame) Carrots, Celery, Lettuce, Broccoli, Cucumber, Sunflower Seed Butter
		2.3 Earth materials have varied physical properties that make them useful in different ways (Soil).	What soil would you want to live in? Build a Lasagna Garden Mud Shakes	Dirt Cups
		2.4 Human beings, like all other living things, have special nutritional needs for survival.	Today I Ate a Rainbow!	Red: Apples, Strawberries Orange: Carrots, Oranges Yellow: Bananas Green: Green Beans, Cucumbers Blue/Purple: Raisins, Grapes, Blueberries
	Language Arts	CCS: Reading: Literature	Books: A Very Hungry Caterpillar Gregory the Terrible Eater	Apple, Pear, Plums, Strawberries, Oranges Spaghetti Squash, Currants, Kale
		CCS: Reading: Informational	Eating the Alphabet, The Carrot Seed, Apple and Pumpkins	Apple, Pumpkin, Carrots, Avocado, Zucchini, Okra, Pomegranate
		CCS: Compose Opinion Pieces	My favorite fruit is….. My favorite vegetable is… My favorite season is…	Any Fruit or Vegetable
		Craft and Structure	The Rainbow Bunch	See Science 2.4 Recipe
	Mathematics	Measurement	Starting Seedlings (seed depth, seedling height, seedling spacing) Sugar Shock: Label Reading/ Measurement of Sugar in Beverages	Edible Seeds (Sunflower, Pumpkin, Corn Nuts, Edamame) Healthy “Soda” i.e. Cranberry/ Orange Seltzer
	Social Studies	Civic Engagement	Transportation: Farm to plate	Local Vegetable or Fruit
		3.3 Applied appropriate historical, geographic, political, economic, and cultural concepts and methods in proposing and evaluating solution to contemporary problems	Identify a contemporary issue (i.e. nutrition) with class and propose a school-wide solution: taste test table	

Grade	Subject	Concept	Lesson Ideas	Recipe Ideas
Third	Science	3.1 Heating and cooling cause materials to change from one state of matter to another and back again. Adding heat can cause solids to melt into liquids.	Ice Cream Lab	Rock Salt Ice Cream
		3.2 Organisms can survive and reproduce only in environments that meet their basic needs.	Plant Protection Scavenger Hunt Transplant Raspberry Bushes	Yogurt topped with Raspberries
	Language Arts	Reading: Literature (Story Structure)	Gregory the Terrible Eater	Spaghetti Squash, Currants, Kale
		Reading: Informational	Eating the Alphabet, The Carrot Seed, Apple and Pumpkins	Apple, Pumpkin, Carrots, Avocado, Zucchini, Okra, Pomegranate
		Compose Opinion Pieces	Local Carrot vs. California Carrot Comparison	Carrots + Kid-Friendly Hummus
	Mathematics	CCS: Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories	Taste Test Graphing	Taste Test Plate: Salted Sunflower Seeds, Lemon, Oranges, Carrots, Kiwi, Chocolate
		CCS: Measure and estimate liquid volumes and masses of objects using standard units	Classroom Cooking	Any recipe using measuring cups/spoons (Hummus,
		CCS: Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch	Starting Seedlings (seed depth, seedling height, seedling spacing)	Edible Seeds: (Sunflower, Pumpkin, Corn Nuts, Edamame)

Grade	Subject	Concept	Lesson Ideas	Recipe Ideas
Fourth	Science	4.2 All organisms depend on living and non-living features of the environment for survival	Garden Food Web Toss Food Web Stepping Stones	Grape Ants
	Language Arts	Reading: Literature	Gregory the Terrible Eater	Spaghetti Squash, Currants, Kale
		Reading: Informational	Food Waste (Reduce, Reuse, Recycle) by Deborah Chancellor	Use leftover from previous activity to demonstrate a method for reducing food waste
		Compose Opinion Pieces	Local Carrot vs. California Carrot Comparison	Carrots + Kid-Friendly Hummus
		CCS: Conduct short research projects that build knowledge through investigation of different aspects of a topic.	Food Connections Writing Series (Spring Board lesson=> reflection in journals=> Pick one topic after 8 weeks to research)	Local Vegetable+ Hummus Eat the Rainbow Healthy “Sodas” Trail Mix
	Mathematics	CCS: Compare two fractions with different numerators and different denominators	Classroom Cooking: Double a recipe	Kid-Friendly Hummus
		Graphing	Food Waste Math Extension: Record and Graph Lunch Room Food Waste	School Lunch

Grade	Subject	Concept	Lesson Ideas	Recipe Ideas
Fifth	Science	5.2 Perceiving and responding to information about the environment is critical to the survival of organisms	Sensory Food Test	Sensory Food test plate
	Language Arts	Determine a theme of a story, drama, or poem from details in the text, including how characters in a story or drama respond to challenges or how the speaker in a poem reflects upon a topic; summarize the text.	Book: Seed, Soil, Sun: Earth's Recipe for Food. By: Cris Peterson Discuss the cycle of a plant and the importance of seeds	Try various types of seeds: edamame, peas, pumpkin seeds, sunflower seeds and make popcorn on the stovetop.
	Mathematics	Measurement and Data	Measuring growth of plants in centimeters and convert into inches	Grow sprouts/peas ahead of time and sample of the sprout or pea.
		Measurement and Data	Make mud shakes, measure soil layers and make graphs and charts of percentages of soil, sand, silt, clay and organic matter	Dirt Cups
	Social Studies	Locate and gather information from a variety of primary and secondary sources.	Make mud shakes, measure soil layers and make graphs and charts of percentages of soil, sand, silt, clay and organic matter – Critical Thinking and Recording Skills	Dirt Cups
		1.2 Significant events and themes in United States history	Learn about the old world vs. new world through food – Civic Literacy	Make an old world and a new world pizza
		2.4 – Demonstrate an ability to participate in and engage effectively in a range of collaborative discussions (one-on-one, in groups, debate and effective oral presentation).	Students work in groups to research a particular culture and their food and how we might be able to make some dishes healthier	Students will make in class a culturally relevant dish to the culture they researched



Garden study plan reprinted with permission from the National Gardening Association (NGA). For more information on youth gardening contact NGA, 1100 Dorset Street, South Burlington, Vermont 05403; *www.garden.org*.

A garden can support learning in most if not all subjects. See the teacher-generated diagram on the previous page.[2] Teachers have developed many strong connections between gardening and the curriculum. The garden can also foster many aspects of student health, welfare, and growth. Gardening can bring teachers across many grade levels and subjects together as they plan the garden; indeed, interdisciplinary learning is a highlight of the garden-centered curriculum. The initial approach should be straightforward, but with experience, these connections will become deeper, richer, and broader.

There is much concern about the time available for a program such as a school garden, given all the demands on classroom time. The "Why Start a School Garden" section addresses the role of a garden in a standards-based curriculum. Here are some additional reassuring comments from "A Child's Garden of Standards"[3]

"*Standards are intended to ensure that a particular level of rigor is maintained and that the same concepts are being taught in all classrooms at each grade level, whether the classes are across the hall from each other or at opposite ends of the state. Standards determine what and when concepts are to be taught they do not dictate how they will be taught. The how is left to teachers, schools, and school districts. The opportunity to select instructional materials and determine instructional strategies opens the door to the use of school gardens. Although some people fear that standards-based education creates a barrier to teaching in school gardens, the garden experience can be a vital partner with the standards. On the one hand gardening brings life to the standards. The garden provides a full context in which to explore, connect, and expand concepts in the standards. On the other hand the potential for learning through the garden, rich as it is, cannot be realized for many students unless coupled with explicit instruction and clear connections that the standards can provide.*

In addition, garden-based education naturally crosses subject areas, providing an integrated learning experience that is analogous to real-world experiences. Teachers can connect the act of growing food to multiple standards; this integration captivates the mind and encourages the development of lifelong learners."

While standards may differ somewhat from state to state, in general they address similar central themes in each subject. The Common Core standards now widely accepted in Pennsylvania and most other states, will bring much greater uniformity across the country. If you find a lesson plan or curricular theme developed in another state, you will probably be able to adapt it easily to Pennsylvania standards and your own district's curriculum. National scientific organizations (such as the American Association for the Advancement of Science) are active in the development of standards and curriculum, which are often integrated into state standards, thus providing a degree of consistency among states.

How can different classes and grades utilize the garden? You may wish to have each class take care of its own part of the garden, from planting to harvesting. Or each class can take on a defined role in the garden as a whole. In the box is an example of the latter approach.[4]

Healthy Food for Healthy Kids - Delaware

Education Cultivation is our K-5 program, which allows every student in a school of approximately 500 students to engage in hands-on gardening activities through lessons that support the science curriculum. In the Education Cultivation program, students experience "seed to table" growing each and every semester, spring AND fall. We accomplish this in a relatively small garden space by:

- Using fast-growing, cool-weather crops, such as spinach, that can be harvested 6 – 8 weeks after planting
- Employing intensive gardening practices and direct seeding, which allows up to 200 students to plant seeds with their own hands each semester in a 250 sq ft garden
- Designing lessons so that each grade level has a special job to do in the garden each semester which ties-in with their curriculum. For example, 2nd graders prepare the soil for planting at the beginning of the growing season and clean up the garden at the end, because soil composition and composting are required elements of the 2nd grade science curriculum.

Education Cultivation Garden lessons provide opportunities for students to use all of their senses and make learning fun, regardless of students' learning styles and capabilities. Each lesson is 30-45 minutes in length, and includes an introductory piece that is taught in the classroom, followed by a hands-on gardening piece. The program can be modified to fit the needs of a particular school, but a typical program includes the following:

- **Kindergarten and First Grade** plant the seeds, which ties in with their plants and organisms curricula, respectively.
- **Second Grade** prepares the soil at the beginning of the growing season. They also clean the garden, and compost the garden waste at the end of the growing season
- **Third Grade** waters the garden until the seeds germinate, which ties in with their water-cycle studies. They also receive a vegetable nutrition lesson, which ties in with their human body curriculum.
- **Fourth and Fifth Grades** harvest the crops, which supports their studies of plant life-cycles and ecosystems, respectively.

When it comes to teaching lessons, some teachers may be quite comfortable with presenting the material. Or teachers may find it helpful at first to work with someone from a partner organization. A volunteer gardener could teach some or all of the lesson

the first time through, or the teacher could do the classroom material and the gardener could do the hands-on work.

Here are some specific points on how the garden-based curriculum works at Hamilton Elementary School, as described by Dr. Paula Wilson, former principal.

To get all students involved, each classroom in the building "adopted a vegetable". The students started those seeds and cared for the plants as they grew (usually on the classroom windowsill). When the time came to transplant the seedlings to the garden, the students and teachers planted them in the designated location. The students have developed a connection to the garden through starting the seeds and transplanting them. Vocabulary lessons about the garden were used frequently; this is particularly helpful for English Language Learners.

How can we support teachers in developing instruction that goes beyond the traditional classroom? Managing 25 active children outside is a challenge; try to arrange for assistance from another staff member or volunteer at this time. Having tables and benches in the garden will help considerably. It is important to develop a clear set of rules for student behavior in the garden.

Hamilton School Garden Rules:

1. I will listen to adults and follow direction.
2. I will handle tools correctly.
3. I will respect the garden and not run or horseplay in the garden area.
4. I will never eat anything in the garden without asking first.
5. I will always wash my hands after working in the garden.
6. I will not walk on the edges of the gardens.
7. I will not throw stones in the garden.
8. I will not play in the soil.
9. I will only touch the plants when I am told to.

If every child has a clipboard and pencil, then the children can be engaged in various activities while they are not actually doing gardening tasks. Journaling is a very valuable activity, whether it is recording their observations or making hypotheses in a science journal, drawing for an art project, or writing a paragraph about the garden.

There is information on how this school has linked the instructional program to an after-school club and parent participation in the "Cultivating Support" section.

Curriculum Connections for Grade 3
Lori Noyes, Blue Ball Elementary School

Often students use the garden to practice the scientific method. They record in their journals their observations, hypotheses/questions, action taken, and conclusions. Having them observe and come up with their own questions is much better than a contrived experiment.

We study Native Americans, specifically how they used their environment to meet their needs for food, clothing, and shelter. The students discover that corn was very important, and that many of the tribes planted corn, beans, and squash together (the Three Sisters). We plant corn the way they did, in mounds with buried fish heads. When the corn has grown 4 inches, we plant the beans that will climb the corn, and the squash that keeps weeds from growing.

We practice reading procedural text by following directions on seed packets or following recipes to make things such as tomato soup, salsa, and pumpkin pie. This past year they read and analyzed the effectiveness of the directions that came with our cold frames as the teachers assembled them.

Once we baked two pumpkin pies – one with canned pumpkin and one using pumpkin from the garden. Students predicted which they will like better. After the pies were baked, they tasted them both and voted for their favorite. The results were graphed and analyzed. Students completed several writing activities. One was a "how-to" guide on processing pumpkin for use in baking. Another was a compare/contrast essay about the two pies.

Agriculture and the Food & Fiber System is a part of our grade 3 curriculum. The garden provides hands-on, personal experience with the steps of producing, processing, marketing, and distributing the crops we grow.

When we study Water, Air, and Nutrient Cycles, our little compost bin provides another hands-on, real life experience for understanding that decomposers break down dead things and turn them back into nutrient rich soil for a plant to start all over again.

One year, during our Landforms unit, the weather cooperated and I had students demonstrate their understanding of PA landforms by using the empty garden bed to "build" a map of PA landforms. This had the added benefit of turning over the soil before spring planting.

Learning about weather and the tools to measure weather conditions takes on authenticity as we keep track of weather conditions as they relate to the garden…is it warm enough to plant yet? Do we need to water the garden?

There are countless opportunities to practice measurement skills as we track plant growth.

Children With Special Needs

In the "Planning" section of this manual, there is information and resources on gardening for children with special needs. The book mentioned provides a thorough overview, in the context of horticultural therapy. Horticulture is increasingly practiced in many therapeutic contexts for children and adults (for example, after a stroke or injury), and is being increasingly used as part of mental health programs.

Etherington, Natasha. 2012. Gardening for Children with Autism Spectrum Disorders and Special Educational Needs: Engaging with Nature to Combat Anxiety, Promote Sensory Integration, and Build Social Skills. Jessica Kingsley Publishers.

American Horticultural Therapy Association, http://www.ahta.org

Here is a resource focused more of children with special mobility needs.
http://www.schoolgardenwizard.org/wizard/create/build_safety.html

At that website, see the link to article "Kids with Disabilities Don't Like Radishes Either," which has many good principles and ideas.

Professional Development

Along with curriculum materials, schools developing a garden also need to consider teacher professional development. Teacher and staff training can occur at the individual school, in the district, through the Intermediate Unit, and in the many programs (conferences, on-line, etc.) provided by local, regional, state, and national organizations. Again, consult the "Resources" section for information on these opportunities. Professional development credit is often available. Some organizations may provide resource persons who can provide hands-on training locally; individual schools, districts, or groups of schools could jointly sponsor such activities. When an individual school sets the agenda for professional development, the garden can readily be included. For maximum effectiveness and inclusiveness, appropriate training should be extended to other school personnel who will be involved in the garden and to parents and other community participants.

Many of the programs described throughout this manual offer professional development workshops and courses (on site or on line). Local school gardeners speak very highly of such opportunities, such as the Edible Schoolyard Academy in

Berkeley, CA. Local state extension offices offer many programs about gardening. Seek funding for professional development from your school or district, from your district's Education Foundation, through your garden's fundraising efforts, etc.

Here is an on-line professional development course about garden based learning:
http://tccl.rit.albany.edu/knilt/index.php/Garden-Based_Learning_Across_the_Curriculum
Here is a link to a large collection of materials to conduct a garden training workshop
http://www.csgn.org/csysg-trainer

School Food Service Programs

Many schools have successfully integrated their gardens into the school food service program through the breakfast and lunch program, classroom snacks, etc. Such efforts provide many teachable moments. The food service program is subject to many rules and regulations. A garden project can fit in with new federal guidelines that require more vegetables and fruits. So it is important to work with your school and district food service personnel right from the start. These individuals are educators who are committed to student health and nutrition, and they may welcome the opportunity to prepare dishes from scratch using the garden produce.

The food service staff must provide meals every day for hundreds of children, so they plan in advance with their suppliers. The crops from your garden have to be worked into their planning: Will you have the 50 pounds of tomatoes they need next week?

The list of resources in this section includes many examples of successful efforts to link the garden with the food service. Recipes are included! Also refer to the section on "Policy, Garden Safety, and Food Safety" as you develop ways to use your crops. Here is a report from a nearby Pennsylvania district:[5]

"Great Valley School District's (Chester County, PA) Food Service Supervisor Barb Nissel reports that her school district's gardening efforts continue to thrive. There are a myriad of benefits to having a school garden. The most obvious benefit is an increase in the amount of fresh fruits and vegetables for the school meal program. Fruits and vegetables are being utilized not only in the school lunch program at Great Valley but also for breakfast. In addition, Great Valley makes their own soup, salsa, and spaghetti sauce, which allows them to control the sodium content of these items. Bumper crops of cucumbers are pickled. All this has led to a 34% increase in fruit and vegetable consumption!"

In schools working with Healthy Food for Healthy Kids in Delaware, most of the vegetables grown by the children are used in the cafeteria.6 The Upper Moreland School District (Montgomery County, PA) has a well-articulated statement about students' wellness, along with a garden program (integrated with the food service) and many other activities. For more information, contact the district food service director

who also runs the school garden program. See the wellness section at: http://www.umtsd.org/page/129

Here is a site with many resources about encouraging use of garden produce (and fruits and vegetables in general) in food service programs, including policies and detailed protocols for safety.
http://www.healthyschoolenvironment.org/home/index.html#

The federal Fresh Fruit and Vegetables Program (FFVP, administered by the Pennsylvania Department of Education) provides a fruit or vegetable snack (at least three times a week) to children as part of the goal of increasing consumption and promoting health. Elementary schools with free and reduced price meal eligibility rates at or above 50% are eligible. The funds are used for the purchase and delivery of the fruits and vegetables from a local vendor. Some local schools have used these funds for educational programs. Food service directors can provide information about this program. See: https://www.fns.usda.gov/ffup/fresh-fruit-and-vegetable-program

http://www.education.pa.gov/Teachers - Administrators/Food-Nutrition/Pages/School-Nutrition-Program.aspx (information on FFVP in Pennsylvania)

Schools have many different connections to other groups and organizations. If your school is a "Community School", then these links are already formalized. But think about ways to create win-win situations for your school and for other groups, as discussed above in the "Cultivating Support" section. Some of the garden learning could become part of the after-school program: The garden produce could be used for snacks, and hands-on lessons about cooking and nutrition could be presented. If many of your students go to an off-site after school program, consider how you might work with that group.

Sources of Curricular Materials about Gardening, Nutrition, and Food Service

Project PA
http://www.projectpa.org

Extensive resource about nutrition education and related programs including school gardens. Includes a school nutrition toolkit, webinars, etc.

Edible Schoolyard
https://edibleschoolyard.org/resource-search
Resources compiled by one of the best-known gardening programs, founded by the restaurant owner Alice Waters.

A Child's Garden of Standards (California)
http://www.ucanr.edu/sites/MarinMG/files/122929.pdf
Thorough discussion of standards and extensive list curriculum materials.

California School Gardens Network
http://www.csgn.org/curriculum
Although some of the sources are based on California standards, most are broadly applicable. Includes a database searchable by grade, theme, etc.

Garden Enhanced Nutrition Education
http://www.csgn.org/gene
Resources for nutrition and cooking programs that build on gardening. Materials on teacher training and workshops.

American Heart Association
https://www.wholekidsfoundation.org/downloads/pdfs/AHA_WKF_Curriculum.pdf
The curriculum used in the AHA's school garden program; several local schools have received grants for AHA gardens.

People's Garden – Washington State University
http://peoplesgarden.wsu.edu/toolkit/toolkit-resources/
Extensive set of lesson plans (grades 2-5) and other material on gardening and food service.

Life Lab
http://www.lifelab.org/for-educators/schoolgardens/garden-to-cafeteria
Policy and protocols for school gardens and garden-to-cafeteria

Kids Gardening – National Gardening Association
https://kidsgardening.org/lesson-plans/
https://kidsgardening.org/garden-activities/
https://kidsgardening.org/create-sustain-a-program-nutrition-education-in-the-garden/
Curriculum materials and garden-based activities, such as crafts

Michigan State University Farm to School
http://www.canr.msu.edu/foodsystems/uploads/files/garden_to_cafeteria_guide.pdf

A guide with necessary considerations, tips, and examples on garden-to-cafeteria programs.

U.S. Dept. of Agriculture Team Nutrition
http://fns.usda.gov/team-nutrition
Information on training and technical assistance for foodservice, nutrition education for children and their caregivers, and school and community support for healthy eating and physical activity.

U.S. Department of Agriculture Standards Based Nutrition Education
https://www.fns.usda.gov/tn/dig-standards-based-nutrition-education-ground
Curriculum and many supporting materials, including parent information in English and Spanish. Designed for grades 5-6, but adaptable to other grades. Printed curriculum available free for schools in the National School Lunch Program.

School Garden Curriculum and Lesson Plans (North Carolina)
http://guilford.ces.ncsu.edu/lesson-plan
Grades K-8.

Garden-Enhanced Nutrition Education
http://www.healthyschoolenvironment.org/training-resources/nutrition-education

Grow, Cook, Teach – Massachusetts Farm to School Project
http://www.hungerfreecommunities.org/resource-library/grow-cook-teach-a-resource-guide-for-farm-to-school-activities/
Resources on curriculum and cooking

Project 2061
https://www.aaas.org/programs/project2061
National curriculum and educational outreach program of the country's largest professional association on scientists.

Healthy School Toolkit
https://www.thefoodtrust.org/uploads/media_items/healthy-school-toolkit-original.orginal.pdf
Overview of the problem of obesity and poor diet among children, and programs and policies to promote healthy eating.

Many of the materials listed in the "Resources" Section also contain information on curriculum

References

[1] Callahan, Kate and Kleinman, Amy. FoodCorps Connecticut.

[2] Garden Pathways. Life Lab. [Retrieved February 25.2018] www.lifelab.org/2017/06/garden-pathways/

[3] A Child's Garden of Standards: Linking School Gardens to California Education Standards. Nutrition Services Division, California Department of Education, 2002. [Retrieved February 25, 2018.] http://ucanr.edu/sites/MarinMG/files/122929.pdf

[4] Healthy Foods for Healthy Kids. [Retrieved February 25,2018] http://www.healthyfoodsforhealthykids.org/programs/

[5] 5 Local Farming and Gardening Benefits Great Valley School District's Children. Project PA. [Retrieved February 25, 2018.] http://www.projectpa.org/ppa-v3.8.2/images/farm-to-school/greatvalley-schoolgarden.pdf

[6] Healthy Foods for Healthy Kids. Education Cultivation [Retrieved May 15, 2013.] http://www.healthyfoodsforhealthykids.org/

Assessment

Assessment will take many forms. It is important that you develop your assessment tools and strategies at the outset of your planning. Determine the schedule for assessments and who will be responsible for conducting the assessment. Make sure that your assessments are authentic: they should "indicate [the] learner's progress through their performance on real tasks". [1]

Why Evaluate?[2]

Performing an evaluation serves many purposes:

- It helps school staff members keep abreast of what is and is not working with the school garden project.
- It enables staff to anticipate problems and generate new ideas for improving and sustaining the project.
- It helps teachers and administrators ensure that students are making educational gains with the garden programs and activities.
- It builds solid evidence for the value of the project and helps convince potential supporters that the garden—both the physical site and the educational activities it supports—deserves their support.

Principles of Assessment[1]

These 12 principles can be applied directly to assessment situations and tasks:

Learner centered principles of assessment (in Lambert & McCombs, 1998) provides guidelines for assessment reforms that support students' learning.

1. The fundamental purpose of any educational assessment of students should be to promote meaningful learning.
2. Assessment should elicit students' genuine effort, motivation, and commitment to the assessment activity and situation.
3. Assessment should provide credibility and legitimacy to a broad range of talents and accomplishments of students across the curriculum.
4. Assessment should occur continuously in classrooms in order to provide longitudinal evidence of individual progress.
5. The strategies, skills, and knowledge required to excel on academic assessments should be the same as those required to master the curriculum on a daily basis.
6. Assessments should be based on authentic and meaningful tasks that are consistent with the regular curriculum and instruction provided in the classroom.
7. Assessments should be fair and equitable to all students regardless of prior achievement, gender, race, language, or cultural background.

8. Assessments should measure students' motivation, attitudes, and affective reactions about the curriculum as well as their cognitive skills, strategies, and knowledge.
9. Assessments should include exhibits, portfolios, and performances to demonstrate a wide range of behavior and accomplishments.
10. The design of standards of excellence and assessment systems should be negotiated by the participants – including parents teachers, administrators, and students – in districts and states in order to ensure consensus, commitments, and ownership among the primary stakeholders.
11. The results of assessment should provide clear, comprehensible, and immediate feedback to the participants.
12. All assessments should provide for periodic review and revision among the participants and consumers of assessment information.

Attributes of Performance Based Assessments[1]

Authentic performance-based assessments have four basic characteristics in common (Wiggins, 1989 in Darling-Hammond, 1998):

1. **Assessment tasks are representative of performance:** They are designed to be truly representative of performance in the field. For instance, a nutrition curriculum may include teams planning and/or preparing a nutritionally balanced meal with produce from the garden.

2. **Criteria are well–articulated:** The criteria used in assessment seek to evaluate "essentials" of performance against well-articulated performance standards that are openly expressed to students and others in the learning community, rather than kept secret in the tradition of content based examinations. These criteria are usually multifaceted, representing the various aspects of a task, rather than reduced to a single grade. The criteria in this way, guide teaching, learning and evaluation and illuminate the goals of learning.

3. **Self–assessment:** plays an important role in authentic tasks. A major goal of authentic assessment is to help students develop the capacity to evaluate their own work against public standards; to revise, modify, and redirect their energies, taking initiative to assess their own progress.

4. **Accountable to the learning community:** Students are generally expected to present their work and defend themselves publicly and orally to ensure that their apparent mastery is genuine. This characteristic of authentic assessment serves other goals as well, signaling to students that their work is important enough to be a source of public learning and celebration; providing opportunities for others in the learning community, that is students, faculty and

parents to continually examine, refine, learn from an appreciate shared goals and achievements.

Why is assessment important, not just in the classroom, but also in any endeavor? In order to improve your program from year to year, you need a consistent, well-designed, and systematic way to record what you have done and determine if you have achieved your goals. Some of the results of your evaluation will be used when you plan the program for the next year. Such formative assessments involve feedback to the decision-making process so that you can build on strengths and improve on weaknesses. At the end of the project (or at set intervals for an ongoing project), you should conduct a summative evaluation to analyze your results and determine the impact of your efforts on the students and any other intended audience. This information will be used internally (to inform future planning) as well as externally, such as in reporting to the community and to donors (past and prospective).

School personnel are usually quite familiar with assessment procedures and will play an important role in formulating and carrying out the evaluation process. They know how to evaluate the progress of their students day by day and to use that knowledge to guide future instruction. Schools and districts likewise perform thorough evaluations of their programs and activities. Although outside evaluators are often used in education, we assume that for financial reasons the school garden team will be evaluating its own program. But if you want to call on outsider evaluators, others involved in gardening may be able to help.

Analyzing data about all aspects, the garden is a key part of the evaluation process, so make sure you have data-collection systems in place from the outset. Just a few examples of the data to record are volunteer hours contributed, pounds of vegetables harvested, number of students and hours spent in the garden, and value of produce donated to charities.

Sources of Assessment Tools

Many of the materials listed in the "Resources" section include information on assessment. Often, the curricular materials and lesson plans you find will include assessment ideas. Following are resources specifically related to assessment.

Cornell University Garden Based Learning:
http://gardening.cals.cornell.edu/program-tools/evaluation-toolkit/

Garden Based Learning:
Considering Assessment from a Learner-Centered Perspective
Download at
http://www.hort.cornell.edu/eames/belize/readings/Garden-Based-Learning-Considering-assessment-from-a-learner-centered-approach.pdf
This source offers a brief but thorough discussion of the educational principles of school gardening. Presentation of the principles and goals of authentic assessment as applied to gardens. It also includes sample rubrics and evaluation tools. It emphasizes student-centered approaches to learning and assessment.

Farm to School Evaluation Toolkit:
http://www.farmtoschool.org/resources-main/farm-to-school-evaluation-toolkit
This source includes many ideas relevant to school gardens. This collection of survey information and other evaluation tools can help practitioners assess farm to school outcomes with different participants including students, foodservice staff, foodservice directors, farmers, educators, and other stakeholders.

Assessments can take many forms. A survey or test before a single lesson or before a more extensive program followed by a similar assessment afterwards ("pre-test/post-test") is a very useful method to show change in knowledge or attitudes. For long-term projects, a portfolio of student work (perhaps including a journal) can provide valuable information on progress. Some assessments will be quantitative, for example based on scores on a survey or short-answer test. Others may be qualitative, for example based on descriptions from students or teachers.

What will you assess? You will need to construct the appropriate evaluation tools for these assessments; fortunately, model tools are widely available. The assessment should closely track the goals you established in your planning process (see the "Planning and Implementation Steps" section). For a school garden, the most important assessment will be the impact on the students. For example,

- What content in various subject areas have they learned?
- How have their attitudes about vegetables changed?
- How have their attitudes about environmental sustainability changed?
- How have their social skills such as teamwork and responsibility improved?
- How have students with different learning styles or with different academic strengths been impacted?
- How have their problem solving and other higher-order skills improved?

You may want to conduct a "customer satisfaction survey" with those who have participated in the garden program. Assessing the impact on the community is also important. For example:

- How effectively have you mobilized volunteers?
- How broad has been the financial support?
- What impact has there been on attitudes and food choices?

The actual performance of the garden should be assessed as you plan for the next season. For example,

- What plants grew well or poorly?
- Were there disease or pest problems?
- Although you can't predict or change the weather, were you able to deal with too little or too much rain?
- Did you have the tools and equipment you needed?
- How well did your composting program work?
- Were you able to maintain the garden over the summer?

Sample Assessment Tools

1. General assessment

This example covers many different aspects of the garden.[3]

Self-Assessment Worksheet

Self-Assessment Worksheet: Revisiting your Goals

Read each of the following questions and take time to write your responses. You may want to have each teacher who is participating respond to some portions individually, such as the first section addressing learning goals.

Tip: At the conclusion of the evaluation, all of the components can be assembled into an "Annual Report" for the school, which will be of great use in new funding projects.

1. Garden as a learning environment
   a. How did the garden support the larger educational goals and values of the school?
      Tip: List the goals and address each one separately. You may find that great progress was made on some, while others were neglected. Evaluating progress against the goals will help determine whether each goal should be kept, modified, or deleted in next year's plan.
   b. What educational activities and lessons did you incorporate into the garden?
   c. What activities did you plan to enable learners to:
      i. Use the garden for science and multi-disciplinary learning?
      ii. Gain confidence and enthusiasm for learning?
      iii. Acquire gardening and environmental stewardship skills?
      iv. Achieve other educational goals through active participation in the garden?
   d. How did the garden meet the learning objectives of a particular lesson or unit?
   e. Did some goals take priority over others and how should this influence the design?
   f. How did you meet the needs of students with disabilities or special learning issues?

2. School garden team
   a. Did the team promote active participation by administrators, teachers, students, parents, neighbors, and volunteers?
   b. Did the school motivate and train the entire faculty, teachers from a specific grade level, or only interested teachers to use the garden?
   c. Did every team member get involved, or did most of the work fall to one or two staff members?

3. Garden maintenance needs
   a. What were the special maintenance needs of the garden and how were they met?
   b. Did you have a system in place for assigning garden duties?
   c. Did the school have an appropriate system for maintaining the garden during the summer and the holidays?
   d. If vandalism was a potential challenge, how was it discouraged or minimized?

4. Teacher training
   a. How was teacher training handled with respect to curricular connections as well as gardening basics?
   b. Were training workshops scheduled at convenient times and locations for the majority of the participants?
   c. What topics or content met teachers' needs and interests the best? What additional topics or content are needed?
   d. Did the activities and lessons meet the local, state, and national standards?

5. Student involvement
   a. How was the student body involved with the garden?
   b. What aspects of garden installation and maintenance did the students participate in?
   c. What classes, grade levels or groups of students used the garden on a regular basis after installation?
   d. Were the students engaged in active discovery, problem solving, and questioning?
   e. What events and activities made the garden part of the students' daily lives (such as recess time, story hours, etc.)?

6. Parents, community, and networking
   a. How did the garden team work with existing in-school networks of parents (PTO/PTA/Local School Council)?
   b. Were opportunities tapped into to use the support and resources offered by parents and parent groups?
   c. Was there a citywide network of school garden projects and teams that the school participated in? If so, how did participation help sustain the garden?
   d. How was the school garden used and supported by the community? What opportunities existed?

7. Extra-curricular activities
   a. For which extra-curricular and community activities were the garden used?
   b. Were events, programs, or celebrations planned in the garden?
   c. What ceremonies or cultural events were held in the garden?

2. Assessment of students' interest in new foods

Many reports indicate that a garden program can increase the likelihood that children will expand their food preferences. Here is a sample survey form to assess "neophobia", the aversion to new foods.[4]

Neophobia Evaluative Assessment

What grade are you in? _____

Fruits and Vegetables: What Do You Think About them?

FRUITS				
1. How much do you like fruit?	A lot	A little	Not very much	Not at all
2. How much do you like tasting new fruits?	A lot	A little	Not very much	Not at all
3. Will you taste a fruit if you don't know what it is?	Definitely	Probably	Probably not	Definitely not
4. Will you taste a fruit if it looks strange?	Definitely	Probably	Probably not	Definitely not
5. Will you taste a fruit if you've never tasted it before?	Definitely	Probably	Probably not	Definitely not
6. When you are at a friend's house, will you try a new fruit?	Definitely	Probably	Probably not	Definitely not
7. When you are at school, will you try a new fruit?	Definitely	Probably	Probably not	Definitely not
8. When you are at home, will you try a new fruit?	Definitely	Probably	Probably not	Definitely not
9. How many times have you tried a new fruit since school started this year?	Never	1 time	2 times	3 times	at least 4 times

VEGETABLES					
10. How much do you like vegetables?	A lot	A little	Not very much	Not at all	
11. How much do you like tasting new vegetables?	A lot	A little	Not very much	Not at all	
12. Will you taste a vegetable if you don't know what it is?	Definitely	Probably	Probably not	Definitely not	
13. Will you taste a vegetable if it looks strange?	Definitely	Probably	Probably not	Definitely not	
14. Will you taste a vegetable if you've never tasted it before?	Definitely	Probably	Probably not	Definitely not	
15. When you are at a friend's house, will you try a new vegetable?	Definitely	Probably	Probably not	Definitely not	
16. When you are at school, will you try a new vegetable?	Definitely	Probably	Probably not	Definitely not	
17. When you are at home, will you try a new vegetable?	Definitely	Probably	Probably not	Definitely not	
18. How many times have you tried a new vegetable since school started this year?	Never	1 time	2 times	3 times	at least 4 times

3. Portfolio Assessment

Because school garden projects extend over long periods of time and may cover many areas of the curriculum and of personal development, educators often use a portfolio to collect student work and provide evidence of student progress. There is a thorough discussion of portfolios for school gardens in the publication, "Garden Based Learning: Considering Assessment from a Learner-Centered Approach" from which the following template is quoted[1]

Student Garden Portfolio Design Worksheet

(Modified version from Arter & Spandel, 1998)

1. For the student garden assessment portfolio, who will be involved in planning the design of the portfolio?

2. Which of the following purposes are important for your assessment system?
   - To show growth or change over time
   - To show the process by which work is done, as well as the final product
   - To create collections of favorite or personally important work
   - To trace the evolution of one or more projects/products
   - To review curriculum or instruction
   - Large scale assessment
   - Program evaluation
   - Other

3. What are the major instructional goals for your program? How will portfolios be used for instructional purposes?

4. How will you prompt students to help them self-reflect on the work they are choosing for their portfolio?

5. What is the general curricular focus of the portfolio system you are planning?
   - Reading
   - Math
   - Science
   - Writing
   - Social studies
   - Art
   - Interdisciplinary
   - Environmental education
   - Nutrition
   - Other (specify)

6. Decide what is required to be included in the student portfolio to provide evidence of student's achievement of the goals of the program.
   - What is required to be included in all portfolios?
   - List a number of categories of things to be included in the work students select for their portfolio.
   - How many samples of each of these things do the students have to select?
   - How many open ended choices for the
   - portfolio will you allow, if any?

7. For the portfolio system you are developing, choose one the types of products that students will be asked to place in their portfolio. What are your criteria for judging performance?

8. For your portfolio system, which of the following considerations do you think are likely to be important in assessing the portfolios as a whole product?
   - Amount of information included quality of individual pieces
   - Variety in the kind of things included
   - Quality and depth of self-reflection
   - Growth in performance

- Apparent changes in attitude or behavior,
- as indicated on surveys, questionnaires, etc.
- Other (specify)

9. What criteria will you use to assess student self-reflection in the portfolio?
   - Thoroughness
   - Accuracy
   - Support of statements by pointing to
   - Specific aspects of work
   - Good synthesis of ideas
   - Self-revelation
   - Other (specify)

10. Who will help develop, select and adapt the performance criteria?
    - Students
    - Teachers
    - Curriculum experts
    - Evaluation and assessment experts
    - Other

11. Who will select specific work samples for the portfolio?
    - Students only
    - Teachers only
    - Student and teacher

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[1] Garden Based Learning: Considering assessment from a learner-centered approach. Center for Youth Development, University of California. 2003. [Retrieved December 28, 2017]. http://www.hort.cornell.edu/eames/belize/readings/Garden-Based-Learning-Considering-assessment-from-a-learner-centered-approach.pdf

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[4] National Farm to School Network. [Retrieved December 28, 2017]. http://www.farmtoschool.org/resources-main/farm-to-school-evaluation-toolkit

Resource List

BOOKS AND WEB PUBLICATIONS

Books are available from commercial booksellers unless otherwise noted.

"A Child's Garden of Standards"

Download at https://www.ucanr.edu/sites/MarinMG/files/122929.pdf
Extensive standards-based curriculum guide, primarily for grades 2-6, for all subject areas. Materials grouped around 5 aspects of seed to table: gardening, nutrition, cooking, waste management, and agricultural systems.

Books and Curricula from the National Gardening Association Kids Gardening Program
View at https://kidsgardening.org/kidsgardening-books-and-curricula/
Books for children and adults and curriculum guides. The items are sold through the Gardeners Supply Co., with a discount for schools. See the web page for ordering information.

"CDC Guide to Fruit and Vegetable Strategies to Increase Access, Availability, and Consumption"
Download at http://www.cv/obesity/downloads/FandV_2011_WEB_TAG508.pdf
A comprehensive manual from the Centers for Disease Control and Prevention on many strategies, including community and school gardens. Includes rationale, evidence, key steps in planning and implementation, case studies, and extensive resource lists.

"Fresh from the Farm – The Massachusetts Farm to School Cookbook"
Download at www.farmtoschool.org/resources/MA_farm_to_school_cookbook
A handbook for school food service programs about utilizing fresh produce. Useful for school gardens as well as farm to school programs. Recipes designed for large quantities, and include nutritional information.

"Garden Based Learning: Considering Assessment from a Learner-Centered Perspective"
Download at https://www.hort.cornell.edu/eames/belize/readings/Garden-Based-Learning-Considering-assessment-from-a-learner-centered-approach.pdf
A brief but thorough discussion of the educational principles of school gardening. Presentation of the principles and goals of authentic assessment as applied to gardens. Includes sample rubrics and evaluation tools.

"Gardening for Children with Autism Spectrum Disorders and Special Educational Needs: Engaging with Nature to Combat Anxiety, Promote Sensory Integration, and Build Social Skills" (Natasha Etherington, author)
Guidelines for parents and teachers (who may be new to gardening) to help children with special needs learn, play, and socialize.Explores the therapeutic potential of nature using a mindfulness approach.

"Gardening with Children" (Beth Richardson, author)

A detailed guide for adults on ways to include children in all aspects of gardening: "to satisfy your need for contemplative time in the garden and nurturing time with the children that you so love".

"Gardens for Learning"
Download at https://www.csgn.org/content/california-gardens-learning
A very extensive resource on all aspects, with lists of many other resources. (Some materials are specific to all-year outdoor gardening in warmer climates.)

"Getting Started with Garden-Based Learning – An Introductory Guide for Program Leaders/Educators"
Download at
http://files.campus.edublogs.org/blogs.cornell.edu/dist/3/72/files/2011/03/a-Guide-to-Getting-Started-with-Garden-j15-24fs5dm.pdf
Helps gardeners and educators focus on goals and priorities, and steps to assure engagement and support of a broad range of participants.

"Got Dirt?"
Download at https://www.dhs.wisconsin.gov/physical-activity/foodsystem/gotdirt.htm
A tool kit for youth gardens (in schools, child care centers, and the community), with case studies and resource lists for each type. Also available in Spanish.

"Grow, Cook, Teach! A Resource Guide for Farm to School Activities"
Download at http://www.hungerfreecommunities.org/resource-library/grow-cook-teach-a-resource-guide-for-farm-to-school-activities/
Includes practical information and very extensive lists of resources on school gardens; cooking; and agricultural curricula.

"Healthy School Toolkit"
Download at http://thefoodtrust.org/uploads/media_items/healthy-school-toolkit-original.original.pdf
The Food Trust, in Philadelphia, is a leading organization addressing issues of food access, obesity, etc. This Toolkit is designed for schools, parents, policymakers, and community groups who are interested in improving the school environment to help prevent childhood obesity.

"How to Grow a School Garden – A Complete Guide for Parents and Teachers" (Arden Bucklin-Sporer and Rachel Kathleen Pringle, authors)
Based on the authors' years of experience with ecologically rich school gardens. Covers all aspects of establishing and maintaining gardens for grades K-8. Includes lesson plans, classroom management tips, etc.

"Our Generous Garden" (available in Spanish as "Nuestra Huerta Generosa") (Anne

Nagro, author)
Order from https://gardenabcs.com/garden-books-for-kids
How children grow a garden and impact their community, for ages 3-10.

"Our Super Garden" (available in Spanish as "Nuestro Súper Jardín") (Anne Nagro, author)
Order from https://gardenabcs.com/garden-books-for-kids
Explores healthy eating using garden produce, for ages 3-10. "Children learn it's OK to try new foods and why fruits and vegetables are an important part of a healthy diet". Includes recipes.

"Penn State Master Gardener Manual"
Buy book at https://extension.psu.edu/master-gardener-manual
Manual used in Master Gardener training program. Covers not only vegetable and flower gardening but also lawns, shrubs, trees, etc. Basic and applied information on botany, entomology, plant pathology, etc. Over 800 pages.

"Revisiting Garden Based Learning in Basic Education"
Download at http://www.fao.org/3/a-aj462e.pdf
Published by the United Nations Food and Agriculture Organization. An excellent introduction, based on world-wide best practices, to the goals and impacts of the school gardening movement. Includes information on model programs and underlying educational theory.

"Setting Up and Running a School Garden"
Download at http://www.fao.org/3/a-a0218e.pdf
Very comprehensive book for schools, parents, and communities, based on world-wide analysis of successful programs. Reviews all the steps in developing a school garden. Given the international perspective, this could help teachers show students what children in other countries are doing. Comprehensive focus on all aspects of the food system. Contains fact sheets on foods, nutrition, and garden practices.

Slow Food USA School Garden Guide
Download at http://www.slowfoodusa.org/files/files/slow-food-usa-school-garden-manual.pdf
Detailed manual, aligned with the principles of the Slow Food Movement – food that is good, clean, and fair.

"Smart by Nature: Schooling for Sustainability" (Michael Stone, author)
Published by the Center for Ecoliteracy. "Describes strategies for greening the campus and the curriculum, conducting environmental audits, rethinking school food, and transforming schools into models of sustainable community."

"Vegetable Gardening: Recommendations for Home Gardeners in Pennsylvania"
Buy book at https://extensionn.psu.edu/vegetable-gardens
Written by Penn State Extension. General material on gardens with detailed, specific information on how to grow many common crops. Includes information on managing pests and weeds.

WEB SITES

We have kept this list short because each of the listed sites contains many links to other resources.

Collective School Gardens Network https://www.csgn.org
Very extensive information on all aspects of school gardens. Links to curriculum resources, lesson plans, funding, building a support network, and garden related books for children. Information on outreach and support. Material for organizing a teacher training workshop

Cooking with Kids https://www.cookingwithkids.org
Elementary-level curriculum to engage students from diverse cultures with fresh, affordable foods. Curriculum supports standards across many disciplines.

Cornell University Garden Based Learning https://gardening.cals.cornell.edu
A very comprehensive collection of materials for school and community gardens, and gardening in general. Lesson plans, curriculum resources (including art), evaluation materials, citizen science activities.

Cornell University Garden Mosaics
A program that connects youth and elders to investigate the mosaic of plants, people, and cultures in gardens. Features intergenerational mentoring, multicultural understanding, and community action. Projects, science information pages, and community-building activities. The website is off-line (as of March 2018) but is expected to be reposted at https://civicecology.org/outreach/garden-mosaics

Edible Schoolyard http://www.edibleschoolyard.org
Founded by famed restaurant owner Alice Waters. Extensive resource collection on school gardens and school lunch programs. "When schools prioritize health and social well-being in tandem with academic goals, and extend their mission to include families and surrounding communities, students thrive."

Grow to Learn NYC http://www.growtolearn.org

Very comprehensive resource with toolkits, curricula, videos, etc. on all aspects of gardening and food service. Very helpful guide (with checklists, worksheets, etc.) on organizing, planning, assigning responsibilities, etc. at http://www.growtolearn.org/resource/grow-to-learn-step-by-step-registration-guide

Harvard University School of Public Health Nutrition Source
https://www.hsph.harvard.edu/nutritionsource
Authoritative information (for adults) on all aspects of nutrition.

Healthy Foods for Healthy Kids http://www.healthyfoodsforhealthykids.org/
Food and garden-based educational programs (in Delaware) that support content standards and promote student health so youth will develop lifelong wholesome eating habits by experiencing the joy of growing, cooking, and eating garden-fresh vegetables.

Healthy Meals Resource System
http://healthymeals.fns.usda.gov
U.S. Department of Agriculture web site with extensive links to best practices, recipes, etc., in support of child nutrition programs.

Healthy School Environment http://www.healthyschoolenvironment.org
Group works with food service directors, teachers, community partners, and growers/distributors to increase consumption of fresh produce. Information on using produce in school cafeterias, including recipes and safety guidelines. Extensive training resources on promoting fruits and vegetables.

Life Lab http://www.lifelab.org
Web site on garden-based learning, focusing on helping educators and families who wish to engage youth in gardens. Programs for teens on youth empowerment and food justice. Many publications and web resources

Life Lab Resources in Spanish http://www.lifelab.org/2011/07/spanish
A compilation of materials from various sources, including complete school garden manuals.

Massachusetts Agriculture in the Classroom http://www.aginclassroom.org/ag-curriculum
Excellent "How to Guides" on topics such as siting the garden, soils, raised beds, seeding, etc.

National Agriculture in the Classroom http://www.agclassroom.org/

An extensive web site of materials for teachers and students in all aspects of food and nutrition, developed by the U.S. Department of Agriculture. Lesson plans searchable by grade, subject, standard, etc.

National Farm to School Network http://www.farmtoschool.org
In addition to resources about farm to school connections, includes many resources related to school gardens, school nutrition and food service programs, etc. Working with farmers may complement your gardening activities. Contact Pennsylvania coordinators Deb Bentzel (dbentzel@thefoodtrust.org) or Kelsey Porter (kporter@thefoodtrust.org).

National Farm to Preschool Network http://www.farmtopreschool.org
A component of the National Farm to School Network. Resources include information on preschool gardens. "Preschool gardening engages children by providing an interactive environment to observe, discover, experiment, nurture and learn." Materials and programs suitable for any child care setting.

National Gardening Association Kids Gardening https://kidsgardening.org
Comprehensive web site with dozens of how-to guides on curriculum, activities, fundraising, organization, community engagement, and all aspects of gardening.

Project PA http://www.projectpa.org
Extensive resource (from the Penn State Department of Nutritional Sciences) about nutrition education and related programs including school gardens. Includes a school nutrition toolkit, webinars, etc.

School Garden Wizard www.schoolgardenwizard.org
Comprehensive resource for K-12 school gardens created by the Chicago Botanic Garden and the U.S. Botanic Garden. Step-by-step guidance in sections including "Make the Case", "Plan for Success", "Create the Garden", "Learn in the Garden", and "Keep it Growing". Highlights many issues school gardeners will face and offers solutions.

Sowing the Seeds of Success http://gardening.cals.cornell.edu/program-tools/
A comprehensive resource on the organizational and "people" aspects of a gardening program. Tools to start, sustain, expand, and assess the program, with program development exercises.

Team Nutrition http://teamnutrition.usda.gov/default.html
"Team Nutrition is an initiative of the U.S. Department of Agriculture Food and Nutrition Service to support the Child Nutrition Programs through training and technical assistance for foodservice, nutrition education for children and their caregivers, and school and community support for healthy eating and physical

activity." Material on school gardens, extensive resource list, downloadable graphics, and lesson plans (including "Garden Detective" multi-disciplinary curriculum). Includes materials in Spanish.

University of California Davis Center for Nutrition in Schools http://cns.ucdavis.edu
Extensive resource on school nutrition, including gardens. Large collection of curriculum materials for grades preK-12. Provides nutrition curriculum that is evidence-based, aligned with standards, and integrated with other subject areas.

Whole Kids Foundation http://www.wholekidsfoundation.org
Information on gardening and on nutrition (including recipes). See the comprehensive "School Garden Resource Center".

Children's Gardening Books

Anholt, L. (2003). Camille and the Sunflowers. London, England: Frances Lincoln.

Archer, J. & Craig, C. (2018). Plant, Cook, Eat! A Children's Cookbook. Watertown, MA: Charlesbridge.

Aston, D. (2016). A Beetle is Shy. San Francisco, CA: Chronicle Books LLC.

Aston, D. (2011). A Butterfly is Patient. San Francisco, CA: Chronicle Books LLC.

Aston, D. (2007). A Seed is Sleepy. San Francisco, CA: Chronicle Books LLC.

Aston, D. (2006). An Egg is Quiet. San Francisco, CA: Chronicle Books LLC.

Aston, D. (2015). A Nest is Noisy. San Francisco, CA: Chronicle Books LLC.

Brown, R. (2014). Gardening Lab for Kids: 52 Experiments to Learn, Grow, Harvest, Make, Play and Enjoy Your Garden. Beverly, MA: Quarry Books.

Bunting, E. (1996). Sunflower House. San Diego, CA: Voyager Books Harcourt Brace & Co.

Carle, E. (1987). The Tiny Seed. New York, NY: Simon Spotlight.

Cole, H. (1997). Jack's Garden. New York, NY: Harper Collins.

Cornell, K. (2015). The Nitty Gritty Gardening Book: Fun Projects for All Seasons. Minneapolis, MN: Lerner Publishing Group.

Ehlert, L. (1987). Growing Vegetable Soup. Boston, MA: Houghton Mifflin Harcourt.

Ehlert, L. (1988). Planting a Rainbow. Boston, MA: Houghton Mifflin Harcourt.

French, V. (2010). Yucky Worms. Somerville, MA: Candlewick Press.

Galbraith, K. (2011). Planting the Wild Garden. Atlanta, GA: Peachtree Publishers, Ltd.

Gibbons, G. (1991). From Seed to Plant. New York, NY: Holiday House.

Glaser, L. (2010). Garbage Helps Our Garden Grow. Minneapolis, MN: Millbrook Press.

Gray, R. (2015). Flowers Are Calling. Boston, MA: Houghton Mifflin Harcourt.
Grigsby, S. (2010). In the Garden with Dr. Carver. Park Ridge, IL: Albert Whitman & Company.

Henderson, K. (2004). And The Good Brown Earth. Somerville, MA: Candlewick Press.

Messner, K. (2015). Up in the Garden and Down in the Dirt. San Francisco, CA: Chronicle Books LLC.

Richards, J. (2002). Fruit is a Suitcase for Seeds. Minneapolis, MN: Millbrook Press.

Siddals, M. (2010). Compost Stew An A to Z Recipe for the Earth. New York, NY: Tricycle Press.

Socha, P. (2017). Bees, a Honeyed History. New York, NY: Harry N. Abrams.

Stevens, J. (1995). Tops and Bottoms. New York, NY: Houghton Mifflin Harcourt.

Stewart, S. (1997). The Gardener. New York, NY: Farrar, Straus and Giroux.

Tamar, E. (1996). The Garden of Happiness. New York, NY: Harcourt, Inc.

Voake, S. (2012). Insect Detective. Somerville, MA: Candlewick Press.

Wellington, M. (2005). Zinnia's Flower Garden. New York, NY: Puffin Books.

Winters, K. (2013). Buzz About Bees. Markham, Ontario, Canada: Fitzhenry & Whiteside.

Woolf, A. (2016). You Wouldn't Want to Live Without Bees! New York, NY: Scholastic Inc.

Worth, B. (2001). Oh Say Can You Seed? All About Flowering Plants. The Cat in the Hat's Learning Library. New York, NY: Random House Children's Books.

Zoehfeld, K. (2012). Secrets of the Garden: Food Chains and the Food Web in Our Backyard. New York, NY: Alfred A. Knopf.

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