

Gardening Guide

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I Why Should You Plant a School Garden?

GARDEN SAFETY

Gardening is fun, but certain safety precautions must be followed:

ESTABLISH GARDEN RULES

Students can write them on a poster and sign their names in agreement. A few suggestions might include:

- Always put tools away so no one trips over them.
- Ask for help: Don't try to lift plants, dirt, or tools that are too heavy for you.
- Be careful with sharp tools like shovels or hoes.
- Always handle those tools slowly and carefully.
- No running in the garden.
- Wear closed-toe shoes.

REQUIRE PROPER HAND WASHING

of all persons working in the garden, including staff, students, and volunteers. Hands should be washed before and after working in the garden. Hands should be washed using soap and water. Alcohol-based (>60%), rinse-free hand sanitizers should be used when hand washing with soap is not possible. Hand sanitizers are not as effective when hands are visibly dirty. See pp. 4-5 for proper hand-washing guidelines. Do not let anyone work in the garden while sick, or until 24 hours after symptoms, such as vomiting or diarrhea, have subsided.

There is much research supporting school gardens. Some of the benefits to having students learn about and work in a garden include:

- **Increased fruit and vegetable consumption**
(McAleese & Rankin, 2007)
- **Improved nutrition knowledge and vegetable preferences**
(Morris & Zidenberg-Cherr, 2002; Lineberger & Zajicek, 2000)
- **Increased science achievement scores**
(Klemmer, Waliczek, & Zajicek, 2005; Smith & Motsenbocker, 2005)
- **Improved social skills and behavior**
(DeMarco, Relf, & McDaniel, 1999)
- **Improved environmental attitudes**
(Waliczek & Zajicek, 1999; Skelly & Bradley, 2000)

When students get hands-on experiences, it transforms abstract learning into something very real and meaningful. Creating this connection for children by enabling them to play a role in the success of the harvest can give them greater ownership of the garden and increase the likelihood that they will adopt the healthy behaviors associated with it. Learning these behaviors at a young age makes it easier for kids to maintain healthy habits into adulthood (Lohr & Pearson-Mims, 2005).

Read on to learn about the many types of gardens, how to plan and maintain them, and ways to gather support from the school and parent community to help build something special.

II Getting Started

Types of Gardens

You don't need to be an expert gardener or have a green thumb. This guide will help even the most novice of gardeners create a special place for children to learn – whether your school has a large plot of land or a sunny windowsill. The type of garden you choose will depend on your school's space, resources, and volunteer level.

In-Ground

This is the traditional outdoor garden. Unless the area has been cultivated before, you will either need vigorous help from adult volunteers or a tiller to break the compacted soil prior to planting. You will need to test the soil to ensure there are no contaminants. Adding compost to the beds each year can replenish nutrients.

Raised Beds

A raised-bed garden allows you to start with healthy soil right from the beginning. The beds are framed with either rot-resistant wood (like cedar), concrete blocks, or recycled plastic planking, and are then filled with soil. These are framed structures, typically 9 inches tall on soil, or up to 2 feet tall on paved surfaces. A raised-bed garden is usually more expensive at first, but the benefits may outweigh the costs. Raised beds are easier to cultivate, have fewer weed and drainage problems, and the raised soil and plants are protected from foot traffic. The soil in a raised-bed garden also warms up more quickly, adding valuable time to the growing season. This can be especially important for a school garden that is only available to students during the school year.

Containers

Even if you have little space, poor soil, or are surrounded by cement and blacktop, you can still have a thriving garden and nutrition education experience. Containers can be used indoors or outdoors. Typically, garden containers are made of clay, plastic, or wood, but plants will grow in anything that holds soil and has drainage holes. Window boxes and hanging baskets work well if you have little or no ground space, but be sure to use lightweight containers if they will be hanging. By adding handles or wheels, you can move plants to where they'll grow best as conditions change. Containers allow you to maximize your space by taking advantage of small sunny window ledges and courtyards.

When choosing what type of containers to use, keep in mind the larger the container, the larger the plant you can grow to maturity. Some plants (e.g., tomatoes) require deeper soil for the root system; therefore a deep pot is essential. Others (e.g., beets, radishes, spinach) have compact roots, which do not require a deep container. Smaller containers dry out more quickly than larger containers, but larger containers with more soil and larger plants are more difficult to move.

Containers need proper drainage, otherwise the roots may drown. If the container doesn't have drainage holes, make ½-inch holes at or near the bottom of the pot. Elevate containers that have drainage holes on the bottom with blocks or bricks to allow water to drain out of the holes.

Indoor Gardening

Indoor gardens are a good option for areas where winters are long and growing seasons are short. The location for an indoor garden is in front of well-lit windows. Windows that face south and west are best and usually receive enough light to grow leaf and root vegetables and herbs. Spend a few days observing your window space to determine how much light is available for an indoor garden.

Grow lights designed to hang low over growing areas are an effective way to grow indoor crops. With grow lights, you can control the amount of light your plants receive and expand your crop options to produce like tomatoes and strawberries.

BE SURE TO CLEAN AND SANITIZE GARDEN EQUIPMENT

and containers that are used to hold produce.

DOCUMENT AND POST STUDENT ALLERGY INFORMATION

where teachers and volunteers can see it easily, along with procedures to follow in the event of an allergic reaction.

GARDEN SAFETY

To keep your garden safe, use only nontoxic, non-leaching materials, whether constructing raised beds or using containers.

Avoid pressure-treated wood, used tires, single-use plastics, old railroad ties, etc. Create reasonable barriers to keep wild animals away from the garden, such as fencing, or cages to place over produce items.

Keep in mind these features you may want to include:

- Experimental areas for student inquiry
 - Compost area
 - Toolshed/storage
- Outdoor classroom/meeting area
- Greenhouse/cold frame
 - Community growing space

TOOL LIST

Keep your list as simple and inexpensive as you can, though you may want the following tools available to your students:

- Trowels for planting and digging up weeds
- Stakes for marking garden beds/walkways/label planted areas
- Iron rake for leveling soil
- Twine/string for marking out garden beds/pathways
- Leaf rake for raking up debris
- Hoes for weeding
- Pruning shears/scissors for harvesting produce/cleaning up plants
- Shovels for moving soil and digging larger holes
- Harvest containers (To avoid contaminating the harvest, the containers should be sanitized and have never been used for holding chemicals.)
- Wheelbarrows for moving dirt and garden supplies
- Water cans/hoses/spray nozzles

BEFORE YOU DIG

- Choose a garden site away from potential contamination sources (such as garbage, utilities, animals, water runoff, flooding, and septic systems).
- Contact your local utility company, or dial 811 (the national “Call Before You Dig” number), before digging a site for your garden to ensure that you avoid gas or electric lines.
- Identify soil and water record history from all sources. Test new soil and water samples for contaminants (see more on p. 95).

Time Management

School days are very busy, but careful planning will ensure that your students make the most of their time. Here are some time management suggestions:

Assign students to small garden teams and allow them to name their group. Before you visit the garden, identify jobs and locations, and plan how the teams will rotate through these jobs so everyone gets to try each task and no location gets too crowded.

Here are some ideas of tasks to include on this list:

- Harvest
- Observe (Discover changes in the garden, identify occupants such as birds, butterflies, and bees, and note where they tend to visit in the garden.)
- Prune
- Water
- Weed
- Write a column/draw a picture for the school garden newsletter

Building the Garden

Garden Site Selection and Analysis

Many factors may influence the location of your school garden:

- Is the garden visible to passersby? Allowing others to enjoy its progress is a great way to rally support and interest in the program!
- How easily can students get to the garden?
- Where is the nearest water source? (Water is essential, after all.)
- How much sunlight does the garden get each day?
- What type of soil is in the garden? Has it been tested for contaminants? Can it be improved if necessary?
- Does the garden allow for future expansion? When beginning a school garden, it's best to start small. However, with increasing support, the school may choose to expand, allowing more students to get involved.
- Will this garden be ADA (Americans with Disabilities Act) accessible? Is there potential for providing resources for students with special needs?

Soil

Healthy soil is critical to the success of your garden. Soil anchors roots and provides water and nutrients to the plants. Soil is composed of minerals and organic matter: sand, silt, and clay are the mineral particles; the organic matter is decayed remains of once-living plants and animals. Good plant growth and development depend on the mineral and nutrient content of soil, as well as the amount of sand, silt, and clay present.

Soil particles are nonliving, but are teeming with life, including microorganisms like bacteria and fungi, and larger animals such as worms and sowbugs. Many of these underground inhabitants feed on remains of plants and animals, breaking down their tissues. In the process, they aerate the soil and release nutrients that plants need.

You can learn which macro- and micronutrients are available in your soil and compare that with what is needed by plants for good development and growth. Soil tests will reveal pH levels, or measure the degree of acidity or alkalinity, of your soil. Maintaining a pH balance of your soil is essential to the health of your plants and influences the availability of essential nutrients in the soil. You should also have soil tested to determine levels of contaminants such as chemicals, pesticides, and lead, especially if the site is located near high-traffic zones. Contact your local Cooperative Extension Office for information on soil testing services available in your area.

Irrigation

While an automatic irrigation system is ideal for school gardens to keep up with watering throughout the growing season, the systems can be expensive and challenging to install. Watering can always be done the old-fashioned way, by using a hose. Take care to minimize water pressure so the soil doesn't loosen and drain away (you can attach a spray nozzle to diffuse the water spray), and take care not to drag the hose over plants.

Kids love water. Providing many smaller watering cans will allow students to participate in this task. Be careful not to flood walkways, which can present a safety hazard.

Test all water sources, other than municipal sources, annually for potentially harmful organisms. Ensure your water meets the standards of the Environmental Protection Agency (EPA). Contact your local Cooperative Extension Office for assistance. Use food-grade containers to transport water samples, and be sure to maintain water testing records annually.

IV Planting the Garden

Recommended Plant List

Each lesson in **Dig In!** features specific fruits or vegetables (or subgroup of vegetables) that were chosen because they have a relatively high success rate for growing in a school environment. These fruits and vegetables are also usually available in local markets, making it easy to supplement the school garden harvest to make sure all students are able to taste the produce. However, each lesson allows for flexibility if you'd like to substitute a different vegetable from that subgroup. The list of veggies below has been organized by their subgroups, but is by no means comprehensive. Visit <http://www.choosemyplate.gov> for a complete list of vegetable subgroups.

Planting instructions refer to frost-free dates. These are identified for each geographic area as an estimate of the first date (fall) and last date (spring) in which cold temperatures are likely to occur and cause damage to susceptible plants. You can find out your frost-free dates by contacting your local Cooperative Extension Office <http://www.nifa.usda.gov/Extension/>.

Important Note: Instructions in the **Growing Guide** are meant to provide general guidelines for planting. Since timing and basic care can vary by plant variety, always follow the planting instructions on the back of the seed packet.

DEFINITIONS

The following terms found on seed packets describe the growing cycle of the plant and will help you select the best plants for your school garden.

Take into consideration that perennials and biennials will likely require summer care when many schools are not in session. Depending on your climate, annuals may be chosen that will complete their growing cycle during the school year.

Annual

Completes its life cycle in one season and die after producing seeds (e.g., lettuce, kale, spinach)

Perennial

plant whose life cycle is longer than two seasons (e.g., strawberries, blueberries, fruit trees)

Biennial

plant that lives for two seasons (stores energy during the first season, produces seeds and dies the second). For example, some root crops like carrots and beets form the root in one season, and the flowering/seed-producing tops in the next season. However, we harvest the root for consumption prior to allowing the plant to flower.

Growing Guide

Vegetable/Fruit and Edible Plant Part	Planting Instructions		Basic Care Information			
	Spring	Fall	Planting Depth	Plant Spacing	Days to Germinate	Days to Harvest
DARK-GREEN VEGETABLES						
BROCCOLI (Lessons 1, 4, 7) Flower	SEEDS: Plant indoors 4-6 weeks before last frost date. TRANSPLANTS: Plant outdoors 3-4 weeks before last frost date.	SEEDS: Plant indoors 17 weeks before first frost date; transplant outdoors 12 weeks before first frost date. Protect from heat.	¼"	15"-18"	5-10	60-75
COLLARD GREENS Leaves	SEEDS: Plant directly in garden 3 weeks before last frost date; start seeds indoors 6-8 weeks before last frost date and transplant outdoors 2 weeks before last frost date.	SEEDS: Plant 10 weeks before first frost date.	½"	3"; thin to 6" apart once seedlings are a few inches tall	5-10	40
KALE (Lesson 2) Leaves	SEEDS: Plant indoors 6-8 weeks before last frost date; start seeds outdoors as soon as soil can be worked. TRANSPLANTS: Plant in garden 2 weeks before last frost date.	SEEDS: Plant outdoors 8 weeks before first frost date.	½"	4"; thin to 12"-18" when seedlings are a few inches tall	5-10	70-80
LEAF LETTUCE (Lessons 1, 2) Leaves	SEEDS: Plant indoors 6-8 weeks before last frost date; transplant outdoors 3 weeks before last frost date.	SEEDS: Plant outdoors 6-8 weeks before first frost date.	¼"	10"-12"	4-10	45-70
MUSTARD GREENS (Lesson 2) Leaves	SEEDS: Plant outdoors 3 weeks before last frost date and again 3 weeks later.	SEEDS: Plant 4-6 weeks before first frost date.	⅓" - ½"	3"-5"	5-10	45
SPINACH (Lesson 2) Leaves	SEEDS: Plant outdoors 4-6 weeks before last frost date.	SEEDS: Plant 4-6 weeks before first frost date.	¼"	4"	6-14	40-55
SWISS CHARD Leaves	SEEDS: Plant outdoors 2-3 weeks before last frost date.	SEEDS: Plant 6 weeks before first frost date.	1"	8"-12"	4-14	45-55
RED AND ORANGE VEGETABLES						
CARROT (Lessons 1, 6, 7) Root	SEEDS: Plant outdoors 3-4 weeks before last frost date; continue plantings every 3-4 weeks to stagger harvest throughout growing season.	SEEDS: In warmer climates, plant outdoors 13 weeks before first frost date. Protect from heat.	½"	½"	10-17	60-80

Vegetable/Fruit and Edible Plant Part	Planting Instructions		Basic Care Information			
	Spring	Fall	Planting Depth	Plant Spacing	Days to Germinate	Days to Harvest
RED AND ORANGE VEGETABLES (CONTINUED)						
PUMPKIN Fruit	SEEDS: Sow directly in garden after danger of frost has passed; in far north start seeds indoors 3-4 weeks before last frost date.	Fall planting not recommended.	1"	6 seeds in 2-foot-diameter mound; space mounds 3 feet apart.	7-10	90-130
RED AND ORANGE PEPPERS (Lessons 3, 5, 6, 7) Fruit	SEEDS: Start indoors 8-10 weeks before last frost date. TRANSPLANTS: plant outdoors after last frost date.	SEEDS: In warmer climates, plant indoors 20 weeks before first frost date; transplant outdoors 16 weeks before first frost date.	½"	10"-12"	8-20	80-100
TOMATOES (Lesson 3, 7) Fruit	SEEDS: Start indoors 6-7 weeks before last frost date. TRANSPLANTS: Plant outside when danger of frost has passed.	SEEDS: In warmer climates, plant indoors 20 weeks before first frost date; transplant outdoors 16 weeks before first frost date.	¼" - ½"	18"-24"	6-14	65-90
WINTER SQUASH Fruit	SEEDS: Plant indoors 3-4 weeks before last frost date. TRANSPLANTS: Plant outdoors when danger of frost has passed.	SEEDS: Plant outdoors 13 weeks before first frost date.	1"	6"; thin to 24"-36" as seedlings grow.	4-10	80-120
DRY BEANS AND PEAS						
CHICKPEAS (Lesson 1, 6, 7) Seed	SEEDS: Plant outdoors 4-6 weeks before last frost date.	SEEDS: Plant 4-6 weeks before first frost date.	¼"	4"	6-14	40-55
STARCHY VEGETABLES						
CORN Seeds	SEEDS: Plant outdoors when danger of frost has passed.	SEEDS: Plant 15 weeks before first frost date.	1½" - 2"	6" - 8"	3-10	50-100
GREEN PEAS (Lesson 7) Seeds	SEEDS: Plant outdoors as soon as soil can be worked.	SEEDS: Plant 12-13 weeks before first frost date. Protect from heat.	1"		6-15	60-80

Vegetable/Fruit and Edible Plant Part	Planting Instructions		Basic Care Information			
	Spring	Fall	Planting Depth	Plant Spacing	Days to Germinate	Days to Harvest
STARCHY VEGETABLES (CONTINUED)						
POTATOES Tuber	SEED POTATOES: Early varieties can be planted outdoors as soon as soil can be worked; cut seed potatoes so there are 2-3 eyes per seed; dig trenches 6" wide, 6" deep, and 30-36" apart.	SEEDS: Plant 15 weeks before first frost date.	4"	10"-15"	10-15	70-100
OTHER VEGETABLES						
BEETS Root	SEEDS: Plant outdoor 30 days before last frost date; continue planting every 3-4 weeks into summer.	SEEDS: Plant 8-10 weeks before first frost date.	½"	2"-4"	7-10	50-75
BRUSSELS SPROUTS Leaves		SEEDS: Plant 4 months before first frost date.	¼"-½"	3"-4"; thin to 14"-24" when seedlings are a few inches tall.	5-10	80-100
CABBAGE Leaves	SEEDS: Start indoors 50-60 days before last frost date. TRANSPLANT: Plant outdoors 2-3 weeks before last frost date.	SEEDS: Plant in garden 13-14 weeks before first frost date. Protect from heat.	¼"	18"	4-10	60-100
CUCUMBERS (Lesson 3, 6, 9) Fruit	SEEDS: Start indoors 4-6 weeks before last frost date; plant outside after the danger of frost has passed.	SEEDS: Plant 14 weeks before first frost date.	1"	12"-24"	3-8	60-80
GREEN BEANS Seeds	SEEDS: Plant outdoors when danger of frost has passed.	SEEDS: Plant 12 weeks before first frost date.	1"	6"-8"	4-10	55-65
GREEN & YELLOW PEPPERS (Lessons 9) Fruit	SEEDS: Start indoors 8-10 weeks before last frost date. TRANSPLANTS: Plant outdoors after last frost date.	SEEDS: In warmer climates, plant indoors 20 weeks before first frost date; transplant outdoors 16 weeks before first frost date.	½"	10"- 12"	4-10	80-100
ONIONS Root	SEEDS: Start indoors 8-10 weeks before last frost date. SETS: (TRANSPLANTS) more common, start outdoors 3 weeks before last frost date.	Not recommended for fall planting.	Seed: ¼" SET: depth of bulb.	4"-6"	4-12	60-90

Vegetable/Fruit and Edible Plant Part	Planting Instructions		Basic Care Information			
	Spring	Fall	Planting Depth	Plant Spacing	Days to Germinate	Days to Harvest
OTHER VEGETABLES (CONTINUED)						
RADISHES Root	SEEDS: Plant directly outdoors when temperatures are between 60-65 degrees (F) for optimal taste and growth.	SEEDS: Plant directly outdoors when temperatures are between 60-65 degrees (F) for optimal taste and growth.	¼"	1" - 2"	3-10	18-45 (Spring Varieties) 45-70 (Fall Varieties)
TURNIPS Root/Leaves	SEEDS: Plant in ground as soon as soil can be worked.	SEEDS: Plant 10 weeks before first frost date.	½"	2" - 4"	3-10	Varies; turnip roots/greens can be harvested at desired size throughout season.
ZUCCHINI (Lessons 1, 6, 7) Fruit	SEEDS: Indoors 3-4 weeks before last frost date TRANSPLANTS: Plant outdoors when danger of frost has passed.	SEEDS: Plant outdoors 13 weeks before first frost date.	1"	6"; thin to 24"-36" as seedlings grow.	4-10	50-70
FRUIT						
MELON (Lesson 9) Fruit	SEEDS: Start indoors 3-4 weeks before last frost date; plant directly outdoors, if your season is long enough, after danger of frost has passed.	SEEDS: Plant 15 weeks before first frost date.	1"	SEEDS: Plant 4" apart; thin to 2 feet apart when seedlings grow to touch each other. TRANSPLANTS: Plant 2 feet apart in rows that are 6-8 feet apart.	4-10	80-100
STRAWBERRIES (Lesson 8) Fruit	TRANSPLANTS: Plant outdoors in early spring when trees begin to leaf out.	TRANSPLANTS: In warmer climates, plant in September for spring harvest. Protect from temperature extremes with mulch.	So roots are just covered.	9"; as plants grow they send out "runners" which are daughter plants, clip off all but the healthiest five runners.	Transplants	Harvest strawberries the second year after planting. Berries will be ready about one month after the plants flower.

V Garden Maintenance

Gathering Support

It takes a village to grow and maintain a school garden. Fortunately, there are many ways to enlist help.

- Administrators can help find needed resources.
- Parent or family volunteers can form a garden team and increase the sustainability of the program.
- Teachers can collaborate or team-teach the garden program, which helps to spread the work across many people and increases the curricular integration of the gardens.
- Students can be involved in all stages of the process, whether through classroom activities or after-school clubs, and will feel empowered by the responsibility.
 - Let students help choose which fruits/vegetables will be planted in the garden. This will increase the likelihood that the students will want to taste them when it's time to harvest.
 - Relax your standards. While it is important to guide students on proper planting techniques, students' creativity and effort should not be discounted.
 - Allow students time to explore and enjoy their garden.
- Community volunteers can help maintain gardens. Reach out to your local Master Gardeners, Girl and Boy Scout troops, or school neighbors.

Planting Seeds

You can plant seeds directly outside, or you can start them inside and transplant the seedlings outdoors. There are a couple of advantages to starting plants indoors. Students are able to closely observe the germination process day-by-day, and it extends your growing season by allowing for "starter plants" indoors until the growing conditions outside are favorable. See the **Recommended Fruit and Vegetable List** (pp. 96-99) to identify the best method of starting seeds and/or transplants for your garden.

Here are some considerations when planning to start seeds indoors:

The seedlings' temperature tolerance Some seedlings, including salad greens and peas, are hardy and can tolerate cold temperatures, so you can plant them early in the spring, or in warmer climates, right through the winter! Others, such as legumes and green beans, aren't cold-hardy so you must wait to plant them until the chance of frost has passed. When you plant fall and winter gardens, wait until the temperatures cool before sowing (planting) seeds of heat-intolerant seedlings. Always follow the planting guidelines on the back of the seed packet.

Transplant Tolerance Seeds that germinate and grow better when sown directly into the garden include beans, lettuce, radishes, cucumbers, squash, and peas. Others are more successful if you start them inside (or purchase them at a garden center or nursery) for transplant into the garden, including tomatoes. There are still others that aren't fussy either way. This information should be detailed on seed packets.

LABELING

Have students choose a method of labeling their plants. One way is to write the plant name and date on masking tape and stick it to the outside of the container. This label usually lasts quite well. You might also use an upright label for quick reference, but these tend to get lost more easily.

Starting Seeds Inside

1. Use shallow containers (2" to 3" deep) with drainage holes.
2. Fill containers with a lightweight soil-less potting mix. These mixes are made primarily of ground peat moss and have been sterilized, so they are less apt than garden soil to contain weed seeds, fungi, and bacteria that may hamper growth. These mixes also provide good drainage with the aeration and moisture seedlings need.
3. Moisten the soil before placing it in containers. If you can squeeze a handful of the mix and water comes out, it is too wet and you'll need to add more of the dry mix. The ideal moisture level will feel like a well-wrung sponge.
4. Plant seeds according to the instructions on the packets. If you do not see instructions about how deep to plant your seeds, a simple rule is to plant them 1½ to 2 times deeper than the width of the seed.
5. Water after planting using the mist setting on a spray bottle.
6. Place trays in a location that receives 6 to 8 hours of direct sunlight or under fluorescent lights for 12 to 14 hours per day. Under lights, keep seedlings within 2 to 3 inches of the bulbs.
7. Most seeds germinate best in warm and humid conditions. Comfortable room temperatures (65 to 72 °F) are adequate for most seeds, but if your area is cooler, you can increase the soil temperature with a heat mat (type of heating pad used to increase the temperature of the soil in a seed tray).
8. Check daily to make sure the mix is moist. With the right conditions, most garden seeds should germinate in 7 to 14 days (unless otherwise noted on the seed packet).

Starting Seeds Outside

1. Prepare garden beds ahead of time.
2. Work with students to mark rows and beds, and then sow your seeds, following the instructions on the seed packet for planting depth and spacing between seeds.
3. After planting, water the bed using a gentle soaking spray. A strong stream of water may cause seeds to float to the lowest part of the garden. Check to make sure moisture penetrates a few inches into the soil by inserting your finger into the soil.
4. Encourage students to keep a close watch on the garden, and to keep the soil moist but not soaking, since excess moisture can cause seeds to rot.

COMPANION PLANTING

Some plants appear to perform better when grown near other specific plants. Growing plants near others that complement each other's growth is called "companion planting."

One example is a Three Sisters Garden. According to Iroquois legend, corn, squash, and beans are three "inseparable sisters" who must be close to each other to thrive.

Tall corn stalks provide support for the pole or climbing beans to climb. Beans convert nitrogen from the air into a form the corn plants can use.

Squash (such as trailing summer squash) is a low-growing plant that blocks out sunlight from weeds, inhibiting their growth. (See the student handout **Garden Companions** (p. 79) in Lesson 5 to learn more about companion planting.)

Other plants that are good "companions" are:

- **Spinach and peas and beans:** Peas and beans provide much-needed natural shade for the dark leafy greens.
- **Beets and leaf lettuce:** Beets add minerals, like magnesium, to the soil through composting their leaves which helps lettuces, and other leafy greens grow.
- **Tomatoes, peppers, basil or oregano (herbs):** These fruit plants require high humidity and benefit from shade, so they benefit from each other when planted together or with leafy herbs.
- **Marigolds:** These flowers produce an odor which naturally repels insects that can attack vegetable plants, which is why many farmers advise to plant them in a garden.

THINNING

If too many seedlings emerge in the same spot, consult the seed packet for information on proper spacing, and remove enough extra plants so the seedlings are spaced appropriately.

GERMINATION RATES

Most seed packets also list the germination rate. This indicates the percentage of seeds in the packet that are likely to germinate when planted according to directions. Even with a packet of the freshest seeds, germination is unlikely to be 100 percent.

Transplanting

Seedlings: When seedlings have three to four true leaves, you can transplant them into larger pots or into your garden. “True” leaves are the first set of leaves on a plant that will photosynthesize. The first pair of leaves that appears is the “cotyledons.” Have students observe the emergence of the plant’s leaves and alert you to when it is time to transplant.

If you plan to plant the seedlings directly into the garden, you first need to provide them with a transitional time called “hardening off.” Gradually expose the seedlings to the elements day by day. First, place them in a shaded area sheltered from direct wind, and bring them indoors at the end of the school day. Increase the seedlings’ sun and wind exposure a little at a time, and eventually leave them out overnight. Outdoor conditions also increase evaporation and transpiration, so make sure the potting mix doesn’t dry out! After a week or so, plant them in their final home.

For each transplant, dig the hole a bit bigger than the size of the root ball. If it’s available, mix in some compost. Slide the plant out of the pot carefully, holding the plant by its root ball or leaves rather than the stem. Place the plant in the hole, holding the plant so that it is the same depth in the hole as it was in the pot. Fill in with soil and water well.

Plants often look droopy after transplanting, but in a few days they should recover. Space out the plants in the garden according to the seed packet directions and the design of the garden. Remind students to water the plants according to the seed packet directions.

Watering

Your students will quickly learn that close observation of their plants will tell them when and how much to water. Water carries the nutrients in the soil to the plant’s roots, which then bring the nutrients to the plant. The amount of water each plant needs is based on the type of plant, what it’s growing in, and the amount of heat and light the plant receives. Mature plants generally need a little less water than young seedlings. All plants are happier if they are watered when they need it, rather than on a set schedule. Under normal conditions, plants require about 1 inch of water per week from rain or irrigation. The soil around a plant should be moist, but not too wet. Feeling the soil is one of the best ways to check when it is time to water. Simply poke a finger 1 inch into the soil; if it’s dry, it’s time to water. Water at the base of the plant rather than on the leaves to decrease the possibility of disease, and water in the early morning to avoid condensation on the leaves at night.

A plant will also signal its need for moisture by wilting. If you check the soil around a wilted plant and find it’s already wet, the plant might be suffering from a disease (e.g., fungal wilt). Let the soil dry a little and monitor the plant for a couple of days. If the plant still looks wilted, remove it and the soil around it to prevent the disease from spreading.

Weeding

What we call weeds are simply wild plants that are growing where we don't want them. Teach students how to identify the plants they want to grow, and the weeds they need to remove. It's best to remove these plants because they will compete with your plants for nutrients, space, light, and water. Pull weeds by hand or remove them by hoeing around your plants (scrape just beneath the roots of the weeds), staying far enough away from the base of your plants to avoid damaging the roots of your plants. With either approach, make sure the weeds' roots are completely removed.

Fertilizing

Depending on the condition of your soil and maturity of your plants, you may need to provide additional nutrients for healthy plant growth. Seedlings won't need to be fertilized until after three to four leaves have emerged. Then follow recommendations on the seed packet. Common signs of plant malnutrition include yellowing leaves and poor growth. You can add nutrients by applying compost, organic fertilizers (such as fish emulsion), or synthetic fertilizers such as slow-release pellets. But be careful: adding too much fertilizer can contribute to poor growth and plant diseases, nutrients in the fertilizer that are not used by the plants can pollute waterways and groundwater supplies, and applying liquid fertilizer or slow-release pellets may be hazardous if the directions on the label are not followed carefully. Only adults should handle fertilizers, following manufacturer's instructions. Label fertilizer containers clearly, and secure them in a safe and locked location when not in use.

Mulching

Gardens benefit from the addition of two to three inches of mulch atop the soil. Mulch helps slow water loss from evaporation, moderates soil temperatures, decreases soil erosion, and decreases the spread of soil-borne diseases. There are a number of different materials you can use as mulch, including shredded wood, straw, plastic, and newspaper.

- Make sure the mulch you choose does not inhibit movement or become a tripping hazard.
- Demonstrate for students how to place the mulch around plants gently so it does not damage stems.
- Use small tools to transport and spread mulch to avoid injury to students and plants.
- Avoid mulches, such as cocoa shell mulch, that can easily float into paths from rainwater runoff and create potentially dangerous obstructions.

PESTS AND DISEASE PROBLEMS

Insect and disease problems are easiest to control when caught early. Check your plants regularly for common plant pests like aphids, grubs, and caterpillars. If you find them while their numbers are small, you can keep their damage in check by using a high-pressure spray of water from a hose or removing them by hand. Watch out for spots on leaves, which are signs of fungal and bacterial diseases. Remove spotted leaves and throw them away (never place diseased material in a compost pile, because the pathogens may remain to pass infection on to other plants).

Regular, close observation of your plants should prevent problems from escalating. Never use any pesticides or herbicides in the school garden. Check with your local Cooperative Extension Office for nonchemical alternatives, and local health department about applicable Occupational Health and Safety Administration (OSHA) hazard communication requirements.

For more information visit:
<http://www.osha.gov/dsg/hazcom/index.html>.

CELEBRATING THE HARVEST

See Lesson 10 (p. 62) for a list of ways to celebrate the harvest, as well as students' accomplishments – from a small and simple class party to a school- and community-wide event!

Harvest Guide

Here is a list of fruits and vegetables with a brief description of how to determine when they are ready for harvest and how to harvest them. This is one of the most satisfying steps in gardening. When this time comes, demonstrate for the students how to safely and correctly harvest each crop and allow the students an opportunity to participate. Some produce are best harvested using a knife or other sharp tool. This requires close attention from the teacher and one-on-one instruction to ensure student safety. If this is not a possibility, students should refrain from harvesting such produce. Be sure to use clean harvesting tools.

Broccoli Head is made of tight green buds. Use a serrated knife to cut heads from plant.

Collard Greens Cut individual leaves when they are young and tender and approximately 10 inches long using scissors or pruners.

Kale Harvest individual leaves when they are at least 3 inches long; entire plant can be harvested by cutting at about 2 inches above the soil using pruners or scissors.

Leaf Lettuce Pick/cut individual leaves at any time before the plant flowers using scissors or pruners.

Mustard Greens Individual leaves or the entire plant can be harvested when the leaves are young and tender using scissors or pruners.

Spinach Harvest individual leaves when they are big enough to eat.

Swiss Chard Harvest when leaves are about 6 inches tall using a scissors or pruners to cut leaves at the soil level.

Carrot Harvest when the orange “shoulders” show above the dirt. Gently pull on the base of the stem, just above the root to harvest.

Pumpkin Ripe fruit will have a deep skin color and will make a hollow sound when thumped. If the skin resists puncture when pressed with a fingernail it is ready. Use pruners or scissors to cut the pumpkin away from the rest of the plant.

Tomato Ready for harvest when the fruit develops its full color. Pick individual tomatoes from the plant by hand.

Winter Squash Ready for harvest when fruit is 5 to 8 inches long. Pick individual fruit from plant, leaving the remaining plant to produce more fruit throughout the season.

Chickpeas For fresh eating, harvest beans when pods are still green. These can be eaten raw or cooked. For dried beans, harvest entire plant after leaves have turned brown and withered. Set plants on a flat, warm surface. Once pods have split open and the beans dent slightly when bitten, they are dry enough and ready to be collected. Dried chickpeas (garbanzo beans) can be stored and then prepared for consumption.

Corn Ears should be completely filled with kernels, kernels should produce a milky white liquid when pierced if ready for harvest. Cut each ear from the stalk to harvest.

Green Peas Pods are plump and the seeds are almost full size. Use scissors or fingers to remove the pods from the plant.

Potato Plants begin to turn yellow and wither. Use a small shovel to gently dig up potatoes for harvest.

Beet When the rounded “shoulders” of the beet root appear just above the soil line and are about 1 to 2 inches in diameter, it is time to harvest. Gently pull on the base of the stem, just above the root to harvest.

Brussels Sprouts Pick/cut sprouts from the stem when they are about 1 to 2 inches in diameter.

Cabbage Head should be at least softball-sized and firm. Cut head from stem using a serrated knife; discard outer leaves.

Cucumber Cucumbers are ready to harvest when they are large enough to be pickled/sliced (approximately 5 to 6 inches). Separate the fruit from the plant taking care not to break stems of plant. Harvest regularly so plant will continue to produce fruit.

Green Beans Beans are 3 to 4 inches long and crisp. Pluck individual beans from plant, taking care not to damage stems remaining on the plant.

Onions The foliage begins to turn yellow, and the visible bulb is thumb-size for green onions, and baseball-size for bulb onion. Gently pull on the base of the stem, just above the root to harvest.

Peppers Pick individual fruit from the plant when it is firm and full in color.

Radishes Radishes are the size of a quarter; gently pull on the base of the stem, just above the root to harvest.

Turnips Dig turnips up from the ground at any size during the growing season.

Zucchini It is ready for harvest when fruit is 5 to 8 inches long. Pick individual fruit from plant, leaving the remaining plant to produce more fruit throughout the season.

Melons Fruit produces a hollow, dull sound when thumped. Use a pruners to cut the fruit away from the rest of the plant.

Strawberries Fruit is ready when it is completely red; pick fruit by pinching the stem with your finger and thumb about a half-inch behind the berry.

Collaboration

Summer Maintenance:

Maintaining a school garden during the summer can be a challenge. Here are a few tips to make your garden survive those lonely months:

Use Mulch A thick layer of mulch reduces weed growth, maintains soil moisture, and enriches the soil as it decays. You can use inexpensive organic mulch such as newspaper topped with straw.

Install Irrigation Drip-irrigation equipment is available at most home improvement stores for a reasonable price and you can set it up to run on inexpensive timers.

HARVEST SAFETY

Harvest is an exciting time in the garden!

Students get to literally taste the fruits of their labor.

Before handling or tasting food, make sure students wash their hands, and if students are ill, they shouldn't handle the produce. Even if the food looks clean, or it has rained recently, all fruits and vegetables should be thoroughly rinsed under running water prior to tasting.

Check with your local health department for food preparation policies and procedures. Also, find out if the food grown in your school garden may be used for student tasting or serving in school meals. For more information, download Food Safety Tips for School Gardens: <http://www.nfsmi.org/documentlibraryfiles/PDF/20110822025700.pdf>

ONLINE RESOURCES

U.S. Department of Agriculture (USDA)

- *Healthy Meals and School Gardens – Team Nutrition:* <http://healthymeals.nal.usda.gov/resource-library/school-and-preschool-gardens/school-garden-resources>
- *The People’s Garden Grant:* <http://www.nifa.usda.gov/fo/peoplesgardengrantprogram.cfm>
- *Food Safety Tips for School Gardens:* <http://www.nfsmi.org/documentlibraryfiles/PDF/20110822025700.pdf>
- *U.S. Plant Hardiness Zone:* <http://www.usna.usda.gov/Hardzone/>
- *U.S. National Arboretum Gardening Tips:* <http://www.usna.usda.gov/Gardens/gardeningr.html>
- *Cooperative Extension System Offices:* <http://www.nifa.usda.gov/Extension/>

Many Hands Enlist the help of parent volunteers or service organizations such as the Future Farmers of America, Master Gardeners, 4-H, Scouts, and church youth groups. Create a schedule to ensure that someone checks the garden on a regular basis.

Work With a Summer Camp Many schools offer summer classes or kids’ camps. See if they are interested in taking advantage of your outdoor classroom facilities during the summer months.

Harvest in the Spring Pick as much of your harvest as you can before you leave for the summer. Remove all the plants and then do one of the following:

- **Cover the Soil** Cover your garden with a thick layer of mulch to discourage weeds and decrease water loss.
- **Plant a Cover Crop** A cover crop is a short-lived legume (e.g., beans) or grain (e.g., buckwheat) that you plant to prevent weeds, reduce soil erosion, and boost organic matter. Check with your State’s Cooperative Extension Office for cover crop ideas for your area.

Fall Maintenance:

Unless you live in a climate where you can garden outdoors during the winter months, you will put your garden “to bed” once your harvest is complete. Remove garden plant debris so it won’t harbor pests and diseases that could re-emerge the following year. Plant a cover crop to avoid erosion and weed invasion during the winter. Contact your local Cooperative Extension Service or area nurseries to learn about recommended cover crops and planting times for your area.

Winter Maintenance:

Winter plant maintenance typically refers to indoor plants. Here are some ideas for helping the plants tough it out for a few weeks so they’ll be there to enjoy upon return from holiday breaks:

- If there will be no heat, move plants away from the windows. Although they will get less light, they are more likely to survive light stress than freezing temperatures. Heating mats may be an option, but they should not be left on for long periods of time.
- If your plants are sensitive to low light levels (i.e., vegetables), place them under a grow light with an automatic timer so the lights will continue to turn on each day.
- Do not fertilize the plants before leaving. Fertilizing the plants will cause them to spend energy on new growth and increase their stress.
- If you usually water your plants once a week, water them thoroughly before you leave and they’ll probably survive for a second week. If your plants require more frequent watering, you may want to:
 - Set up a slow-drip watering system.
 - Repot plants into larger containers (although not too large). The additional soil will hold more water for the plants to access.
 - Make a tent around the plants using clear plastic to increase the humidity level and slow water loss due to evaporation.

REFERENCES

- Allow students to take plants home to care for over the break. Be sure to send home an information sheet with care instructions.
- If you're growing annual plants such as salad vegetables, plan to harvest them before the break. Start fresh with a new crop when you return.

Working With Volunteers*

Cultivating people is as important for school gardens as cultivating the soil. A successful garden requires much more than simply coordinating and directing activities. People must feel that they themselves grow in the garden. Here are some ideas for how to build this spirit of ownership:

Community Work Day When the garden has a big task approaching (e.g., preparing the beds for spring planting/cutting back for fall/building raised beds), invite the community to share in the work. Tasks will get done faster and the event turns into a great social occasion.

Acknowledgment Recognize community members who contribute to the garden. Let them know they were important to its success and the education of the students.

Local Experts Find out which parents have gardening knowledge/skills and invite them to share their expertise with the students. Check to see if your community has a Master Gardener program in the area. Master Gardeners are agricultural extension volunteer programs with individuals who are dedicated to teaching their fellow community members about gardening.

Working With Students Not all garden tasks require leading groups of students or being available at a certain time of the school day. When seeking volunteer support, provide a list of tasks that involve working with the class during the school day and a list of tasks that do not.

Communication Hang a message board in the toolshed/storage facility/greenhouse. Encourage volunteers to keep track of what garden tasks they performed when they were in the garden. Also keep emergency contact information at this location. Some additional ways to promote communication are through an email list/phone tree, a newsletter, and a Web page.

Continuation Add a new element to the garden each year and allow all those involved with the gardens to contribute to its growth and success.

***Note:** *Ensure that volunteers are covered by the school district insurance policy in the event of accident or injury.*

VI Additional Resources

Finding resources you need to begin and maintain a school garden can be challenging, but it doesn't need to be a roadblock. Start a garden committee to help drum up support and involve community members. Apply for grants, host fundraisers, or start a youth garden business – get together with your students and committees to come up with creative ideas!

- DeMarco, L., P. D. Relf, and A. McDaniel. 1999. Integrating gardening into the elementary school curriculum. *HortTechnology* 9(2):276-281.
- Klemmer, C. D., T. M. Waliczek, and J. M. Zajicek. 2005. Growing minds: The effect of a school gardening program on the science achievement of elementary students. *Hort Technology* 15(3):448-452.
- Lineberger, S. E., and J. M. Zajicek. 1999. School gardens: Can a hands-on teaching tool affect students' attitudes and behaviors regarding fruits and vegetables? *Hort Technology* 10(3):593-597.
- Lohr, V. I., and C. H. Pearson-Mims. 2005. Children's active, and passive interactions with plants influence their attitudes and actions toward trees and gardening as adults. *Hort Technology* 15(3):472-476.
- McAleese, J. D., and L. L. Rankin. 2007. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *Journal of the American Dietetic Association* 107(4):662-665.
- Morris, J.L., and S. Zidenberg-Cherr. 2002. Garden-based nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. *Journal of the American Dietetic Association* 102(1):91-93.
- Skelly, Sonja M. and Jennifer C. Bradley. 2000. The important of school gardens as perceived by Florida elementary school teachers. *Hort Technology* 10(1):229-231.
- Smith, L. L., and C. E. Motsenbocker. 2005. Impact of hands-on science through school gardening in Louisiana public elementary schools. *Hort Technology* 15(3):439-443.
- Waliczek, T. M. and J. M. Zajicek. 1999. School gardening: improving environmental attitudes of children through hands-on learning. *Journal Environmental Horticulture* 17(4):180-184.