Growing School Gardens:

A How-to Guide for Beginning Desert School Gardens in Tucson

Produced for

Farm to Child Program

Community Food Resource Center

Community Food Bank of Southern Arizona

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Introduction

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Do you find yourself imagining a garden at your school? Do you envision the possibilities that could unfold from first graders devouring fresh radishes, fifth graders tending chickens, or 10th graders turning a compost pile?

This toolkit was created to help you grow the best community-supported school garden possible. We will walk through the basics of creating a community-supported school garden, from organizing to the first dig to managing an aquaponics system. There's a great deal of information and resources here, but start small. (School gardens never are fully functional farms in their first season. Frankly, that's like expecting June in Tucson will be humid.) Like with all K-12 efforts, keeping the greater purpose in mind is crucial, but a school garden will only prosper if each seed is planted with care in fertile ground.

There will be times when pests and problems prevail; there will be times brimming with bumper crops and blossoming students. Keep digging, keep composting, keeping sowing the seeds! Soon enough the garden will flourish, transforming the school and community as it grows.

There are a plethora of (school) gardening resources available in Tucson, in part thanks to the Farm to School Movement and the many amazing food, ecology, and justice oriented Pima County organizations and businesses. Use them! Find seasoned gardeners and farmers within the school community and ask them to lead or be part of the garden production. Reach out to parents who work in construction, wood-working, and carpentry for help in building your chicken coop, tool shed, gathering spaces, etc. Always remember that a school's assets are not just the money it has, but it's network and the ability of that broader community to help out even in small ways.

So now that you have this toolkit, let's grow a school garden!

School Gardens can:

- Be the catalyst to bring a community together and to save a school
- Increase enrollment
- Support the holistic success of students, especially those with behavioral and developmental complexities
- Provide safe havens for students and ecosystems
- Ground any curriculum - from Physical Education to Writing, Chemistry to Art, Cultural Studies to Math.
- Restore soil health, alleviate water table stress and urban water management problems
- Create ecological sanctuaries amidst (urban) development

What is the Farm to School Movement?

In a time when carrots - orange and baby sized - come out of sealed plastic bags, the Farm to School movement is unwrapping the mystery around the origin of food. This movement's main goals are to help sprout school gardens across the country, support local farmers, and advocate for locally grown produce to be incorporated into school meals.

School Gardens have existed in the United States since the early 1900s, with the first appearing outside of Boston around the turn of the century, John Dewey and Maria Montessori, two people who were highly influential on the modern educational system, described combining agriculture and school as a way to help children understand themselves and the world around them.[3]

Approximately 29% of children in Arizona are food insecure.

Using school gardens as a way to produce food was seen as a patriotic duty during the First and Second World Wars, and then as a reform strategy during the 'war on poverty' and as part of the environmental movement. From World War 2 to today, school gardens have coexisted with the rise of industrial agriculture, which is highly subsidized and highly dependent on chemical pesticides and large scale, monocrop commodity farms. "According the 2002 U.S. Census of Agriculture, the number of small farm decreased about 4% between 1997 and 2002. Farms with sales under $2,500 (the smallest category) and those over $500,000 (the largest farms) increased in number, but farms with sales in all categories between $2,500 and $499,999 decreased in number."[4] Losing such a significant job base and market could be crippling not just economically, but as more and more environmental problems and food safety issues arise as a result of problems unique to industrial agriculture. Small and medium sized farms are turning towards alternative markets. These farms present an opportunity for schools and districts to support their local community and increase their food security.

Food security is a newly defined concept used to describe a community's ability to have access to sufficient food that is safe. Food safety is defined as not being vulnerable to foodborne diseases, contamination from harmful bacteria like E. coli, and disruptions in the food chain due to economic instability (rise prices of goods as well as gasoline for food transport). Here at the Community Food Bank, the Community Food Resource Center works towards food security through it's multiple outreach programs. The CFRC also works towards building "food sovereignty," a concept that describes a person or a community's ability to access and control food from an equitable, regional, culturally appropriate food system. The Farm to School Movement is one way to increase both food security and sovereignty in a way that addresses the needs and self-reliance of Tucson's low income communities.

The Farm to School Movement actively works to reduce childhood obesity, food insecurity, and academic performance. Research is showing more and more that students exposed to gardens have "a significant and lasting increase in knowledge and preference for vegetables" and teachers perceive gardens to be "'somewhat to very effective at enhancing academic performance, physical activity, language arts, and healthful eating habits.'"[5] This becomes particularly pronounced when school gardens are integrated into basic education.

Garden-based learning and curriculum addresses the following key areas:

- -Academic development: Gardens provide hands-on, experiential learning particularly in science and maths, as well as language arts and visual arts skills
- -Personal development: Schools can observe the mental and physical effects of a new learning environment, including an improved diet through access to fresh fruits and vegetables and increased sense of community
- -Social and moral development: Gardens provide a very practical way to teach sustainability and environmental education. They also provide avenues to support students as they learn responsibility, hard work, and a respect for their environment (public and private).
- -Vocational skills: Teaching gardening skills at an early age is one way to teach basic vocational skills as well as instill a certain kind of knowledge so that the students are able to produce food later in life, either for subsistence or trade.
- -Life skills: Gardens provide an opportunity to talk about nutrition, plant anatomy and physiology, community service, and environmental care. They also can help enhance students leadership and decision-making skills.[6]

Many Farm to School programs provide health and nutrition education opportunities through "Taste Tests" as well as curriculum development. With childhood food insecurity and obesity prevalent across the country[1], this movement can be the gateway to revitalizing our students. Increasing fruit and vegetable intake has been shown to be beneficial for both the health/wellness of children[2] and their academic performance.[3]

In Tucson's largest district, approximately 51,000 students eat school lunch every day in 94 schools, with approximately 70% of students district-wide eligible for free and reduced lunch. The Community Food Bank's Farm to Child program (FTC) is one example of how the Farm to School movement has engaged with Tucson schools.

So far, FTC has helped launch and support 15 school gardens that are run by students, teachers, parents, and school staff. FTC is currently working with TUSD Food Service on increasing the ability of individual schools to use their garden produce in their cafeteria. Additionally, TUSD Food Service is increasing it's nutrition education resources through school gardens and the amount of local food purchased for the district's school lunches. As more schools establish their own gardens and advocate for fresh local produce in school meals, the better off Tucson's students will be - the *greater* Tucson's future will be.

Strategizing to Grow your Community

1. Establish a school garden, particularly with the help of teachers and school staff. Integrate the garden into the basic school curriculum and use the produce from the garden in school meals.

2. Ask the School Garden Committee to contact the Arizona Department of Education, your school district and school board, and government representatives to advocate for policies that increase local food availability in your school district and support school gardens. Letters to and meetings with representatives are very important. The more we exercise our democratic rights, the more we are heard, the more our needs are addressed.

3. Organize a field trip to a farm, urban or rural, for students at your school. Have students talk to the farmer(s) and learn about how food is grown.

4. Host an event for parents, school staff, teachers, and/or students to envision the ways school lunches and school environments could improve. These issues are directly connected to the conditions at the school, within your neighborhood and community, city, state, country, and the world. By the end of the event, come up with a next action step. Does a group of people write a letter? Do you have a potluck party that celebrates native foods? Can you create a goal/plan to raise funds or find tools for a school garden?

5. Model healthy eating behavior. Whoever you are, regularly sitting with students during a meal and showing how you choose healthy options (a salad, a piece of fruit, skipping a desert) can go a long way to changing students perception of health and eating behavior. If you are a cafeteria staff, encourage a handful of students in each class or lunch period to choose (and eat!) the fruit or vegetable option, or, if possible, the food from the garden.

Reference Guide

1. Desmond, Daniel, Grieshop, James, and Aarti Subramaniam. "Revisiting Garden Based Learning in Basic Education: Philosophical Roots, Historical Foundations, Best Practices and Products, Impacts, Outcomes, and Future Directions." IIEP/FAO SDRE Food and Agricultural Orignization, United Nations and UNESCO International Institute for Educational Planning. October 2002 (21).
2. Joshi, Anupama, Misako Azuma, Andrea, and Gail Feenstra. "Do Farm-to School Programs Make a Difference? Findings and Future Research Needs." Journal of Hunger & Environmental Nutrition, Vol. 3(2/3) 2008 (231).
3. Ibid.
4. Approximately 29% of children in Arizona are food insecure (8% more than the national average) and this has increased approximately 5% since 2006. Feeding America. "Map the Meal Gap: Child Food Insecurity 2012" http://feedingamerica.org/hunger-in-america/hunger-studies/map-the-meal-gap/~/media/Files/a-map-2010/2010-MMG-Child-Executive-Summary-FINAL.ashx (10) and Feeding America. "Child Food Insecurity in the United States: 2006-2008" http://www.azfoodbanks.org/images/uploads/Child%20Food%20Insecurity%202006-08.pdf (4).

"Food security—defined informally as access by all people at all times to enough food for an active, healthy life—is one of several conditions necessary for a population to be healthy and well-nourished. Food insecurity, in turn, refers to limited or uncertain availability of nutritionally adequate and safe foods, or limited or uncertain ability to acquire food in socially acceptable ways." (3) Food security and insecurity is measured through the USDA Economic Review Service's Food Security Scale 18 question survey. Childhood food security and insecurity is measured through the Children's Food Security Scale and determined by answers to 8 of the 18 questions in the FSS. "Families with children, especially those with young children, are the group most likely to be food insecure. In turn, children whose families are food insecure are more likely to be at risk of overweight (>85% weight-for-age) or obesity as compared to children whose families are food secure. Children experiencing child food insecurity, the most severe level of food insecurity, are at even greater risk of being overweight, and this trend has definitively begun by the preschool years (ages 3-5)."(16) It is important to note that households experience periods of, sometimes chronic, food security or insecurity. Food security and insecurity exist in a continuum and are tied to poverty levels as well as access to adequate social safety net services. Feeding America. Cook, Jeng and Karen Jeng. "Child Food Insecurity: The Economic Impact on our Nation. A report on research on the impact of food insecurity and hunger on child health, growth and development commissioned by Feeding America and The ConAgra Foods Foundation " May 29, 2009. http://feedingamerica.org/hunger-in-america/hunger-studies/child-food-insecurity-econ-impact.aspx.

According to the Center of Disease Control and Prevention (CDC), childhood obesity currently affects approximately 12.5 million children and teens (which translates to 17% of U.S. children and teens). Environmental determinants include food consumption habits, physical activity levels, and television viewing levels. CDC. CDC Grand Rounds: Childhood Obesity in the United States. *Morbidity and Mortality Weekly Report*. January 21, 2011. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6002a2.htm

2. Florence MD, Asbridge M, Veugelers PJ. Diet quality and academic performance. Journal of School Health. 2008; 78: 209-215 http://www.actionforhealthykids.org/assets/pdfs/journalofschoolhealth.pdf.

It should be noted that the Arizona Department of Education participates in the newly established USDA Fresh Fruit and Vegetable program which provides participating schools with more funding to increase student intake of fresh fruit and vegetables during school meals. Eight TUSD schools take part in this program for the 2012-2013 school year. http://www.azed.gov/health-nutrition/files/2012/06/selected-ffvp-schools-sy13-web_revised.pdf.

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Seeds and Starts

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Community Roots First

The Garden Team

Starting a school garden can be a wonderful way to build community and leave a lasting multi-use resource for a school. For your school garden to thrive, the effort should involve members of the larger school community from the start. This will help ensure that the garden will be continually cared for and used! The first step should be to set up a Garden Committee or Team.

The Garden Team

The Garden Team will be the group of people most dedicated to the garden. As much as possible, members of the team should be able to commit to working in the garden regularly. The Garden Team can also function as the main organizing body: for example, the team will make decisions on what is planted, garden expansion, and events for the garden - from fundraisers to garden work days to harvest celebrations. Members will be responsible for helping the garden continue, especially when there are changes within the community. Most importantly, the team will be the core of the garden and should be members of the school community.

Start building the team by reaching out to School Staff, Teachers, and Parents! People may surprise you and their motivations for being involved will be very diverse. Encourage individuals who have gardening experience to step forward and lead. Be respectful of individual's interests and abilities and always extend the invitation to those who are interested. The team most certainly should grow! Once you have your core group set, we recommend you meet at least once monthly to go over any progress or challenges that have emerged. The team should be in constant communication with school teachers, volunteers, and parents to increase school wide engagement with the garden. As your Farm to School efforts expand, the Garden Team should be responsible for communicating and coordinating with your cafeteria staff and food services on the district level (or school administration level, if most appropriate).

School Administration

Before the first seed can be planted, it is extremely important to have the school staff on your side. Start with the school principal. Pitch the idea to start a school garden and emphasize how integral the community will be. Hear any concerns or visions for the garden the principal may have. Make sure that you only proceed once school administration and/or district level administration has agreed to the project, either as a trial or a permanent fixture to the school grounds. Stepping on their toes may hinder the longevity and your ability to start the garden in the first place.

School Custodial Staff

Your school's custodial staff should be approached next. Because of their extensive knowledge of the grounds, custodial staff often can help determine the best location for the garden, may even have gardening experience and a desire to be involved in the project. Reaching out to the staff before you dig ground will be one step to showing respect and increasing the likelihood the school community on the whole will be good stewards for the garden. The last thing anybody wants is for the garden to fall to the wayside, become viewed as a nuisance, and unfairly left to custodial staff to clean up. Custodial staff can help keep an eye on the garden, particularly during vacation periods, and make sure it is running smoothly, like the rest of the school.

School Teachers

Another key group to engage would be your school's teachers. If teachers are involved from the beginning, it will be help increase student involvement in the garden. Teachers are uniquely positioned to empower many of their students to take ownership in the garden. Creatively integrating the garden into their curriculum will go a long way to reinforce the garden-based

The Garden Team

knowledge the students develop and has been shown to have many positive educational and behavioral effects. The many reasons for garden integration will be discussed in the Curriculum Resources chapter.

Parents

Garden team members can be parents! Maybe the PTA/PTO at your school can be a major supporting organization. Or, if your school does not have a PTA/PTO, the garden may be a new way to engage parents. Parents can be great partners in after school programming, event planning, fundraising, during work days, harvesting and marketing school garden produce, etc. Most likely, when you start the school garden project, your cafeteria will not yet be able to handle garden produce. Getting parents involved will increase the likelihood students will be receptive to eating fresh food from the garden, at home or at school. Parents are often behind the scenes, but deeply influential members of a school community.

Cafeteria Staff

Whether or not they can be directly involved in the garden, the cafeteria staff definitely need to be approached early as you begin to establish the school garden. If you have any desire for students to run the compost system every day or if you want the garden produce to be used in the cafeteria, the staff need to know that the garden exists and that it is there for their benefit too. Many times, like the custodial staff, cafeteria staff are ignored until long after the garden has been established.

Cafeteria staff see the way the students eat and know first hand how chaotic lunch can sometimes be. The presence of school garden produce in the cafeteria, however, has been shown to increase the willingness of students to eat their vegetables at lunch,[1] which we know improves their behavior and academic achievement. But you need wholehearted staff support in any Farm to School effort.

School gardens, at their best, function in a way that helps everyone in the school. They should be a unifying place for the entire community.

Incorporating a salad bar with fresh produce into the cafeteria as part of a Farm to School program has been shown to increase student fruit and vegetable consumption.[1]

Deepening Relationships

Sometimes it's hard to get people involved. Everyone is busy and, usually, cannot imagine taking on one more responsibility. Sometimes you'll face individuals who cannot see the benefit of a school garden or think it will cause more problems. So when you are approaching someone to tell them about the school garden idea or if you are trying to recruit someone to the Garden Team, there are few key things to keep in mind:

1. Listen. Hear what the other person is saying. Listen for the answers to questions like: why are they interested? What are their concerns? What are they excited about? What are their limitations? Be as supportive as possible.

2. Do your research. Have some cool and exciting bits of information about the promise of school gardens handy. And if someone has a question or concern for you, do your best to answer it.

3. Show off the progress you've made already with the garden and garden team or take whoever it is to a currently fully operational school garden. There are many schools that have model gardens: Manzo and Davis Bilingual, for example, have two very different programs but equally impressive gardens. They are both inspiring examples of school garden potential. Sometimes people just need to see a transformed place to believe it could possible within their own community.

4. Make sure each community member, however they are involved, feel supported, connected, and appreciated. The more mutual respect is shared, the stronger the community bonds will be and the longer the garden will grow.

Reaching Out, Reaching In

School Gardens benefit immensely from community support and partnerships. Many Tucson businesses and organizations provide grants and may donate supplies or help in fundraising efforts for school garden programs. If you have any businesses or organizations near your school, reach out to them! They may surprise you in how they are willing to support your garden. To get you started, here is a list of current grants available for Tucson gardens. (Grants marked with * are national funding sources.) This list will continuously change, so keep your eyes out for others!

Grants

Arizona Commission on the Arts—azarts.gov/grants/organizations-and-schools/

Arizona Farm Bureau Scholarships—azfb.org/public/469/programs/scholarships

Arizona Fish and Wildlife Heritage Grants—azgfd.gov/w_c/heritage_apply.shtml

For: Environmental Education, Outdoor Education, Schoolyard Habitats, Urban Wildlife and Habitat

Arizona State Forestry Division: Community Challenge Grant Program—

azsf.az.gov/grant_information/default.asp

Bookman's School Challenge Grant—bookmans.com/community/school-challenge

Captain Planet Foundation*—captainplanetfoundation.org/apply-for-grants/

Community Food Projects Competitive Grants Program*—csrees.usda.gov/fo/fundview.cfm?fonum=1080

Education Enrichment Foundation Tucson—eeftucson.org

Fuel Up to Play 60*— school.fueluptoplay60.com/funds/introduction.php

Kids Gardening Grants*—grants.kidsgardening.org/

Garden Tool Co.*—gardentoolcompany.com/giveaway

Home Depot Foundation Grants*—homedepotfoundation.org/page/grants

Kids in Need Foundation—kinf.org

Lowes Toolbox for Education Grant*—toolboxforeducation.com/

Native Seed Search Community Seed Grant—nativeseeds.org/index.php/resources/communityseedgrants

National Education Association*—neafoundation.org/pages/grants-to-educators/

Tucson Cactus and Succulent Society School Grant—tucsoncactus.org/html/school_grants.html

Tucson Conquistadores—tucsonconquistadores.com/funding-info-application

Tucson Pima Arts Council—tucsonpimaartscouncil.org/grants/opportunities/

Whole Foods*—wholekidsfoundation.org/gardeninggrants.php

Be Creative

There are countless ways to build partnerships with organizations and businesses in Tucson.

Companies in Tucson may be willing to donate or help purchase garden supplies. Some may be looking for new programs to fund through grants or other charitable donation opportunities. Many coffee shops, for example, will donate their coffee grounds to you for your compost or vermicompost systems. It never hurts to inquire and if funds aren't available now, they may be in the near future.

Don't forget to reach out to your school community. Family members may have connections to other organizations, resources, or skills.

"Permaculture is a way to live sustainably in a region for many generations, taking care of people and taking care of the environment at the same time… As Permaculture designer, we study the patterns found in nature and the lessons found in natural ecosystems. We mimic these patterns in designing sustainable home sites, farms, and neighborhoods, as well as less tangible structures like community economics and food distribution systems."[xx]

Tucsonans To Know

Some organizations do not necessarily offer grants but do offer other services that may be helpful to you, like trainings, field trips, or access to supplies. In the "Start Digging!" chapter, more organizations and resources are listed that are specific to particular garden components.

Relationships

Arizona Cooperative Extension—Focused on agriculture in Pima County and provide resources for farmers—extension.arizona.edu/pima

Arizona Native Plant Society Tucson Chapter– Extensive resources on native plants, including information on species, native pollinator plants, Arizona trees, and native plant nurseries.—aznps.com/chaptes/tucson.php

Arbico Organics—Sells organic gardening supplies and offers pest management solution trainings—arbico-organics.com

Community Food Bank of Southern Arizona, Community Food Resource Center—Free garden-related workshops, seeds for our partner schools, shade cloth at $0.50 a foot.—communityfoodbank.org/programs-services/alphabetical-list/farm-to-child.

Desert Harvesters—Produced resources for working/cooking with and workshops on native, desert foods.—desertharvesters.org

Native Seed/SEARCH—Dedicated to conserving and distributing agricultural seeds and wild relatives from the Sonoran Desert region. Provide seeds and workshops.—nativeseeds.org

Pima County Seed Library—Provide free seeds and classes on seed saving.—library.pima.gov/seed-library/

Sonoran Permaculture Guild—Provide course, workshops, and trainings on designing, building, and growing gardens here in Tucson.—sonoranpermaculture.org

Tohono O'odham Community Action—To see how Farm to School Programs a run on the Tohono O'odham reservation—tocaonline.org

Tucson Botanical Gardens – Provide classes and youth education opportunities.—tucsonbotanical.org

Tucson AquaPonics Project— Wealth of resources and messageboards on all things aquaponics.—tucsonap.org/

Westwind Seed—Specializes in heirloom and open-pollinated fruits and vegetables, as well as designing desert gardens here in Tucson — westwindseeds.org

Notable Persons

Lindsay Aguilar—Tucson Unified School District, Food Services Department, Dietitian and Coordinator with Community Food Bank's Farm-to-Child Program

Sallie Marston—University of Arizona, Geography Program, Community and School Garden Project

Ashley Schmike—Arizona Department of Education, Farm to School Specialist

Planning Tips to Help your Garden Grow

So you've got your Garden Team and recognition from your school administration that a school garden is in the works. The next question is: where will your garden grow? There are some basic requirements that make certain locations better than others. Here are some questions to help you assess what kind of location or which area would be ideal for your team and school community. There are, however, many right answers!

Location Assessment Questions

1. How close is the potential garden area to the school building and cafeteria? Could students get to the garden easily from within the school grounds? Is it accessible during recess? What about during weekends or vacation periods?
2. Will the school building cast too much shade on the potential garden area? From what direction will the area receive its sunlight? Here in Tucson, a growing area needs to receive a minimum of 6 hours of direct sunlight every day for plants to be successful.
3. Will the garden be close to any hazardous materials, from the road, school dumpster, underground piping, etc?
4. Is there a hookup to water nearby? School grounds often times have irrigation systems already in place. Will you be able to control water flow to the garden?
5. What is the topography of the land? Will the monsoon seasons flood the garden completely and/or wash the garden away? How loose and fertile is the soil? Is the location protected from strong winds? Animals? Are any of these barriers surmountable (do you have access to a jackhammer to break up caliche, would you be able to build a fence around the garden to keep animals out, etc)?
6. Make sure your location has space for paths approximately 3 feet wide between garden beds and space to accommodate as many garden features as you would like (i.e. desired number of garden beds, tool shed, chicken coop, compost area, rainwater harvesting cistern, gathering space, etc.) Keep in mind some of these can be placed in other areas of the school grounds as long as their locations are sensible and accessible. We will go over this again in the next chapter.

Have you attended a site design workshop? Do you need to consult with someone who has more experience designing gardens? More information on site design can be found in the next chapter with a short checklist. Before you begin your garden, make sure it is designed well. We recommend following the principles of permaculture design to best address the limitations of school gardens in the desert. These principles can be found on the following page, adapted from *Introduction to Permaculture* by Bill Mollison and from the Sonoran Permaculture Guild.[3]

Permaculture Design Principles

1. Everything is connected: Design garden intentionally keeping in mind relationship between garden elements.
2. Every element should serve many functions.
3. Every function should be supported by many elements.
4. Plan for efficient energy use.
5. Favor biological resources over fossil resources.
6. Recycle energy on-site.
7. Use and accelerate natural plant succession to create beneficial sites and soils.
8. Build a small Intensive system.
9. Use a diversity of beneficial species for a productive, interactive system.
10. "Everything works both ways" - Find solutions in your problems.
11. Use patterns and edges (natural and human patterns working together).

Community members come together to help plant a new tree in Manzo's Garden.

Reference Guide

1. In an assessment of research done on farm to school programs, Joshi, Misako, and Feenstra report the following about the effect on student dietary behavior:

   Of the total 15 studies reviewed for this article, 11 assessed student dietary behavior changes resulting from a farm-to-school program. Of those, 10 studies[16–23,25,26] corroborated the hypothesis that positive dietary behaviors result when students are served more fruits and vegetables, especially when the product is fresh, locally grown, picked at the peak of their flavor, and supplemented by educational activities, and one reported no substantial changes in student dietary behaviors as a result of the farm to school program.[24] Of the 11 studies, 8 reported on programs with a farm-to-school salad bar in the cafeteria,[16–21,25,26] one incorporated local foods in the cafeteria without a salad bar model,[23] and two conducted classroom-based education using local foods.[22,24] Of the 8 salad bar programs, 7 found an increase in the range of 25% to 84% more fruit and vegetable servings consumed by students.[16–21,25] One study reported that 75% of students receiving the farm-to-school salad bar chose a balanced meal without adult intervention as compared to 46% of control students.[26] Another of the 8 salad bar programs also reported a reduction in the amounts of total calories, cholesterol, and total fat in students' daily diets as a result of the farm to school program in the cafeteria.[21] The program with the non–salad bar model in the cafeteria found that 60% of the students reported eating more fruit as compared to a previous year when the farm to school program was not operational.[23]

   Joshi, Anupama, Misako, Andrea, and Gail Feenstra. "Do Farm to School Programs Make a Difference? Findings and Future Research Needs." Journal of Hunger & Environmental Nutrition. 3 (2/3) 2008.
2. Permaculture definition provided by the Sonoran Permaculture Guild. "What is Permaculture?" sonorapermaculture.org
3. Permaculture Principles adapted from Mollison, Bill and Reny Mia. *Introduction to Permaculture.* Tasmani, Australia. Tagari Publications. 2011. and the Sonoran Permaculture Guild's Design Workshop.

COMMUNITY FOOD BANK
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Grow Your Garden

Introduction

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Think about the core of your garden and develop short term and long term plans for it's development. Sketch a map of your complete dream school garden. Make sure to consider space limitations and resources. Most likely, within your school community, there will be someone with some landscape or agricultural expertise who can help you with your design. If not, don't be afraid to reach out to some of the people and organizations on the "Tusconans to Know" list.

As you map our your garden, think about the ways you'd like your school community to interact with the garden. Will you have a gathering space? How about classroom plots? Will components of the garden be spread out across the school campus? Is your school a magnet school or does it have a theme? If so, how might you integrate the garden with that theme?

As your capacity for production expands, so can your garden. Maybe you'll add a chicken coop or an aquaponics system in every classroom. Maybe you'll build a greenhouse. All of these are possibilities. See the "Share the Harvest" chapter for biographies and information on some model school gardens in Tucson that have already expanded their garden.

Remember, start off small. Build what you know you can manage. It is perfectly okay for the garden to be built over phases. In fact, this will probably increase the garden's longevity and level of integration with the rest of the school.

Getting Started

What are your major components of your garden? The core elements should start with garden beds, a watering system, and a compost system.

Starting off with a container garden is a great beginning and certainly is much more manageable for first time school gardeners. There are many ways to build container gardens. Please check out the resource list for more information.

For the purposes of this toolkit, we're going to focus on in-ground garden beds as the core component of school gardens. As we move through the chapter, you will find checklists and supply lists to help you build your garden.

The location of your garden beds should be your first priority and the rest of the garden layout should be decided afterwards. The next section has specifics on locating your beds to ensure they receive their basic necessities.

Once your garden bed locations have been determined, it's time to plan where the remaining components of your garden should be built. In the next section, we will go over specifics for determining garden bed location and constructing a watering system.

The rest of the chapter will walk you through planting, composting, and specialty components. Safety considerations are included at the end of key sections. These safety considerations can be found in this toolkits' companion file as formalized, expanded guides called GHP/GAPs (Good Handling Practices/Good Agricultural Practices). Before you bring students in the garden, be sure to read the formalized guides and make sure your garden meets these requirements.

Certain sections review ways to include students. The final section summarizes the main tips and tricks to working with students in the garden.

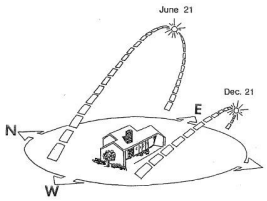
Picking your Plot

Here's a checklist to determine if a site is suitable for growing your garden:

Sun and shade:
Garden's need a minimum of 6-8 hours of direct sunlight

Keep Seasons in mind**:**
In the *winter,* the sun rises in the southeast and sets in the southwest (30* SE to SW). The *north side of a structure* (e.g. a building, a tree, etc) will have more hours of shade in the winter. To make sure your garden isn't shaded during the winter, multiply height of nearest structure south of the plot by 1.4. This will tell you how many feet away from the structure will be shaded on December 21st (winter solstice, or shortest day of year).

In the *summer* the sun rises in the northeast and sets in the northwest. Summer sun lasts from June 21st to September 21st (Summer Solstice and Fall Equinox). You will need to protect your garden from rays coming from the West, 1 pm on. The *south side of a structure* will have shade in the morning and late afternoon. At the Food Bank, we have sun shade cloth you can buy to shade your garden during the afternoon.



Proximity to Utility Lines
First, ask your custodial staff or school administration for a map of your schools below-ground utility network, particularly in areas you are considering for your gardens. It is not a good idea to build an in-ground garden in any area with a high density of utility lines.
If you do not have access to a map of the below-ground utility line network around your school, be sure to keep an eye out for the following lines. It is very important to keep an eye out for the first four:

Color Code for Marking Underground Facilities

ELECTRIC POWER (RED)
GAS-OIL PRODUCT LINES (YELLOW)
WATER SYSTEMS / SLURRY PIPELINES (BLUE)
COMMUNICATION CABLE TELEVISION (ORANGE)
SANITARY SEWER SYSTEMS (GREEN)
TEMPORARY SURVEY MARKINGS (PINK)
RECLAIMED WATER (PURPLE)
PROPOSED EXCAVATION (WHITE)

To Contact the Arizona Blue Stake Center:
- *Dial 602-263-1100 (for Maricopa County) or*
- *Dial 1-800-STAKE-IT (outside Maricopa County)*

Contamination:
Find out from your school administration how your potential plot was previous used. If your plot is near a (previously) painted structure, a road, or an industrial area, it is very important that the soil be tested before planting your garden. Depending on the results and any changes in your neighborhood, it may be wise to regularly test the soil once or twice a year.

Access to Water
We highly recommend installing a drip irrigation system with a timer for regular watering. This will help water the garden consistently, especially over weekends and school vacations. The next section, "Digging In" has information about setting up an irrigation system.

When you pick your plot, make sure it is within a reasonable distance (no more than 20 feet) from a water spigot. If using an irrigation system, you will attach your timer to the spigot. Your main water line will run underground from the spigot and timer to the garden.

We also recommend building your garden on mostly level ground while using *earthworks* and other water conservation methods. This includes digging sunken beds, paying attention to contours in the earth, building berms and basins, building a roof catchment system to collect rainwater in an accessible cistern. For more information, come to our Site Design workshop or reach out to the permaculture organizations for more assistance.

Problem Plants:

Eucalyptus and oleander inhibit the growth of other plants. Bermuda grass can quickly take over your garden. Choose a site that has the least amount of Bermuda grass.

Site Design Checklist

- ☐ **Plot receives adequate sun year round**
- ☐ **Soil has been tested and is safe**
- ☐ **Garden plant roots will not interfere with utility lines**
- ☐ **Water spigot is available nearby**
- ☐ **Plot area is on level ground**
- ☐ **Area is free of problem plants**
- ☐ **Plot area has space for all initially desired garden components like compost piles and garden beds**
- ☐ **Contours of earth have been observed and accommodated in garden layout**
- ☐ **Area is protected from wind and animals**

Digging In

Mark out your garden bed locations. There are many different styles for beds: you could build raised beds in wooden boxes, pile beds into long rows, or you could dig sunken beds. Sunken beds are best for the desert because they help the garden collect and retain water near the roots of the plants. Here are the basics of how our Home Garden team at the Community Food Bank builds them:

1. Dig down at least 2 feet and remove all soil within your mapped out bed location. If you come across caliche (a hard layer of packed earth), try to break through it with a jackhammer. If the caliche is too thick, find a new location for your garden. You may not have to move more than a few feet to find an area without caliche.

2. Refill each bed by mixing half of the removed soil with fresh compost. Beds should be 50% Compost, 50% "old" soil.

3. Use the remaining "old" soil to build raised paths around the garden. This will provide wind protection and help keep water in the garden.

4. Gently, rake the soil smooth and keep it loose and moist while planting.

5. Next, set up your drip irrigation system. Drip lines can lay on top of the garden bed. For garden beds approximately 2 to 3 ft wide, use 3 drip lines at least. Piping connecting beds to the water spigot and timer should be buried under ground as much as possible. Try to bury your main line at least 1ft below the soil surface. This will reduce the likelihood that students will trip on the piping or accidentally damage it.

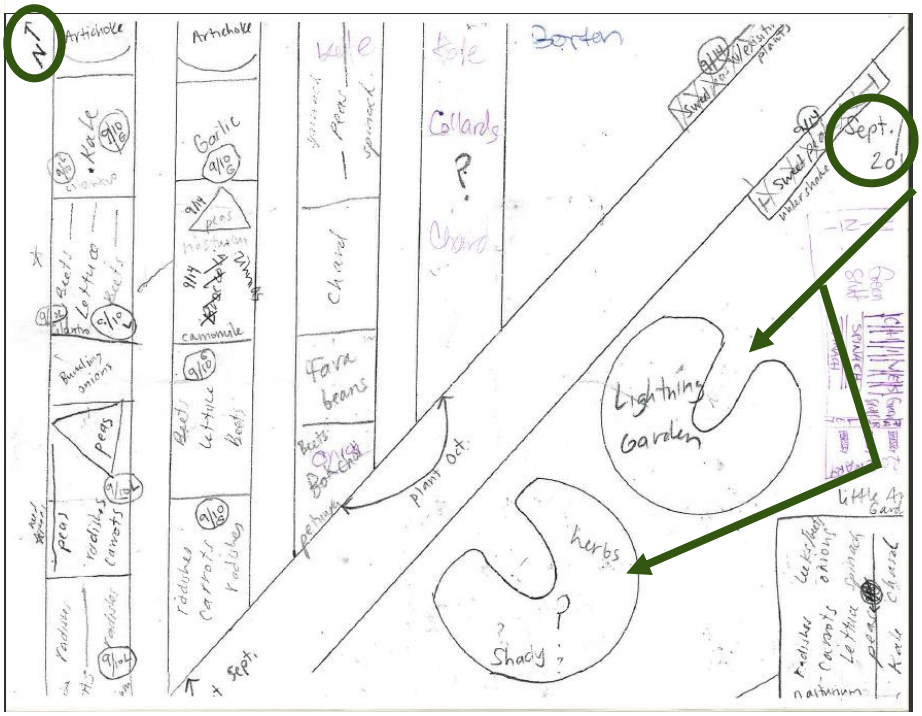
6. Test your system to make sure everything is connected correctly.

7. Once your irrigation system is set up, start planting! Water immediately after planting and remember to set your irrigation timer! See next section for watering/timer setting suggestions.

Garden Maps

Here are a few examples of ways to draw out and design your school garden. You can call in help from a landscape designer or you can do it yourself!

This map is for Borton Elementary School and does not include their chicken coop and rain water cistern. Even though it is hand made, the Garden Team has mapped out what is growing where within the basic structure of the garden beds. They have also included a directional sign and the date.



These are called "key hole" beds. Borton uses them primarily for classroom plots because the shape allows for multiple access angles for students. The traditional rows are the production side.

Tucson soil has:

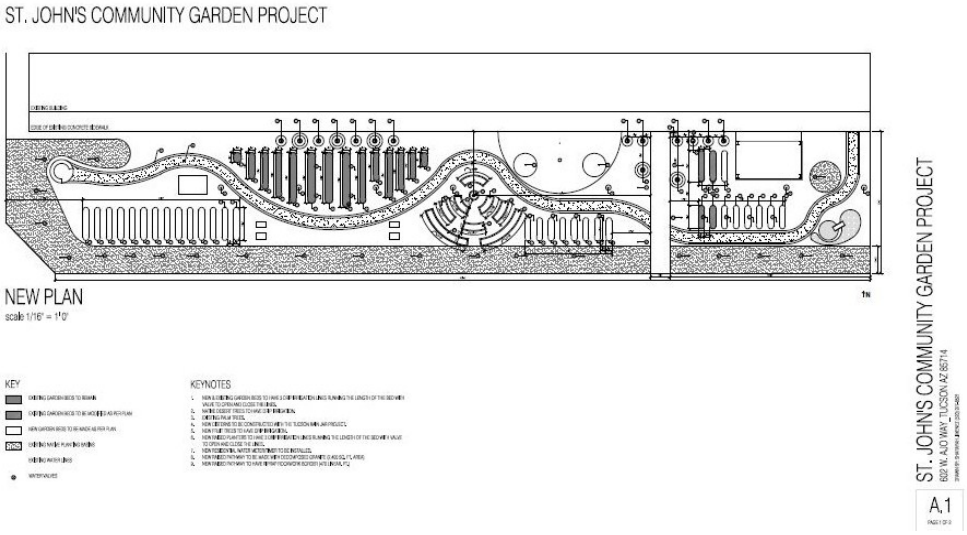
- **Less than 1%organic matter**
- **Layer(s) of caliche, a calcium carbonate layer that has a cement -like quality that can block water and root development.**

Vegetable garden soil needs to:

- **have a neutral pH**
- **contain nitrogen, phosphorus, magnesium, iron, and zinc**
- **be loose so water and air can reach the microorganisms and plant roots in the soil.**

Building your garden beds with finished compost will help boost the organic matter content, improve aeration in the soil, and increase the availability of the necessary nutrients for your garden.

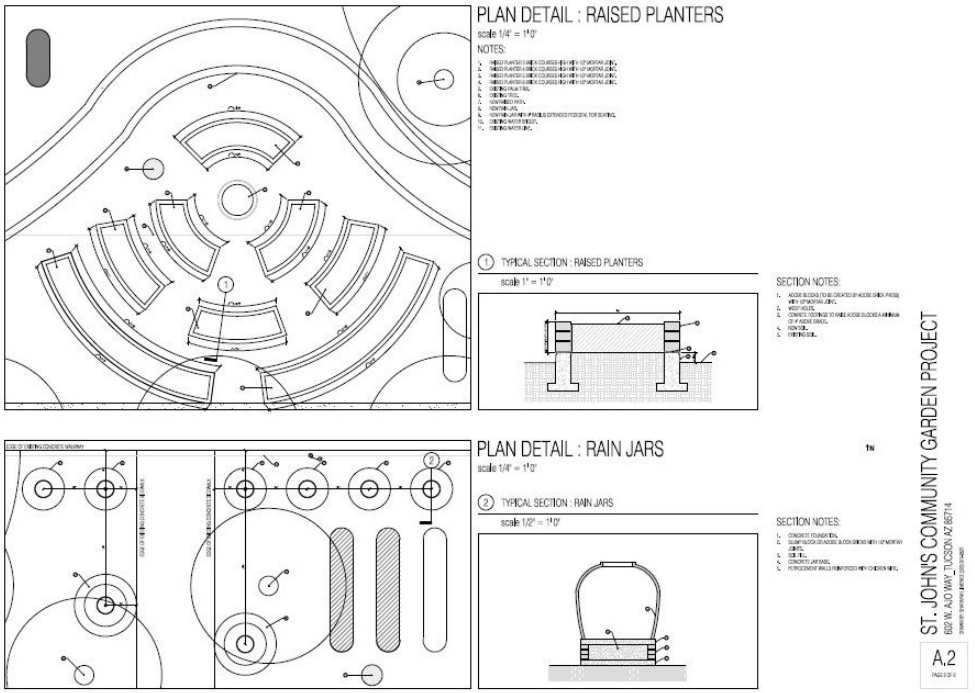
Here is the professionally drawn map for St. Johns Community Garden. This kind of map is useful for building your garden at the beginning. It is a beautiful and detailed rendering of the garden's layout and structure. It, however, is not the appropriate map for knowing what is growing in their garden. A separate map with the basic structure is necessary as their garden grows.



"We have a little garden,
A garden of our own,
And every day we water there
The seeds that we have sown.

We love our little garden,
And tend it with such care,
You will not find a faded leaf
Or blighted blossom there."

- Beatrix Potter



Garden Equipment and Supply Cost Estimates

Fencing Materials	Description	Estimated Cost
Nonpressure-treated redwood posts	4"x4" posts, 8 ft. tall (posts needed about every 6-8 ft.)	$13
Wire for fence	6 or 8 ft. tall 4" wide holes	$80 for 100ft. roll
U nails (poultry staples), ¾ inch	1 box	$3-$5
Soils	**Description**	**Estimated Cost**
Soil delivery (check local companies)	Depends on cubic yards and delivery costs	$200-$300 (for 5 yards)
Generic soils and/or compost		$6-$10 per bag
Compost bin		$15-$55
Compost thermometer		$15
Mulch	**Description**	**Estimated Cost**
Straw bales		$8 per bale
Gardening Tools	**Description**	**Estimated Cost**
Hand trowels		$7
Gloves		$4
Round point shovel		$15
Flat shovel/square point shovel		$15
Spading fork		$20-$30
Pitch fork		$20-$30
Leaf rake/lawn rake		$10-$15
Hard rake (hard metal tines)		$15
Four-tine cultivator (spading fork)		$30
Hoe		$15
Push broom		$15-20
Long-handled loppers		$30-60
Hand pruners/clippers		$10-15
Wheelbarrow (assembly required)	4 cubic ft., wooden handles	$30
32-gallon garbage can		$15
PH soil test kit		$20
Watering/Irrigation	**Description**	**Estimated Cost**
Plastic watering cans	Wide mouth for hose nozzle	$6-9
Soaker hose		$6-15
Bubbler		$8
Spray nozzle		$3-12
Hose	Kink free	$14-40
Irrigation system: poly line, connectors, spaghetti line		$100-$150

Remember:

Many Tucson businesses can donate supplies or money to purchase equipment for school garden projects.

Some supplies, like wheelbarrows and rakes, are necessary only on specific days and can be borrowed.

Manzo students digging to help install a garden element that uses earthworks.

Grow Well in Tucson

Healthy Planting Principles: Choosing what to plant should be based on what makes sense for your school community. We think it's particularly great when the garden aims to feed the school—at least for one event each semester to start. Starting off with salad crops (like carrots, lettuces, radishes, onions) and herbs is often an easy way to get the garden going. Try to pay attention to the season and to upcoming school breaks. Once your team has a rhythm for the garden, think about expanding or moving on to more difficult to grow plants.

Don't get discouraged and do make mistakes! Gardens are very resilient and are a learning process for everyone involved. If this season doesn't produce a bumper crop, reflect on what happened and think about how to address similar issues in the future. But just keeping digging! Just keep planting!

At Manzo, Norma Gonzalez teaches her students about xinachtli, a traditional Aztec planting/seedling sowing style.

ENCOURAGE PLANT DIVERSITY:
Growing a variety of plants not only provides more educational opportunities for your garden. But it means you will have a healthy garden. A diverse garden will deter pest problems as well as create a highly productive space. Keep the following three principles in mind when planning and planting your garden:

PLANTING FOR INSECT DIVERSITY AND CONTROL:
Even with a food production focus, it is a good idea to incorporate (native) flower beds to attract pollinators. Additionally, gardeners use plants to aid in the control of pests, by growing plants that pests don't like or that attract predatory insects. Most insects are beneficial to a garden, though, sometimes, population size can increase beyond sustainable levels.

We highly recommend that you attend a training on a technique called Integrated Pest Management to better understand how to naturally control your insect population. There are countless books and resources available but here are some important herb-insect relationships to keep in mind:

Borage planted near tomatoes, squash, and strawberries repels tomato worms.
Nettle and horseradish protect potatoes from potato bugs.
Rosemary will keep cabbage moths away from cabbage, beans, carrots, and sage. Mint also helps discourage the cabbage moth population as well as many other egg-laying insects. Thyme will repel cabbage worms too.
Marigolds repel Japanese Beetles, which can decimate a garden.
Chives and leeks deter carrot flies.
Garlic is the super hero of the garden and wards off almost all bugs, including aphids and Japanese Beetles.

Plants like lavender, rosemary, sage, and chilies can help repel insects, while nasturtiums will distract pests from your vegetables.

Cilantro, daisies, chamomile, and mints will attract beneficial insects, particularly those that prey on harmful pests. Some beneficial insects include: ladybugs, lacewing larvae, ground beetles, parasitoid wasps, hover flies, praying mantis, and nematodes. These eat many of the main pests: aphids, caterpillars, beetles, mealy bugs, whiteflies, thrips, mites, tomato hornworms, and scale insects.

If necessary, there are a few ways we can decrease harmful pest populations including handpicking and drowning them in soapy water, spraying your plants with water, from a spray bottle or hose, using an organic and biodegradable insecticide or repellant.

Much of this information can be found in:
The Biodome Garden Book
by Patricia Watters.

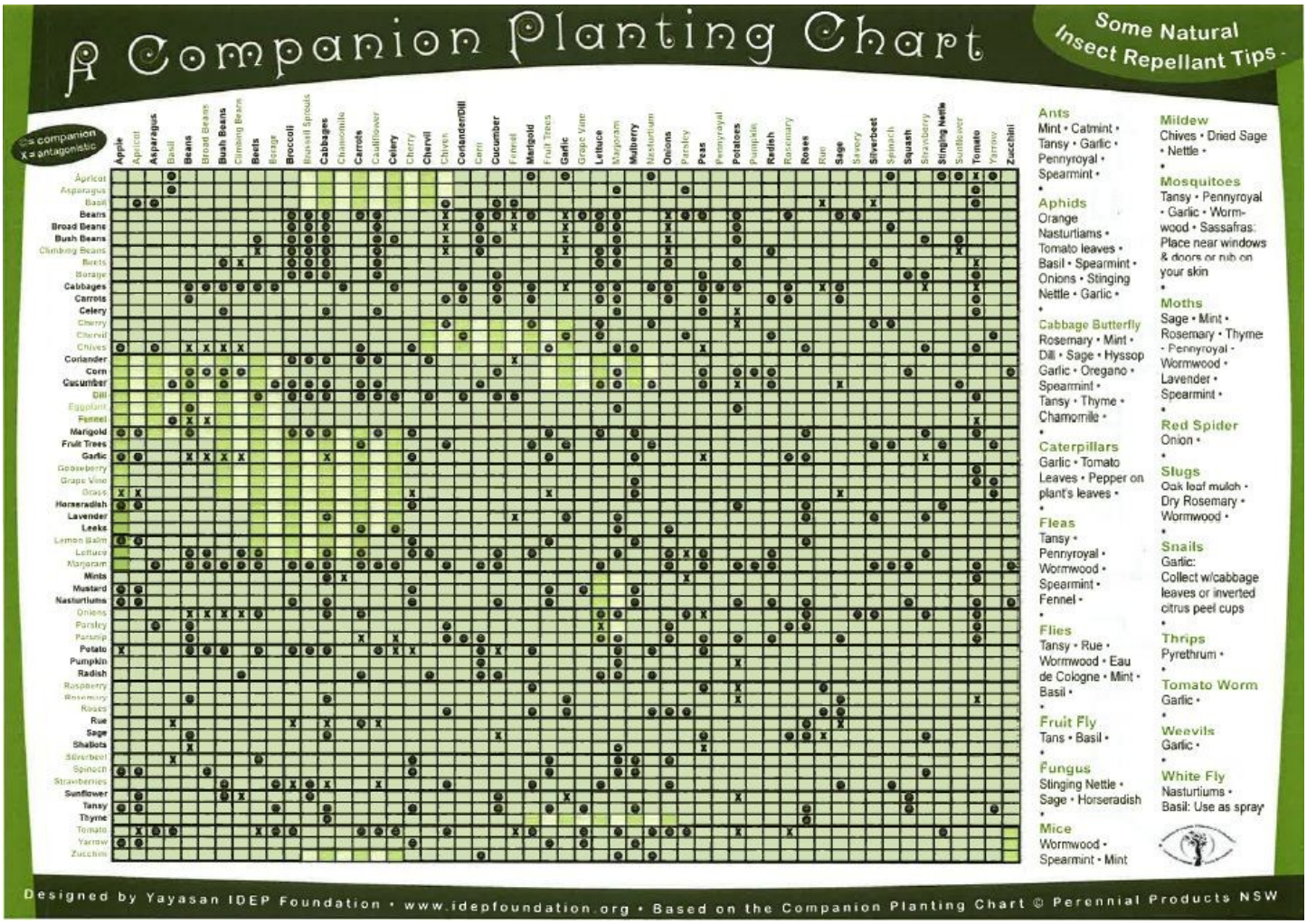
COMPANION PLANTING

When growing, plants utilize different spaces and different nutrients. Take advantage of these differences to maximize your garden's production! For example, in many Native American farming traditions, particularly in the Southwest, three plants are known as the Three Sisters: corn, beans, and squash. Corn provides height and shade, beans add nitrogen to the soil through their root system, and squash provide ground cover to increase ground moisture. Beans and Squash rely on the Corn for it's height and wind protection; all three for rely on each other for vining support. Eating the three together is also a nutritional super meal—together they provide all essential amino acids, several necessary vitamins, as well as a balance of carbohydrates and vegetable fats.

Carrots and radishes grow well together too. The radishes are ready for harvest before the carrots. Pulling them out of the ground frees up aerated space for the carrots to grow more.

Growing root crops next to brassicas (for example, beets next to cabbage) will maximize ground use as well as deter pests.

Below is a companion planting chart to help you get started. An electronic copy (called "companion planting chart.jpg") can be found in the companion file.



Grow Well in Tucson

ROTATION:

Rotation means not planting the same type of plant in the same spot year after year. Rotation helps the long term vitality of a farmed area. Often, when working with a rotation scheme, the first year is difficult because the soil isn't as nutrient rich. The second year is better and the third highly productive. If you don't rotate your crops, you may deplete the nutrients to a point which decreases your productivity or you may increase plant family specific pest population in your soil or microclimate.

Some plant diseases are specific to plant families. Most commercial seed packets will indicate plant family name. Some plants are surprising relatives! We recommend rotating so each family group grows in a different plot each season. This is one reason it is important to keep a seasonally accurate map of your school garden.

These are a few common school garden plant families:

Fruit crops (Solanacaeae-tomatoes, peppers, squash, eggplant, potatoes). It is crucial to rotate this family because continual planting in the same area can generate soil diseases.

Root crops (carrots, beets, radish)

Leaf crops (Brassicaceae-cabbage, mustard, broccoli, cauliflower, kale) In your garden, grow different brassicas far away from each other. Otherwise, you run the risk of building up Brassica-specific pests in your soil which will eat away at their roots and destroy your crop.

Onion family (Alliaceae-onion, leek, garlic)

Beet (Chenopodiaceae- beets, spinach, chard)

Squash (Curcurbitaceae-squash, melon, cucumbers)

Carrot (Apiaceae-carrot, dill, parsley, fennel)

Harvesting carrots at Manzo.

NUTRIENT REQUIREMENTS

Some plants require more of certain nutrients than others. We provide this information so you are aware and take it into consideration when planning your garden. If you have access to soil analysis testing, that's great, but it is not absolutely necessary. Just try to avoid growing plants near each other that consume large quantities of the same nutrients.

Keep the following major nutrients in mind and their main "eaters."

Phosphorous– Fruiting plants (tomato, melon, squash), use phosphorous for root, flower, and fruit development.

Nitrogen-Leafy plants (spinach, lettuce, cabbage), use nitrogen for green growth.

Potassium– Root crops (garlic, carrots, radishes) use to protect plant from the cold and protection from disease.

FALLOW PLOTS AND COVER CROPS

Another way to increase production is to let one plot a year lie fallow (left empty of crop planting). Planting a cover crop (a plant to be tilled into the soil shortly before maturity, as it will increase nutrients in soil) will also increase your productivity in that plot during the following year.

Beans, peas and other plants in the legumeaceae family fix nitrogen into the soil after heavy feeders have been planted there. Nitrogen availability is usually the limiting factor in garden productivity.

We recommend planting beans or peas in a plot and tilling them into the soil before they reach maturity every 3-4 years. For a garden-based chemistry lesson, the nitrogen fixation process is pretty cool especially when if you can use the garden to test hypothesis.

PLANTING TECHNIQUES

From Seed:

On the back of seed packets, spacing measurements are listed for between seeds, rows and depth at which the seed should be planted.

The phrase "rule of thumb" may have an agricultural origin as many farmers, around the world, use their thumb to approximate spacing. From the top of your thumb to your first knuckle is about 1 inch. Also, if you stretch out your hand, your pinky is approximately 6 inches away from your thumb. These are some of the most common and useful measurements to know when planting. Generally, on a school garden scale, you are able to disregard row spacing requirements. These measurements are mostly for industrial size farms.

Seed depth information can be found on seed packets. A simple rule is that planting depth should be three times the size of the seed. If you are planting very small seeds like for mustard greens, it may be easier to make a furrow. A furrow is a long, very shallow indention or trench. It is barely perceptible. The furrow helps to keep the seeds in place, so they don't roll away when you water your garden for the first few times.

Once you have planted your row, gently cover it with surrounding soil. You do not need to pat or press the soil down. Compacting the soil will actually make it difficult to germinate. Once your seeds are covered, gently water your garden. If you have a drip irrigation system set up, turn it out for 20 –30 minutes. If you are hand watering, use a sprinkling can and water softly. Fast moving water will displace your seeds. You will need to water every day, certainly until the seeds germinate, to maintain soil moisture.

From Seedling:

Seedlings are usually grown in a block of soil in a growing cup, usually plastic The process of moving them from the cup to your garden bed is called transplanting. Transplanting seedlings to your garden is a fairly easy task.

Here are the basic steps to successful transplanting:

1. Plan to transplant early in the morning, late evening, or on a cloudy, cool day. This will reduce the shock to your plant as it settles into its new environment.

2. Correctly space your transplants onto of your garden bed.

3. Dig deep holes into your soil for each plant. Each hole should be big enough so that the entire block of soil can fit and will be covered by your garden bed soil. You do not want the tops of your soil blocks to be exposed.

4. Remove your seedling, while keeping the block of soil and root system intact. The easiest way to do this is to gently squeeze the bottom of the growing cup and push the soil block up.

5. Gently place the plant into your hole. Fill in any air pockets around the soil block with soil from your garden. Like when planting seeds, do not press down on the soil.

6. Water gently and as soon as possible after planting your bed. Water your plant well for the first three to four days to make sure the soil stays moist as the plants root systems expand into your garden bed. Then water as needed.

Planting Resources

Try these for more on plant relationships and desert gardening:

Carrots Love Tomatoes: Secrets of Companion Planting for Successful Gardening by Louise Riotte

Rodale's Successful Organic Gardening Companion Platning by Susan McClure and Sally Roth

Extreme Gardening: How to Grow Organic in the Hostile Deserts by David Owens

Gardening the Deserts of Arizona: What to Do Each Month to Have a Beautiful Garden All Year by Mary Irish

The Organic Gardener's Handbook of Natural Pest and Disease Control: A Complete Guide to Maintaining a Healthy Garden and Yard the Earth-Friendly Way edited by Fern Marshall Bradley, Barbara Ellis, and Deborah Martin

Additionally, the Arizona Cooperative Extension has an Urban Integrated Pest Management Toolkit adapted for schools as well as other IPM resources available at this website—
cals.arizona.edu/urbanipm/schools/tool_box/index.html

Tips for Transplanting with Young Students

- It is easiest to transplant with no more than 10 students at a time. If you have more students and more than 10 seedlings to transplant in the garden, break your students off into teams with different jobs around the garden. Rotate them through until you have transplanted all of your seedlings and the teams have completed all of their garden jobs. A job can be chasing a butterfly or running with your chickens just as much as it can be doing plant observation. Still, it's always good to have a supervisor with each team, if possible.

- Lay out the garden bed with the correct spacing, then assign one student each plant. Show your students how to kneel or sit next to the garden bed without stepping on the bed.

- Particularly if you have limited number of shovels, pair neighboring students together. The first student will dig their hole. Once a student is done digging, they can pass the shovel to their partner.

- To help with hole size estimation, ask the students to place their seedlings (still in their growing cups) into the ground. If the top of the cup is level with the garden bed, then they've dug the right size hole! If students have difficulty, ask them to watch their classmates or you dig a correctly sized hole.

- Try referring to transplants as "babies" or "baby plants" and emphasis the importance of being kind and gentle with them.

- Removing seedlings from their growing cups can be tricky.
  First, ask the students who have already dug their holes to show you their "Peace Sign" with their index and middle fingers.
  Then, demonstrate gently "hugging" the base of your plant. Your plant's base should be resting in between your two fingers, while your remaining fingers grip the outside of the cup.
  While everyone is still "hugging" their plant cup, ask each person to lift the whole cup into the air about eye level. (Sometimes it helps to channel your students energy if you encourage them to stand up and "greet the sun" with their plants.)
  Ask your students to squeeze the bottom of the cup. Explain that
    - it is time to flip the cup over to remove the plant,
    - if they've squeezed the bottom enough, the plant will pop out of the cup and into their hands
    - it is important that they don't drop the plant or squeeze it once the soil block is in their hand.

  First demonstrate with your plant. (If your students are standing, ask them to kneel back down by their hole.
  Then, ask your students to flip their plants, remove the cup, gently place their other hand on the exposed bottom of the soil block, flip the plant right side up, and place it into their hole. (If you have a large group of students, have students on one side of the garden bed go first.)
  The last step, filling in the air pockets with soil, can be described as "tucking the plant into bed." Again, this description emphasizes being gentle as well as gives you great visual imagery.

- If you have watering cans, students usually can water fairly well on their own. Otherwise, turn on your drip irrigation system, or water after your students have left.

GERMINATION

In our Harvesting Guide excel sheet, we've given the range of dates during which time you should see your crops sprouting. If you are unsure, germination usually occurs within 1 to 2 weeks after planting.

THINNING

Sometimes seeds gather in a small area. This can happen because too many seeds spilled out of your seed package or water movement. If your plants germinate and are crowded around each other, you will have to thin your bed. Thinning involves removing some plants so that others have enough space to grow to their full size.

Once a plant has 2 to 4 leaves, you can either pull individual plants out or cut them at their base with scissors. Pulling tends to cause unnecessary root system disturbance. The easiest way to decide which plants to remove is to determine which ones look the weakest or which ones are most in the way of proper spacing (as determined by the information on your seed packet).

TRELLISING

Plants with vines, like tomatoes, beans, and peas, need support to stand up so there is more room for other plants in your garden bed. You can grow vining plants on string attached to sticks, on a fence, or other trellising materials. Instructions on how to trellis can be found in any gardening book or by doing quick research online. The basic concept, however, is simple. The vining plants need to grow against a sturdy structure that will not fall over with the weight of the plant. You use the string to contain the plant in a confined area or to redirect vines as they grow. There is no need to tie the string around specific stems; mostly the string provides a buffer and tells the plant to grow in another direction.

SHADING

Tucson, as any year-round resident knows, has intense summer sun. Some plants need shade, particularly when the sun is directly overhead and the hottest. The shade helps regulate moisture loss from the plant and the soil. When planning your summer garden, keep this issue in mind. Tomatoes and chilies, the main summer crops, especially need extra shade. You can use shade cloth, burlap, or old sheets to lay on your beds. Or, you can design your site to have a summer patch that will receive shade from a nearby tree. We stress using an irrigation system also in part because slow, deep, regular watering during the rest of the year will help the soil maintain moisture during the hot summer.

WEEDING

There are different tactics for weeding. For some people, they weed religiously. For others, they let the weeds grow alongside their crop plants. It is a personal preference, but it is important to keep the following in mind:

1. Pull weeds if they are spreading across the garden. Bermuda grass is a notorious invasive species.
2. Don't let the weeds get too big or produce their own seeds. If they get too big, they've taken water and nutrients away from the rest of your garden. If they produce their own seeds, their population may explode during the next season.
3. Some weeds are edible and only considered weeds because we didn't actually plant them ourselves. Common ones here are wild amaranth and purslane. Both are highly nutritious and wild amaranth is native food source here. Try them both!
4. Don't use chemicals to kill them. This will destroy the general soil health of your garden and you may accidentally harm the rest of your plants. Additionally, they are expensive. It is easy enough to pull weeds up individually. Just be sure to get as much of the root system as possible.

COMMUNICATION

Whoever plants or harvests in the garden should be aware of what is growing in the garden. In one of our schools, an intern had seeded a number of plots. A few days later, during a school family work day, a number of volunteers and students planted transplants in the same location and ended up disturbing the plots so much that seeds were buried in the soil and unable to grow. This is another key example of why an accurate map is necessary and available.

As your garden and garden team grow, you may get to the point where you can support a school lunch or two every now and then. If you have laid the ground work, you will already have a great relationship with your cafeteria staff. Even if you don't, it is a good idea to approach the staff to find out what they would be capable of and interested in serving. Planning your next season with their input will most likely increase their support of the garden.

There are examples of schools across the country that have established relationships between their school garden team, food service managers and staff, and local farms in the area. They have coordinated so well that students harvest a small amount of one crop at school and later that week a local farm sends enough of the same crop for the cafeteria staff to serve for lunch. This requires deep commitment, shared sense of responsibility and possibility, and a lot of coordinated communication.

Desert Watering

Set your water timer to three times a day for 20 minutes each. Increase the length of time if the soil seems to dry out and cannot maintain moisture level. Decrease if garden shows signs of *overwatering: soil is muddy or not draining well, plants show signs of brown leaf tips, wilting, yellowing leaves, leaf drop, or brown roots.* Regularly inspecting your irrigation system and how your garden responds to your watering schedule is crucial.

At the different stages of a plant's growth, your plants will need differing watering schedules.

Seed: Keep soil moist in about the top two or three inches to allow seedlings to break out of their seed coat and come easily through the soil surface.

Seedling: As the seedling emerges and grows, water more deeply to encourage root growth. This means decreasing the number of times the irrigation system turns on during the day, but lengthening the time of each watering session - for example, change schedule to twice a day for 40 minutes each.

Established Plant: Keep at least the top foot moist and allow the soil to barely dry out between deep waterings.

When to Water: Especially with an irrigation system in place, it is important to check the soil with your finger, once or twice a week. Often the soil may look dry on the surface but it is moist just below. If the soil is dry down to one inch, then water the garden. When you water, make sure you're watering deeply to encourage root growth. There are metal probes you can buy, but try to learn how to observe your garden's water level. When a plant wilts and the soil is dry, it often means that the plant needs water. However large, leafy plants, such as squash, often wilt in the middle of the day in summer. This wilting is normal; just make sure that the plant has recovered in the morning.

Your garden will retain water if your irrigation is set to water during times with indirect sunlight. Particularly in the desert, evaporation happens easily and intensely, particularly during the middle of the day with sun directly overhead. For a schedule with three watering sessions, set the timer to water once in the morning just after dawn, once in the mid morning (11am) or mid afternoon (3pm), and once before sunset.

Planting Well

Here is a planting guide we have developed to assist you with the growing season here in Tucson. It is available in both English and Spanish at the Community Food Bank.

On seed packets, there is often information about when to plant. Unfortunately, this is information is geared for gardeners and farmers in "hardiness zones" where agriculture is more commonly practiced.

Use this planting guide instead to help you determine when to plant which crop in your garden.

Planting Guide

- This planting guide gives you information about what vegetables and fruits you can plant INTO YOUR GARDEN during each season in Tucson.
- Some plants, like lettuce or radishes, can be replanted every 2-4 weeks, for a continuous harvest.
- All vegetables and fruits listed can be directly planted from seed into your garden unless they say "plant" next to them. These will do better by planting a seedling. You can grow seedlings, but it takes special care and advance planning. Call the number below for more information about starting small plants.

January-February

Arugula	Kale
Asparagus	Kohlrabi
Beet	Leek
Bell Pepper (seed)**	Head Lettuce
Bok Choy	Mustard Greens
Carrot	Scallions
Chard	Parsley
Chia	Parsnip
Chicory	Radish
Chilies (seed)**	Rutabaga
Cilantro	Spinach
Collards	Tomatoes (seed)**
Corn Salad	Turnip
Eggplant (seed)**	Wildflowers

Mid-March

Amaranth	Bell Pepper (plant)
Basil	Radish
Black Eyed Peas	Summer Squash
Bush & Pole Beans	(Zucchini, Patty Pan)
Sweet Corn	Sunflowers
Chilies (plant)	Tomato (plants)
Cucumber	Tomatillos (plants or seed)
Eggplant (plant)	Winter Squash
Gourds	(butternut, pumpkins)
Melons	
Okra	

April to Mid-May

Amaranth	Hard Winter Squash
Basil	(butternut, pumpkins)
Black Eyed Peas	Melons
Bush & Pole Beans	Okra
Sweet Corn	Summer Squash
Cucumber	Sunflowers
Gourds	Sweet Potato

June

Chilies (seed)**	Tomato (seed)**
Eggplant (seed)**	Tomatillos (seed)**
Bell Pepper (seed)**	Okra

July-August

(with the monsoons)

Amaranth	Melons
Basil	Okra
Black Eyed Peas	Bell Pepper (plant)
Bush & Pole Beans	Radish
Broccoli (seed)**	Summer Squash
Sweet Corn	(Zucchini, Patty Pan)
Cabbage (seed)**	Sunflowers
Cauliflower (seed)**	Tomato (plant)
Chilies (plant)	Tomatillos (plant)
Cucumber	Winter Squash
Gourds	(butternut, pumpkins)

September-November

Arugula	Garlic
Asparagus	Herbs (except Basil)
Beet	Kale
Bok Choy	Kohlrabi
Broccoli (plant)	Leek
Brussels Sprouts	Lentils
Cabbage (plant)	Lettuce
Carrot	Mustard Greens
Cauliflower (plant)	Onions & Scallions
Celery	Peas
Chard	Radish
Chicory	Rutabaga
Cilantro	Spinach
Collards	Turnip
Fava & Lima beans	Wildflowers

** These seeds need to be protected from cold and freezing in fall/winter and heat in spring/summer. Start seeds indoors with lots of light, or in a small greenhouse or shade house. In 6-8 weeks the plants will be ready to plant outside.

Compiled from Tucson Organic Gardeners (tucsonorganicgardeners@hotmail.com) & Native Seeds/SEARCH (www.nativeseeds.org)

Call 622-0525 if you have questions about your garden

www.communityfoodbank.org

Seeds or Seedlings?

Plant SEEDS directly into your garden for:

All root crops: carrots, turnips, rutabagas, beets, etc.

Most crops with big seeds: corn, beans, etc.

Most crops that grow in vines: cucumbers, squashes and melons, etc.

Most crops with tiny seeds: lettuce, etc.

Plant SEEDLINGS for:

Most brassicas: cabbage, broccoli, cauliflower, etc.

Most summer crops: eggplant, tomatoes, peppers, chilies, etc.

Either SEEDS or SEEDLINGS for:

Most leafy greens: lettuce, chard, kale, collard greens, mustards, etc.

Pay attention to the time in the season to help make this decision. If it's early, cold temperatures can kill off a seedling, but if it's late, starting from seed might take too long and you'll miss your window.

Harvesting Well

This harvesting guide will help you determine when your crops are ready to be harvested. It is based on the dates in the planting guide. It is available at the Community Food Bank in both English and Spanish.

Harvesting Guide

This harvesting guide gives you a rough sense of when vegetables and fruits will be ready to harvest based on the Planting Guide.
Harvesting information, found on Seed Packets, provides a reliable time frame if you are unsure.

Please keep in mind.
Some plants, like lettuce or radishes, can be replanted every 2-4 weeks, for a continuous harvest.

August - September

Amaranth
Basil
Pole and Bush Beans
Black Eyed Peas
Sweet Corn
Cucumber
Eggplant
Gourds
Melons
Okra
Bell Peppers
Chili Peppers
Radish
Squash
Sunflowers
Sweet Potato
Tomatillos

October

Amaranth
Arugula
Basil
Pole and Bush Beans
Topsy Beans
Beets
Black Eyed Peas
Bok Choy
Broccoli
Cabbage
Cauliflower
Chia
Sweet Corn
Cucumber
Eggplant
Gourds
Lettuce
Melons
Mustard Greens
Okra
Bell Peppers
Chili Peppers
Radish
Squash
Sunflowers
Sweet Potato
Tomatillos
Tomatoes

November - December

Amaranth
Arugula
Basil
Fava Beans
Pole and Bush Beans
Lima Beans
Topsy Beans
Beets
Black Eyed Peas
Bok Choy
Broccoli
Brussels Sprouts
Cabbage
Carrot
Cauliflower
Chard
Chia
Chicory
Cilantro
Collards
Sweet Corn
Eggplant
Gourds
Herbs
Kale
Kohlrabi
Leeks
Lentils
Lettuce
Melons
Mustard Greens
Okra
Onions
Parsley
Sweet Peas
Bell Peppers
Chili Peppers
Radish
Rutabaga
Spinach
Squash (Butternut and Patty Pan)
Sunflowers
Tomatillos
Tomatoes
Turnip
Wildflowers

January - February

Amaranth
Arugula
Fava Beans
Lima Beans
Beets
Bok Choy
Broccoli
Brussels Sprouts
Cabbage
Carrot
Cauliflower
Celery
Chard
Chicory
Cilantro
Collards
Herbs
Kale
Kohlrabi
Leeks
Lentils
Lettuce
Mustard Greens
Onions
Parsley
Sweet Peas
Rutabaga
Scallions
Spinach
Turnip
Wildflowers

Call 622-0222 if you have questions about your garden.
www.communityfoodbank.org

We have also created "Harvesting Guide.exl" which will help you electronically keep track of your garden. The file will tell you if your planting date is seasonally correct and then it will give you specific harvest dates. The harvest date range indicates when you should begin harvesting. For most crops, you will be able to harvest until the plant dies. See the next page for successful harvesting tips as well as harvesting safety concerns.

Harvesting Guide

This harvesting guide gives you a rough sense of when vegetables and fruits will be ready to harvest based on the Planting Guide.
Harvesting information, found on Seed Packets, provides a reliable time frame if you are unsure.

Please keep in mind.
Some plants, like lettuce or radishes, can be replanted every 2-4 weeks, for a continuous harvest.

Call 222-0222 if you have questions about your garden.
www.communityfoodbank.org

March - April

Amaranth
Arugula
Beets
Bok Choy
Brussels Sprouts
Carrot
Celery
Chard
Chicory
Cilantro
Eggplant
Herbs
Kale
Kohlrabi
Leek
Lentils
Lettuce
Mache
Mustard Greens
Onions
Parsley
Rutabaga
Scallions
Spinach
Tomato
Turnip
Wildflowers

May

Basil
Pole and Bush Beans
Cilantro
Collards
Cucumber
Eggplant
Gourds
Herbs
Leek
Parsnip
Bell Peppers
Chili Peppers
Parsley
Rutabaga
Squash
Tomato

June

Basil
Pole and Bush Beans
Topary Beans
Black Eyed Peas
Collards
Sweet Corn
Gourds
Leek
Melons
Okra
Oregano
Parsnip
Bell Peppers
Chili Peppers
Radish
Rutabaga
Squash
Sunflowers
Tomatillos
Tomato

July

Basil
Pole and Bush Beans
Topary Beans
Black Eyed Peas
Sweet Corn
Gourds
Melons
Okra
Radish
Rutabaga
Squash
Sunflowers
Sweet Potato
Tomatillos

Special Crops

Asparagus:
Harvest two to three years after planting

Garlic:
Look for Yellowing Tips

2

Harvesting Well

Harvesting, believe it or not, helps plants produce more. Once your garden plants are mature, it is a good idea to regularly harvest to extend the life of your plant and to enjoy the fruits of your labor.

Check on your garden every day to make sure there aren't any pests eating your plants. Pests will slow your plant growth and may even kill your plants altogether. So keep a vigilant eye on your plants, especially check the underside of your leaves.

If you use the HarvestingGuide.exl file, check to see if your crops are ready to harvest during the determined date range. Regardless, there are few key ways to tell if your plants are ready to harvest.

For leafy greens:

Plants like kale, chard, broccoli leaves, and basil produce edible leaves. Harvest when there are multiple sets of large leaves. Harvest the older, outer most leaves first. Remove these leaves at the base the stem or plant. For basil, wait until there are a couple of sturdy stems approximately 6-8" in height. Harvest whole stems at a time and remove at places where offshoots on each side of the stem has emerged. These offshoots will grow into new stems.

For plants that bear fruits:

If your plant bears fruit, it usually has flowered and a vegetable (or fruit) has developed from that flower. (Incorporating garden observation during the flowering and fruiting periods is a great way to concretely teach students about plant biology and reproduction.) A good way to tell if the fruit is ready to harvest is to give it a gentle tug,. If the fruit remains on the plant and/or you seem to be pulling on the whole plant, it definitely is not ripe. But if it naturally releases, then you've picked it at the right time.

Manzo students harvest lettuce to sell at the market.

For cucumbers, and eggplant, it's a matter of size preference usually. For tomatoes, regularly harvest as they turn red. If you think you have harvested a tomato too early, you can let it sun ripen by putting them on a window shelf for a few days. Squash will produce more individual fruits if they are harvested at smaller sizes. (The tugging test doesn't work very well for any kind of squash as you usually have to chop it off at the base of the stem.)

For peppers, if you leave them on the stem, eventually they will change colors from green to red (or whatever color your corresponds to your pepper variety—there are some that are orange, some that are purple!). All peppers can be eaten when green—it's a matter of preference and taste. Non green peppers have usually bolder flavors,

and red chilies are usually spicier. The color change corresponds to the break down of chlorophyll (another great inspiration for a garden-based lesson).

For roots:

Your root vegetables will be ready to harvest if you can see the tops of the vegetable peeking out of the soil. The larger the top is, the bigger the vegetable. Pull a few out at a time to see if you like the size. Certain varieties of carrot are shorter and more round, rather than long. Check to see what you planted and what the seed packet says is a usual size.

For radishes, the earlier you pick them, the sweeter they are. The longer you leave them in the ground, the more spicy and bitter they can get. (If you leave them in too long, they will get very woody and unappetizing). For some people, they prefer radishes on the spicy side. Usually students who have never eaten a radish before do better with ones that are sweeter and smaller sized.

For spinach, mustard or salad greens:

These greens are very exciting to have in a garden. Usually they are ready to harvest every 2-4 weeks. The key to harvesting is to trim off the tops of the leaves. Be sure to leave in tact the crown, a small cluster of leaves at the base of the plant. The crown is where new leaves are produced. If you take of the crown, the plant will die. If you leave the crown, you may be able to continually harvest for an entire season without reseeding. It is easiest to trim with a pair of scissors. If the leaves become to large, the lettuce may be bitter. For greens like arugula and some mustard greens, bitter is better!

For bok choy:

Commercial harvesters will cut bok choy at its base, which is why grocery stores that sell bok choy only have them available as whole heads. For the purpose of a school garden, we recommend continually harvesting the outer leaves like any other leafy green. Again, when to harvest is a matter of size preference. if you notice your bok choy plants seem to be crowded with leaves, it is a good idea to harvest the outer leaves as soon as possible.

For head lettuce or cabbage:

Harvest when heads are desirable size by cutting off at the base, and leaving some leaves on the stem in the ground. If the head begins to crack or becomes pointed, twist entire head a half turn and pull. Cabbages left too long are usually susceptible to cracking.

For broccoli or cauliflower:

Harvest when the large center cluster or florets are well formed and before they shoot up and flower. Cut with 1 1/2 inch stem attached. The broccoli should be harvested before any yellow buds appear and all of the buds are shut. Broccoli will sprout new clusters along the sides. These will not be as large as the main, first cluster, but they can be harvested continuously. Harvest every few days to prevent flowering. If the cauliflower has brown spots, it is too ripe.

For corn:

The first ears to ripen are usually in the center of your corn area. The silk will darken as it matures. The end of the ear should be blunt. Test an ear by pulling down part of the husk and press on a kernel. If sweet, milky juice comes out, you've got a ripe ear of corn! Congrats!

For melons:

Melons are difficult. Cantaloupes can give off a musk smell when ripe or they can naturally separate from their stem. Watermelons tendrils can dry up when the fruit is ripe. Some people wait until the watermelon makes a hollow sound when tapped with a fist. Really the only way to know is to experiment and try a melon.

For garlic and onions:

Harvest both when the leaves turn yellowy, brown. Pick off any flowers that develop. Chives can be harvested as the green shoots develop. Green onions can be pulled out anytime. Some wait until the leaves fall over, which usually indicates the bulb is done growing.

For asparagus:

Asparagus takes 2-3 years to grow. The shoots are ready once they've reached a desired height. Chop them off at the base where they've started to get woody.

Safety on the Farm Considerations

Harvesting Safety:

For plant health, produce should be cleanly cut so as to not weaken the plant, making it susceptible to diseases or a pest infestation.

Pre-rinse the produce with potable water to remove most of the soil and debris. It is best to do this in the garden area.

Personal Safety:

Students and staff who are ill or have been ill in the last three days should not participate in the harvest.

Wash hands thoroughly (i.e., at least 20 seconds with soap and water) before harvest, and again after using the restroom, touching the face, coughing or sneezing.

If there are students with allergies at the school, keep allergenic types of produce separate.

Bandage all wounds and discard produce that has contacted blood or other bodily fluids.

Avoid eating produce during the harvest.

Handling Safety:

Harvesting tools (e.g., knives, scissors, and work gloves) should be cleaned with water and a detergent or sanitizer. They should be stored in a safe place, away from bathrooms or other gardening areas. Harvesting tools should only be used for harvest!

Use hard plastic containers that are easy to clean and that do not shatter easily. Rinse them well after use, and sanitize them thoroughly prior to the next harvest. Store them with your other harvesting tools.

Any harvesting tools should be sanitized. If you have a good relationship with your cafeteria staff, ask them if you can run your tools through their sanitizer after you are finished harvesting.

Label the produce with the date, location of harvest, and the group that performed the harvest. Keep a permanent document with this information, to allow problems to be traced back to the source if a contamination event should arise.

Cleaning:

After you are finished harvesting, it is time to prepare your produce for consumption or sale.

Wash your produce thoroughly. Use potable water to clean the produce. You do not and should not use any soap product in cleaning process. The wash water should be **at least 10°F warmer than the produce's pulp temperature**, to keep contaminants in the water from being sucked into the produce.

Immediately prior to serving, perform a more thorough wash. For durable produce such as melons, scrub with a brush, even if the peel will be removed. Then rinse thoroughly.

Avoid soaking the produce in standing water.

Storage:

If the produce is wet from pre-rinsing, dry it with clean paper towels before storing.

Refrigerate the produce promptly after harvest.

Store produce in sanitized containers that include the labeling information from harvest.

Food storage areas should be kept clean and free of rodents or other pests.

Cool the produce to 40°F within two hours of harvesting (or within one hour if the temperature is above 90°F) to reduce the risk of foodborne illness.

Use a "first in, first out" method to avoid excessive storage times for produce, meaning harvested food should be consumed, sold, or given away within a day or two of harvesting. Waiting longer will decrease the nutrient value and taste of your produce, as well as leave it vulnerable to food borne pathogens.

Preparation:

Before serving, inspect for signs of damage, soil, or insects. If in doubt about damaged produce, cut away the affected area or discard the item.

Compost

What is Compost?
Compost is dark, crumbly, earthy-smelling, decomposed organic matter that will improve your soil quality and help your plants grow. It is a natural fertilizer. The best news is that you can easily make it yourself with many of the things you normally throw away.

For the garden, the compost will help maintain nutrient health, control soil erosion, increase produce yields, and help regulate water/moisture levels in sandy, desert soil. Compost will also reduce plant stress during drought or frost.

Why should we compost at our school?
Compost has many benefits in a school.

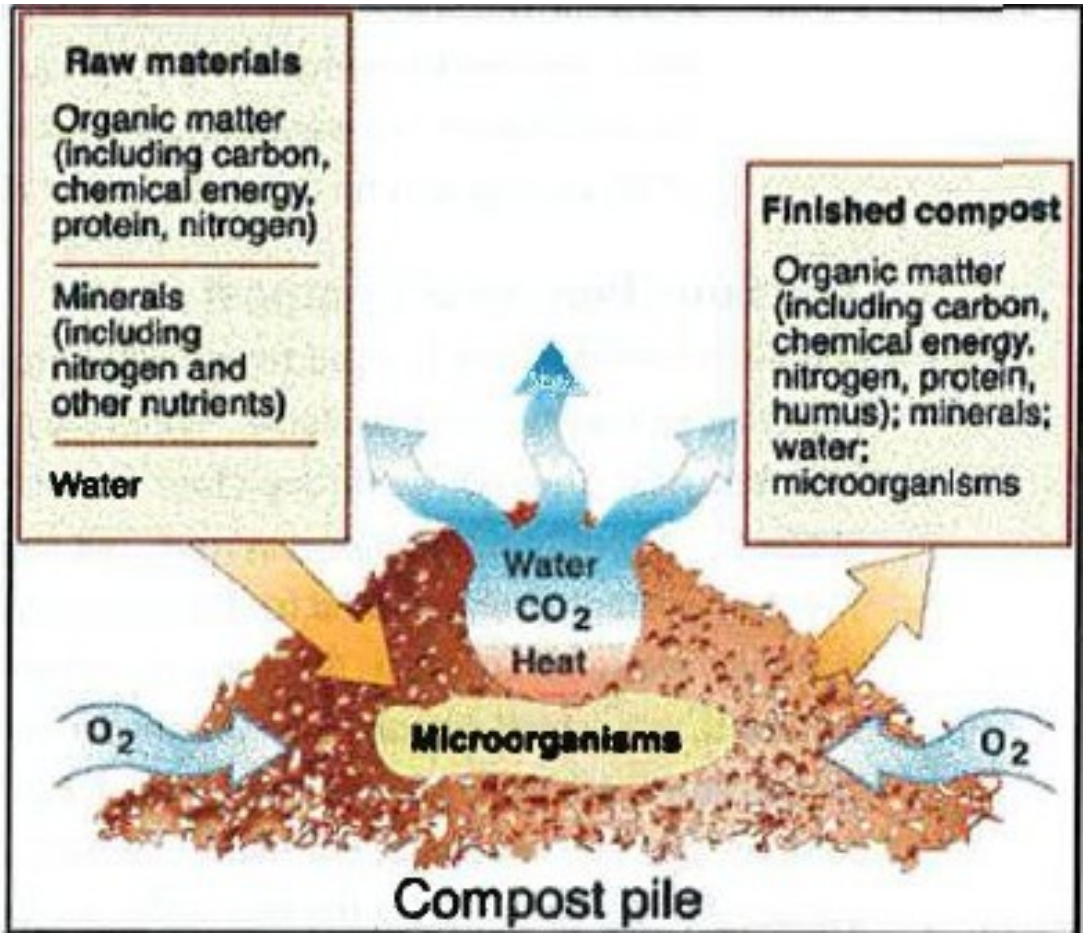
A composting system:

- is a very tangible example of a micro-ecosystem
- provides a way for students to observe aerobic (and anerobic when a problem arises) decomposition
- Is an easy way to talk about the cycle of life
- teaches about ecological stewardship when paired with discussions about waste and landfills.

How should we compost?
There are two kinds of composting systems we recommend for school gardens: regular compost bins and a vermicompost container.

Both systems require a balance and can be done using only waste inputs from the school. Remember: composts are living ecosystems that rely on micro-fauna (small insects and bacterial life) that need care and attention much like any other farm livestock.

The following sections will walk you through setting up your compost systems.



Compost Bins

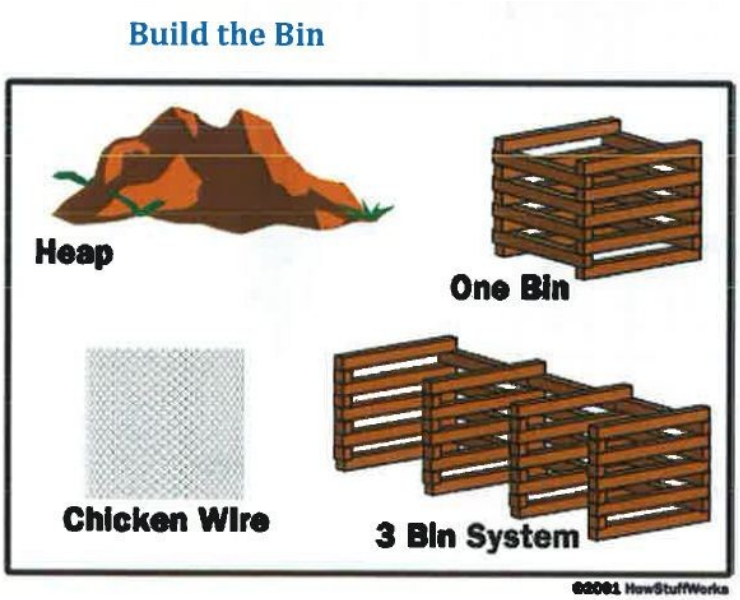
BUILDING A COMPOST BIN

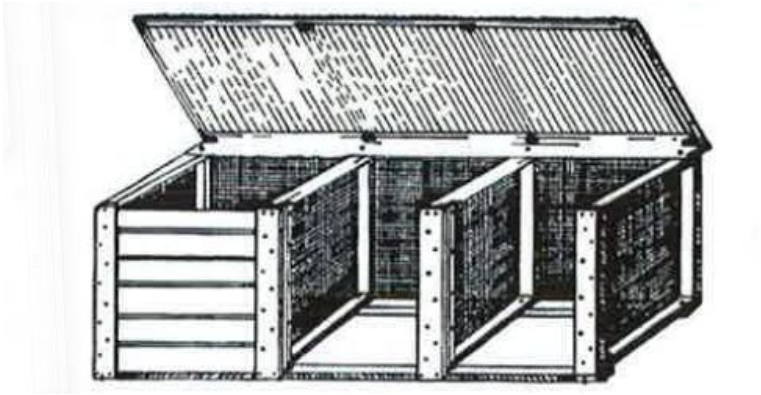
1. During your site design phase, choose a place that is not right next to your garden, but nearby. An optimal location is under a tree in the shade. If the compost pile is too close to the garden, pests may move from your compost pile to your garden which will only create more problems later on. Keep in mind: as your garden expands, you may find it beneficial to have two, three, or more compost bins.

2. Build your composting bin. A common and easy way to build a bin/composting area is to cover the flat side of (donated) wooden shipping pallets with chicken wire. Then attach 3 pallets together as shown in the "Build the Bin" image below. If you don't use a pallet, the bin should be at least 3 ft across. Especially if you only build one compost bin and it will not supported by another structure, it helps to dig about 6 inches into the ground to stabilize bin.

3. Start your compost pile by adding alternating layers, 6 inches deep each, of brown material then green. Brown material should always be the bottom and top layers of any pile. Fill the bin about ¾ths full.

4. Once your pile has been established, start a composting system at your school. You can ask students to bring in food scraps from home, but that usually gets messy. A constant supply of food scraps, however, can be collected from the cafeteria. (See Studen Run Composting System Suggestions.)





5. Once you have filled your bin, let it sit for 2-3 months. Make sure to keep pile moist, turn when necessary, and monitor it's temperature. The compost is ready once its internal temperature has stabilized, it is dark in appearance, clean and sweet in aroma. Sift out the large clumps which can be used to start the next pile. Add finished compost to the soil in the garden, or use it as mulch above ground.

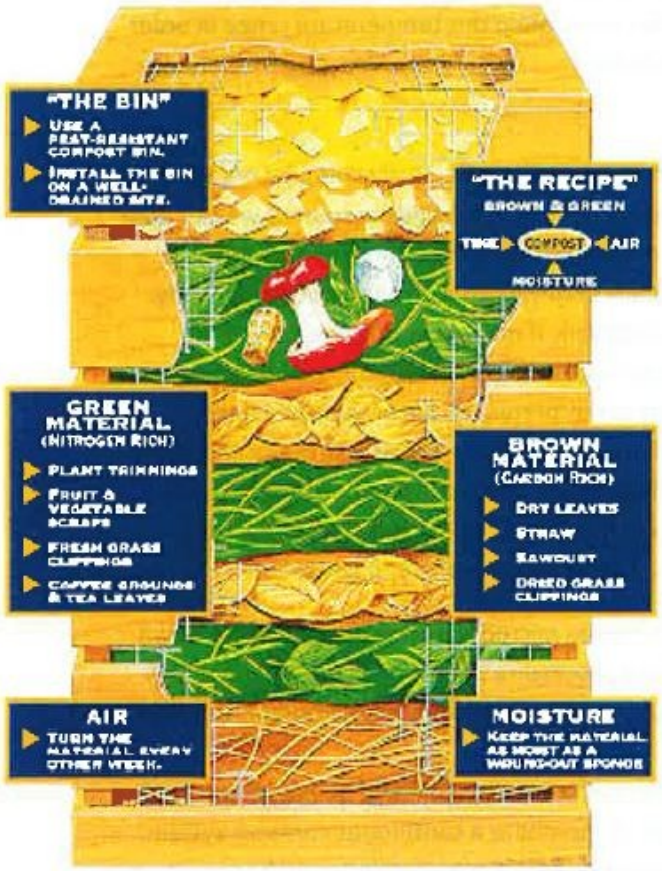
6. Composting does not need to be exact. Remember: brown plus green matter and keep it moist—that's all it takes! The speed at which it decomposes and the quality will reflect how much you attend to it. No matter how much or how little you attend your compost pile it will decompose over time.

Composting

WHAT TO COMPOST
Most anything organic can be composted. Compost however needs a balance of 75% Brown (carbon rich)and 25% Green (nitrogen rich) components.

Brown components include: brown, dry plant matter, straw, sawdust, newspaper and recycled paper.
Green components include: Food scraps, manure from non-meat-eating animals, green plant matter.

At the end of this section are a number of compost system related signs we've created. One is a bilingual poster to help students decide what they can and cannot compost. If you set up a system with school meal food scrap collection, make sure the students monitor the collection carefully. Otherwise, cheeseburgers and peperoni pizza may appear in compost piles fairly often.



What to Compost:

1. Dry Layer
(Carbon Rich)

- Straw Hay Bales (cost: $9 at local feed store)
- Dry plant matter
- Newspaper/paper bags/non-glossy shredded paper
- Hair or feathers
- Sawdust (from nontreated wood)

2. Wet Layer
(Nitrogen Rich)

- Fruit & vegetable scraps
- Leftover cooked grains
- Coffee grounds & tea bags
- Green plant matter from your garden (except grass)

3. Manure Layer
(Nitrogen Rich)

- From **non-meat eating** animals such as horses, cows, sheep, goats & chickens
- See Safety on the Farm Considerations, particularly if using animal manure in your garden.

What NOT to Compost:

- Meat Products
- Cooking oils, fatty foods
- Dairy products
- Egg shells (except in small quantities)
- Pet waste
- Coal/charcoal/ashes
- Colored paper
- Non-biodegradable matter such as plastic or toxic materials
- Diseased plants
- Bermuda grass
- Eucalyptus, oleander, tamarisk/ saltcedar or creosote leaves

School Composting Resources:

Check out the School Composting Manual from Mansfield Middle School and Mansfield Board of Education in Connecticut. This very comprehensive manual can be found at ct.gov/deep/lib/deep/compost/compost_pdy/schmanual.pdf or by going to ct.gov and searching "school compost." The manual appears as the pdf "School Composting Manual".

Gardening with Kids has developed a Compost Activity Kit, K-8—gardeningwithkids.org/compost-activity-kit-k-8-all-3-teacher-guides.html
And a Basic Composting Book—gardeningwithkids.org/basic-composting.html

Cornell University has developed a guide for high school teachers interested in assisting with their students composting research projects.—compost.css.cornell.eduCIC.html

Student Run Composting System Suggestions

From our experience working with many schools, student-run school garden compost systems work best when students are able to work on the system for at least a full semester and in teams. This kind of system will increase students sense of responsibility, community dedication, and team work abilities.

Each team should check off a list of their responsibilities, record their time, observe and record an aspect of the composting system, and be able to self-assess their success. Included at the end of this section are compost system signs designed for students.

To maximize the number of students involved, every day compost is collected, have at least two shifts: one in the morning and one after food scraps have been collected. The morning team will dig a hole as deep as possible into the pile. After food scraps have been collected, the second shift should be responsible for adding that day's food scraps to the compost pile. This second team could be broken up into two teams, one that monitors food scrap collection and another that adds the food scraps to the compost bin.

Start your food scrap collection project small. Teach students about the difference between compostable food scraps and non-compostable food scraps. Then with cafeteria staff and school authority permission, set up a table with a bucket for scrap collection once a week. Students can regularly sit at the table to teach the rest of the school about what scraps can be collected. (At the end of this section is a bilingual sign of what is and isn't compostable for your lunch room.) At the end of the lunch period, the buckets contents should be added to the compost pile. The bucket should be rinsed. Rinse water should be poured onto compost pile. The bucket should then be returned to the cafeteria, where it can be sanitized and ready for the next days use.

Eventually, you can work your way up to collecting every day at breakfast, lunch, and snack times.

Manzo student running her compost shift with the help of a University of Arizona Intern.

Although this system will limit the number of students who are able to be on a team and involved in the compost system, it will produce fewer headaches and composting problems. If not maintained properly, decomposing material in compost piles can become health hazards and will create an administrative reason to shut down the garden.

Please pay close attention to the Safety on the Farm Considerations.

Farm to Cafeteria Concerns

If you plan to use your school made compost in your garden and, eventually, your garden produce in your cafeteria, it is imperative that you follow the Safety on the Farm Considerations and any forthcoming restrictions or rules from your school administration, district and district's food service division, the Arizona Department of Education, or the Arizona Health Department.

Reach out to the Community Food Bank, soil biologists and/or the Cooperative Extension at the University of Arizona, or anyone with extensive farming experience if you have any questions about the safety of your compost pile.

Because schools serve such a large number of students, we must be very diligent about composting safely. For inexperienced composters, we recommend that you **do not** include animal-products of any kind. For these systems, follow the "Safety on the Farm Considerations" on this page and the plant-based composting section in the Composting GHP/GAP (included in the companion file).

Many schools in Tucson have or would like to have a chicken coop, which requires cleaning once a week. Some schools are neighbors with ranches or have built partnerships with them. It is completely understandable to want to use these readily available sources of manure for your compost. It is vital that you have a well maintained compost system without manure sources, before you consider moving on to include animal manure. A well maintained system is one with regular maintenance and one that has exhibited very few problems over the life cycle of the compost pile(s). Once you are at this stage, carefully follow the *Manure Management in School Gardens* guidelines (or any forthcoming rules and restrictions from the previously mentioned school authorities). These preliminary guidelines can be found on page 40 and in the manure management section of the Composting GHP/GAP.

Before beginning or working on your schools composting system, please attend a training on composting and ask any questions you may have.

Safety on the Farm Considerations

These guidelines are for plant-based compost piles that should NOT include animal products, animal fat, or animal waste. **If chicken manure or other animal manures will be included in the compost pile, see the separate guidelines for *Manure Management in School Gardens*.**

Compost System Design:

Place the compost piles in a secure location away from potential contamination, such as garbage, water, runoff, etc. Restrict access by animals as much as possible.

If possible, build physical barriers to keep wind and water runoff from carrying the compost away from the pile.

Containers used to collect kitchen scraps for the compost pile should be cleaned and sanitized between uses.

Compost System Procedure:

Hands should be scrubbed thoroughly after handling the compost.

Make sure that your compost heap creates enough heat for microorganisms to break down the components of the compost. A temperature range of 130-150°F is ideal, but >160°F can be dangerous. Your compost pile temperature must be in this range for minimum of 3 consecutive days before the compost pile is ready to cure.

Allow plenty of time for composting. Fully composting the vegetable scraps, which involves periodically turning the pile with a shovel, normally takes a minimum of 1-2 months under optimal temperature and moisture conditions. Letting the compost "cure" for several months, even after it appears finished, is ideal. This will result in a more chemically stable end product that is better for germinating sensitive seedlings.

Your compost is ready to use when it is dark brown, crumbly, fluffy, and has an earthy odor. The original food scraps included in the pile should no longer be recognizable. Before applying compost to garden, make sure to sift out large pieces or recently added composting materials.

Student Run Compost System Signs

These signs were created to help our schools run their student run compost systems. The first sign is for the lunch room to help students sort their lunch waste correctly. We recommend laminating it and placing it next to the food scrap collection station.

The four orange and white signs are for the outdoor compost system. Each sign is printed double sided, laminated, and kept next to the compost piles. Laminating them protects them from outdoor weather damage and allows students to write on them with dry erase markers.

Create another student team (or entrust a regular volunteer) to permanently record the data in a notebook kept inside or in a data collection computer file. This will help prove the compost to be safe for garden use.

Feel free to modify these signs however you need to best address your school community.

COMPOST SYSTEM

MORNING SHIFT

Temperature: °F
Up or Down?
Morning Shift Time
Start: End:
Elapsed: Faster or Slower?
Is Site Clean? Yes No

Team Initials:

LUNCH SHIFT

Collected Food Weight: lbs oz
Lunch Shift Time
Start: End:
Elapsed: Faster or Slower?
Is Compost Table clean? Yes No

Team Initials:

POST-LUNCH SHIFT

Is Site Ready for next day?
Yes No
Post Lunch Shift Time
Start: End:
Elapsed: Faster or Slower?

Team Initials:

Morning Shift Responsibilities Checklist

Recorded Data for Shift?
YES NO
Hole dug through center to bottom?
YES NO
Collected un-decomposed food in bucket?
YES NO
Sealed Bucket with top?
YES NO
Safely Stored Next to compost pile?
YES NO
Area clean and compost pile contained?
YES NO
Tools put away?
YES NO
Site looks "professional"?
YES NO
Team Initials:

Lunch Shift Responsibilities Checklist

All team members present for lunch collection?
YES NO
Recorded Data for Shift?
YES NO
Lunch Room Table left clean?
YES NO
Area clean and compost pile contained?
YES NO
Tools put away?
YES NO
Site looks "professional"?
YES NO
Team Initials:

Post-Lunch Shift Responsibilities Checklist

Recorded Data for Shift?
YES NO
Lunch and morning shift scraps added to compost pile?
YES NO
Buckets are rinsed?
YES NO
Hole filled in with at least 6 inches of dry material on top of all newly added food scraps?
YES NO
Area clean and compost pile contained?
YES NO
Tools and Buckets put away?
YES NO
Site looks "professional"?
YES NO
Team Initials:

Vermicomposting

Vermicomposting is the process of using worms for compost. Using a vermicompost system provides a very manageable, small-scale way to start composting. Vermicomposting additionally presents fewer safety concerns, as it is contained and does not need regular maintenance. Vermicompost produces a smaller amount of compost, however it is highly beneficial for a garden and can be used sparingly.

Many of our schools have Worm Wigwam style bins. If raising $2,000 for a bin is not possible, it's easy enough to have small scale system which re-uses plastic storage bins. This may also provide an opportunity for several classrooms to have their own bin. Red wriggler worms are the most commonly used. Worm bins need to be placed in locations with moderated temperature (soil temperature should ideally remain between 60 and 80*) and away from light and other disturbances.

MAKING AND MAINTAINING A WORM BIN:

1. You will need two plastic storage bins approximately the same size, at least 8 in tall. If they are identical you will only need one lid. If they are not identical, the larger one must be taller and have a lid.

2. Drill several small holes into the bottom of the interior bin. On the sides of the interior bin, along the rim, drill a ring of holes all the way around.

3. If your bins are not the same size, place support bricks in the bottom of the exterior bin. These bricks will lift the interior bin, making it easier to collect compost tea later.

4. Fill interior bin with dry materials like shredded paper and completed compost. Every four inches or so, dampen each layer with water and mix. It should be as damp like a damp sponge.

5.Once you have filled your bin to about 4 inches from the bin's top, dig about 6 inches down into the center and add about 2 pounds of worms to your bin.

6. Let your worms settle into their bin for at least a week before disturbing their habitat again. Match how often you feed them to how often they work through the food scraps from the last feeding. (The longer worms have to process their food, the more likely it will be that what you harvest will have a higher casting concentration. Some industrial vermicomposters give their worms one or two months to process their food before harvesting or adding new food.) If you notice that there is still food in the bin, wait until they've worked through it all before adding more food. To feed them, pick a side of the bin and dig about halfway down, add appropriate food scraps, and re-cover. The next time you feed them, pick the opposite side of the bin. Maintain alternating sides for as long as you have the bin.

7. Over time, your worms will break down most of the bedding. When you notice that the bedding is all gone, add fresh dry materials like shredded paper to the bin as evenly as possible.

8. It's important to keep your worm bin moist and protected from temperature extremes. Normally, water from food scraps will keep moisture level up. If you notice it is dry, add water to the bin. Also, you can try freezing your food scraps in between feeding. This will not only increase the available water, but will help break down the food scraps some, making it easier for the worms to feast. Worm bins should be kept away from direct sunlight and the lid should remain on the bin at all times, except when feeding.

WORM TEAM AND CASTINGS:

If you do water your bin, check to see if any drainage collects in the bottom. This excess water is called worm tea. It is filled with micronutrients and microorganisms that are highly beneficial for your garden. Collect it and mix 1 part worm tea with 9 parts water. This mixture can be applied to your soil in place of watering or you can use a spray bottle and spray your plants to protect them against pests or diseases.

To harvest your worm castings, stop feeding your worms for at least 1 week. Place a couple inches of bedding and buried food onto a wire mesh screen and rest this screen on top of contents of your worm bin. After about a day, most of the worms should have migrated to the food source on top of the screen. Remove the screen. Harvest the castings in your bin and refill the bin with layers of new bedding, complete compost, and finally the worms, etc on top of the screen.

A note about antibiotics:
Manure can contain antibiotics that were given to the animals, either to treat illness or for disease prevention. These antibiotics can be taken up by plants that are fertilized with the manure, and can reach detectable levels in the resulting produce.

A USDA study in Maryland found that composting the manure at high temperatures helped in breaking down the antibiotics. They found that adding straw to the manure pile helped with this break-down by warming the pile and allowing air to pass through.

Composting the manure decreased the antibiotic content by up to 99%, showing another benefit of thorough composting, in addition to the importance for reducing pathogens.

Safety on the Farm Considerations

Manure Management Guidelines for School Gardens

Important Note: Using manure that has not been composted completely and properly is a safety hazard, as raw manure often contains harmful pathogens. If your school is unsure of whether it can compost the manure according to these guidelines, consider avoiding manure use entirely.

Manure Storage:
If it is necessary to store the manure on school grounds prior to composting, keep it as far away as practical from areas where fresh produce is grown and handled. Where possible, build physical barriers to keep wind and water runoff from carrying the manure out of the intended areas. Store the manure in a "downhill" location to minimize water runoff. Keep unwanted animals out of the manure storage area.

Manure handling:
After handling the manure, thoroughly wash your hands with soap and warm water. Wash tools that had direct contact with the manure.
Do not use the same tools for manure handling that you use for crop harvesting (e.g., buckets or gloves). Do not allow uncomposted manure to contact the produce, the people performing the harvest, or any of the equipment that will be used for harvesting. Remove or wash manure-contaminated clothing, including shoes and gloves, before going indoors and especially before eating, drinking or preparing food.

Obtaining manure from outside sources:
If the composted manure is obtained from a commercial source or donor, request a copy of records showing details of the composting process, to ensure that it was fully composted and that safety standards were met.

Composting with Manure:
Proper composting *drastically* reduces the number of pathogens in manure.
Monitor the temperature. The pile must heat to 131-170°F for at least three days. Because the outside of the pile will be cooler than the inside, the pile must be turned at least once during these three days to ensure that all parts are exposed to the hot center.
Reaching the proper temperature is crucial to reducing pathogens.
However, exceeding this temperature range is detrimental to the microbial activity, and can also create a fire hazard.
Turning the pile periodically is helpful for providing aeration.

The compost pile should feel damp, like a rung out sponge, at all times and should maintain the carbon-nitrogen balance. Add more carbon-rich material if the pile smells or is too wet, particularly when being turned. more frequently. If you add too much carbon-rich material, the pile will not reach the required temperature and more manure or vegetable scraps should be added.

Using bulky items like straw and leaves will also help the pile to aerate. However, if all of your carbon-rich material is very bulky, microbes will have trouble breaking it down. Some non-bulking options readily available at schools include shredded non-glossy paper and lunch napkins.

After your pile has maintained a temperature between 131-170°F for at least three days, it is time for the pile to cure for 2-4 months before use. During this time, you will not add anymore materials to the pile, but it must be exposed to air and moisture, and should be turned weekly. The curing stage allows microorganisms to multiply and outcompete any remaining pathogens.
Do not allow cross-contamination of mature manure with fresh, uncomposted manure.

Using composted manure in the garden:
Keep a record of where and when manure is used in the garden and the origin of the manure, to ensure traceability in case a contamination event should arise.

Manage Specialty Components

This section provides overviews of components you can add to your garden over time as you find funding. They are not necessary components of gardens, but all provide exceptional learning opportunities. If you think you would like to add one of these elements, make sure you have enough community support for the install as well as for long term maintenance and engagement.

Remember, start your garden small. Add new components when you are ready. Some components, like rainwater cisterns, are easy to add and its just a matter of funding. Others, like aquaponics, are whole new living systems that take extra care, resources, and dedication to manage.

At the Community Food Bank, we have workshops on the following components you can incorporate into your garden. Many of the organizations listed in the "Tucsonans to Know" section do as well. At the end of each section, there is a short list of other organizations you can turn to specifically for these projects.

Rainwater Harvesting

Tucson receives an average rainfall of 11 inches each year, which means approximately six inches of rain falls during the Monsoon season and six inches of rain falls in winter time.

As Tucson's population grows, so does the city's water demand. In the last 50 years, the groundwater levels have dropped by more than 200 feet. Large-scale agriculture uses about 68% of Arizona's water.[2]

We recommend building a rainwater harvesting system to replace some of your garden use and to help relieve urban water management problems.

Here are some resources to learn more about water conservation methods:

Tips on water conservation
wateruseitwisely.com/100-ways-to-conserve/index.php

Rainwater harvesting
harvestingrainwater.com/rainwater-harvesting-inforesources/

Tucson City Government can help you select trees good for water conservation strategies for your garden or school grounds—
tucsonaz.gov/tcb/tft/treedescriptions.htm

WATER HARVESTING SYSTEM DESIGNERS AND INSTALLERS

Many schools have connected a large cistern (a tank for storing water) and appropriate plumbing to their gutters to collect rainwater for their gardens. These are some helpful people, organizations, and businesses that can help with designing your system.

Clay Brown's Plumbing (Greywater installer)
(520) 331-5656
cbrownplumbing@gmail.com

Dan Dorsey (Passive and active rainwater design)
sonoranpermaculture.org
Dorsey@dakotacom.net
(520) 624-8030

Brad Lancaster (Rainwater/ greywater system design)
harvestingrainwater.com

Southern Arizona Rain Gutters, Inc. (Gutter and cistern installers)
(520) 299-RAIN (7246)

Realm (Rainwater, greywater, landscape design & install)
(520) 791-9131
realmenvironments.com

Ethos Rainwater and Erosion Control (Passive and active rainwater harvesting system installer)
Lincoln Perino
(520) 444-3360
elperino@gmail.com

Grow with the Flow Permaculture LLC (Passive and active rainwater harvesting system installer)
Sylvia Lindemann
(520) 204-7947
growwiththeflow2000@gmail.com

Water Harvesting International (Rainwater harvesting systems)
Mark Ragel
(520) 631-4676
waterharvestingint.com
markaragel@gmail.com

Watershed Management Group, Inc.
(520) 396-3266
watershedmg.org
Tucson-based non-profit that helps install rainwater harvesting systems as educational-based projects. Free hands-on water harvesting workshops, consulting, gray water co-op (attend workshops to learn and assist in constructing home systems including your own home after attending four workshops). Has worked with schools in the past to assist in water harvesting projects.

CISTERN MATERIAL SUPPLIERS:

Culverts
Arizona Culvert/Pacific Corrugated Pipe Company
(520) 426-6000
General pricing- Culverts are cut to length, and range from 3' to 12' in diameter. 4' diameter is $28/ft, 5' diameter is $40/ft, and 6' diameter is $45/ft.* You can pick up, or pay $200 for delivery to Tucson.

Cistern lids and rainhead screens
Advantage Air Mechanical (Ask for Dwayne)
(520) 792-1201
General pricing- Cistern lids with openable observation ports: 4' diameter $225, 5' diameter $238, 6' diameter $265.* Rainheads can be made to have 3" or 4" drains (depending on what size pipe you want to use), and range between $65-75. Lids and rainheads must be ordered- they are custom made.

Polyethylene cisterns
Loomis Tanks (Steve Poteet- rep)
(520) 889-1338
General pricing- Contact Loomis for a price list- they offer tanks from 100gal to 10,000gal. Approx $0.80/gallon

Concrete cisterns (made custom to order)
Arizona Precast Septic Concepts
(520) 663-3459
General pricing- APSC offers 750, 1,000, and 1,250 gal tanks, at approximately $0.90/gal. Cisterns are custom made, and they will require a drawing from you with port locations for inlets, outlets, manway, and overflow.

Full-port spigots (great for gravity-pressure water systems)
Ferguson Plumbing- various locations around Tucson
Cost around $10 each
PVC and ABS pipe, and backwater valves for end of overflow pipe

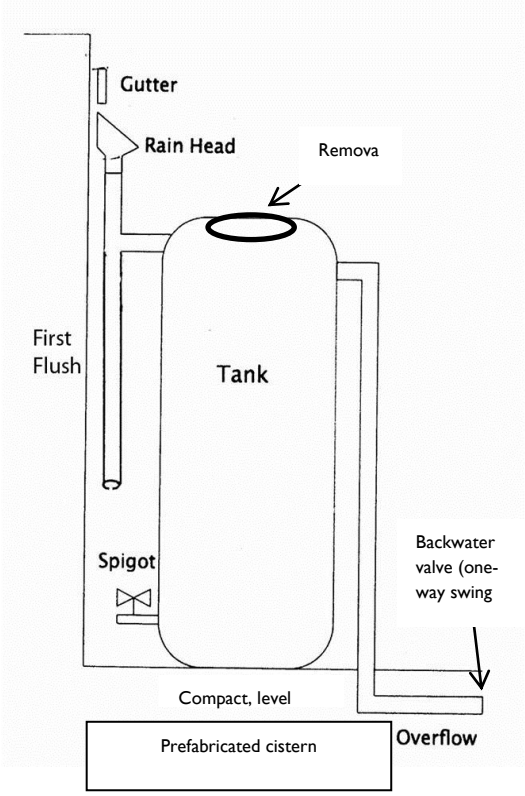
Ferguson Plumbing (see above)
Plumbing Suppliers Inc.
(520) 326-6433
General pricing: 3"diameter Schedule 40 PVC (potable-rated) runs around $1.40/ft, non-potable is cheaper. 1" diameter Schedule 40 PVC runs around $0.40/ft. ABS (black plastic sewer pipe) is now more expensive than PVC, but always check with the supplier for most recent pricing.

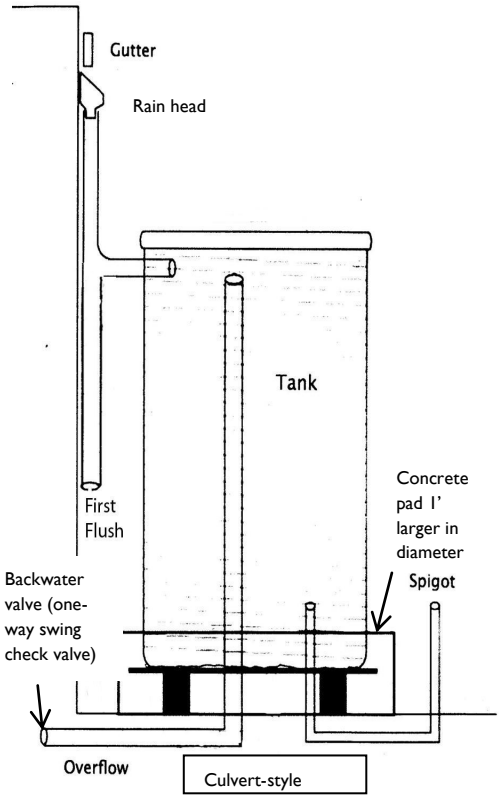
PASSIVE WATER HARVESTING MATERIAL SUPPLIERS

Rock- Catalina Granite
Churchman Sand and Gravel
(520) 325-1611
General pricing: $25/cubic yard *

Rock- Gold/Brown Rip Rap
Sonoran Landscaping
(520) 293-0705
General pricing: $30/cubic yard*

Mulch- Chunky Wood Mulch for trees and perennials
Can be picked up for free from:
Nordstrum's Firewood
(520) 881-0822
Or delivered for free from landscaping companies such as Arapahoe Tree Service (520-883-7727) or Romeo Tree Service (520-603-0143).





Chickens

Another component you can easily add to your school garden is a flock of chickens.

The chickens provide eggs which are easily sold at student markets. Money from students farmers markets can generate enough cash flow to cover the costs of taking care of your chickens.

Having a flock of chickens provides an easy, hands-on way to talk about life cycles and relationships within a community.

Building a chicken coop will be another way to engage your schools parents and families. The chickens also provide extra material for your compost (though if you incorporate chicken manure, please follow the "Manure Management Guidelines" carefully) and a way to sustainably some food waste from your cafeteria.

Please come to our workshop on chickens or reach out to other Tucson organizations who can help support you as you add your feathery friends to your garden.

Local places to find chickens

Craiglist's Farm and Garden For Sale section often lists chickens and other chicken related items—tucson.craigslist.org/gra/

AZ Hatchery—Azhatchery.tripod.com

Lee's Pet Barn—4604 S 6th Ave

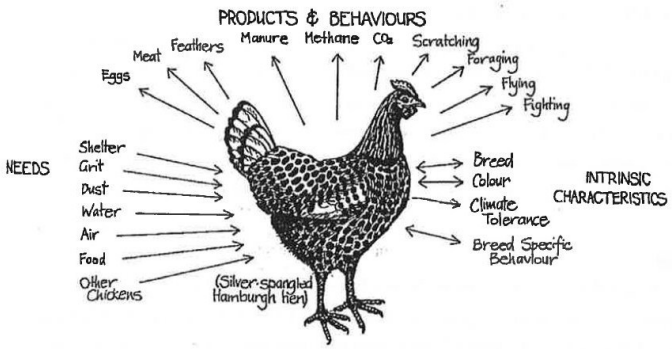
OK Feed and Supply—besttucsonpetstore.com

ZenHens

A Tucson cooperative that works to provide local, fresh, organically raised chicken eggs and produce.—zenhens.net

Tucson CLUCKS

A Facebook group to help organize Tucsonans interested in urban chicken raising.—facebook.com/groups/1822564118915 86/?ref=ts



Here are Chicken related resources:

Chicken Coop Kits—Henspa.com

Fencing—premier1supplies.com

My Pet Chicken will help you determine which breeds to use—mypetchicken.com/chicken-breeds/which-breed-is-right-for-me.aspx

Mail Order Chicks—

Moyerschicks.com
Mcmurrayhatcher.com/index.html
Cacklehatcher.com
Hoffmanhatchery.com
Meyerhatcher.com
Privetthatchery.com/home/default.aspx
Ridgwayhatchery.com

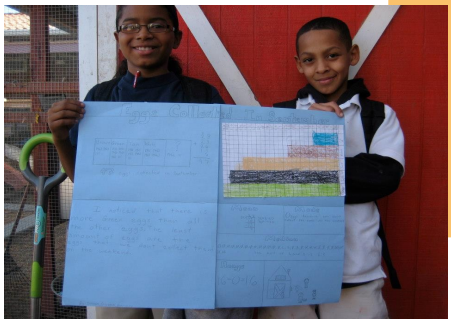
Poultry Magazines—

Backyardpoultrymag.com
Backyardchickens.com
Acresusa.com/magazines/magazine.htm
Backhomemagazine.com
Hobbyfarms.com
Practicalpoultry.com
Mortherearthnews.com
Smallfarmtoday.com

Coop Supplies—

Cconly.com
Poultrymansupply.com
Randallburkey.com

Students at Manzo analyze egg harvesting data as part of their math class.



Chicken Coop Basics

A chicken coop needs a couple of key elements. Do keep permaculture principles in mind when you design your coop.

Design Basics:

1. Your coop needs to be protected from potential predators (like dogs), a feeder and a waterer.

2. Generally, the more room chickens have, the less aggressive they will be. Plan for a minimum of 6-8 square feet per bird within the chicken coop. We recommend that your chicken coop be in a place where you can let your chickens roam without the getting into your garden. They need more space if they will only live in the chicken coop, and a little less space if they are free range chickens (regularly able to roam freely in an expansive space). Most of our schools let their chickens out into the garden area (but away from the production area) every day.

3. Chickens need roosting space, with each chicken needing between 6 and 10 inches of space on the roost. The space requirement is dependent on the breed. Again, the more space the better. The roost is a simple bar that is elevated above their nesting boxes and easily accessible to the chickens inside the coop.

4. The chicken coop needs to be ventilated and shady. We recommend using chicken wire for your coops walls. If Tucson goes through a very cold winter, with many freezing nights, like this past winter, we recommend covering the walls with cloth. In the summer time, however, chickens are susceptible to heat exhaustion if they do not have regular access to food, water, and shade. We recommend you build your chicken coop roof near a tree and with a solid material. (This will allow you to collect rainwater off of your roof too!)

5. Your chicken coop needs to be built downslope from your garden and your cured compost so rainwater doesn't accidentally carry any pathogens into either system.

6. Include a number of nesting boxes in which chickens can lay eggs. An ideal nesting box has a door on the outside of the chicken coop to make harvesting easier. We recommend one box for every 2 or 3 chickens.

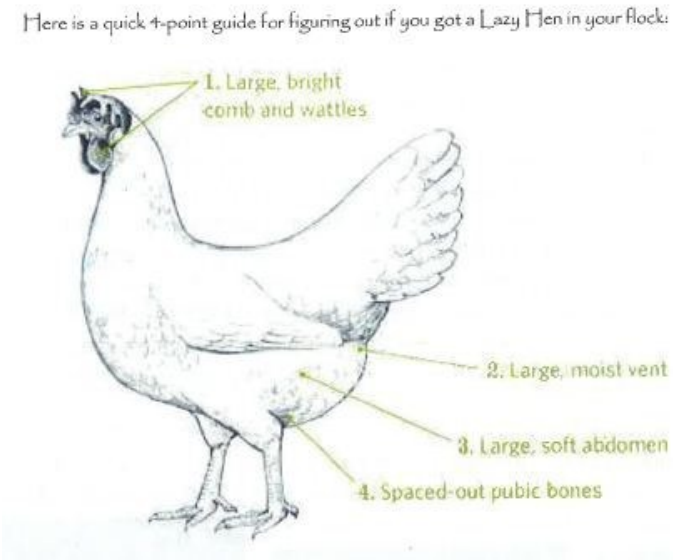
7. Chickens need different kinds of food at different stages of their life. Once they begin to lay, they should be fed layer pellets to help give them a balanced diet. Feeding them food scraps, including eggshells, is also ideal. Chickens are carnivorous and like to forage for weeds, bugs, and grubs.

Note: You DO NOT need a rooster for eggs. We strongly discourage adding a rooster to your chicken flock.

These are images of the Manzo Chicken coop.
They have a rain cistern that collects water from the chicken coop roof. On the top shelf, they store smaller, hand tools and chicken coop supplies, while the bottom level walls store their larger shovels and pitch forks.

Chicken Health Basics

Sometimes in a flock you will get a Lazy Hen or a hen that will not lay eggs. A Healthy hen will lay approximately 20 dozen eggs a year and can live more than 10 years.



To determine if you have a Lazy Hen, an adult should inspect the following aspects of a check, while wearing disposable gloves:

1. Check out their combs and wattles. Lazy Hens have smaller combs and wattles.

2. Pick up each hen and look at her vent. A good layer has a large, moist vent. A Lazy Hen has a tight, dry vent.

3. Put your hand on the hen's abdomen. It should feel round, soft and pliable, not small and hard.

4. With your fingers find the pubic bones (they are between their breastbone and vent). With a good layer, you can press 2-3 fingers between the pubic bones and 3 fingers between the breast bone and the pubic bone. A Lazy Hen has pubic bones that are close and tight.

Health Concerns

Watch out for any ill hens. The rest of the flock with peck at an ill chicken, often until it bleeds or dies. If you notice chickens are behaving this way, put the ill chicken in a separate cage with water and food. Cover the cage with a cloth or put up an opaque barrier between the cage and the rest of the chickens. The flock will not attack if the ill chicken is contained and hidden.

More Resources

Tucson Poultry, Pigeon and Ornamental Fowl Association—facebook.com/TucsonPoultry

City Chicks by Patricia Foreman

Avoid the Vet: How to Keep Your Birds Healthy and Happy by Practical Poultry

Backyard Livestock: Raising Good, Natural Food for Your Family by Steven Thomas

Backyard Market Gardening: The Entrepreneur's Guide to Selling What You Grow by Andy Lee and Patricia Foreman

Backyard Poultry Naturally: A Complete Guide to Raising Chickens Naturally by Alanna Moore

Chicken Coops: 45 Building Plans for Housing Your Flock

Chickens in Your Backyard: A beginner's Guide

How to Raise Chickens: Everyting You Need to Know by Christine Heinrichs

Keeping Chcickens! Tending Small Flock in Citis, Subrubs, and Other Small Spaces by Barbara Kilarski

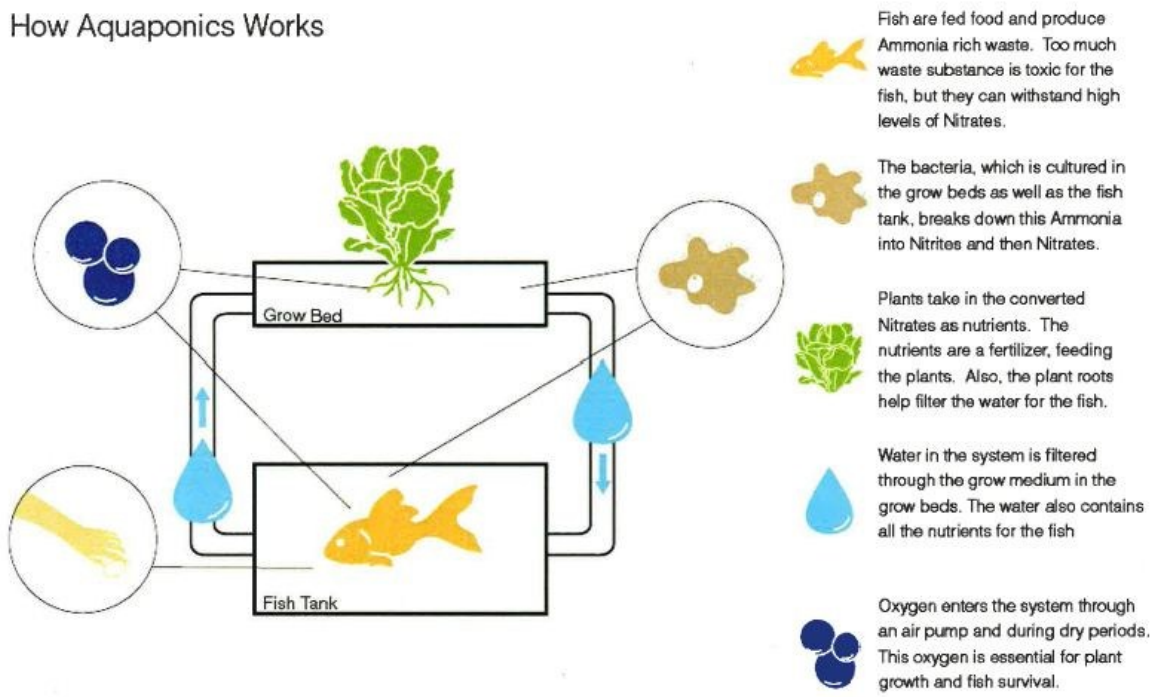
Keeping Chickens: The Essential Guide to Enjoying and Getting the Best From Chickens by Jeremy Hobson and Celia Lewis

Success with Baby Chicks: A Complete Guide to Hatchery Selection, Mail-Order Chicks, Day-Old Chick Care, Brooding, Brooder Plans, Feeding, and Housing by Robert Planmondon

Aquaponics

Aquaponics is the process of raising fish and plants in a re-circulating system. The basics of an Aquaponics system include: fish tank(s), a fish feeder on a timer, grow bed(s), a pump and piping to circulate the water from the fish tank through the grow beds and back again. The fish waste becomes the plant fertilizer; while the plants filter the water for the fish.

Aquaponics, when practiced correctly, relies on beneficial bacteria (Nitrosomonas bacteria and Nitrobacter) which converts the ammonia fish excrete to nitrite and then nitrate via the nitrogen cycle. Plants convert the nitrate into amino acids.



For schools, aquaponics systems provide a wealth of teaching prompts for many ages. It is *extremely important* that the aquaponics system is well maintained and monitored *weekly*. Like compost, aquaponics is a living system that needs care and attention. Included on the next pages and in the companion file are aquaponics signs we've developed to make it easy for students to be involved in the process.

There are countless ways to build an aquaponics system. Please come to our Aquaponics Workshop and reach out to other organizations and businesses specializing in Aquaponics.

The following resources can help you build and maintain your system:

Backyard Aquaponics—backyardaquaponics.com

Aquaponics USA—Aquaponicsusa.com/Aquaponics_USA_Products.html

Local Roots Aquaponics—localrootsaquaponics.com/systems.html

Aquaponics Community Forum—Aquaponicscommunity.com

Tucson Resources

Tucson Aquaponics—tucsonap.com

EcoGro Tucson—Ecogrohydro.com

Growers House Hydroponics Supplies—Growershouse.com/about-us

Sea Of Green (on 4th)—Sea-of-green.com

Arbico Organics—Arbico-organics.com

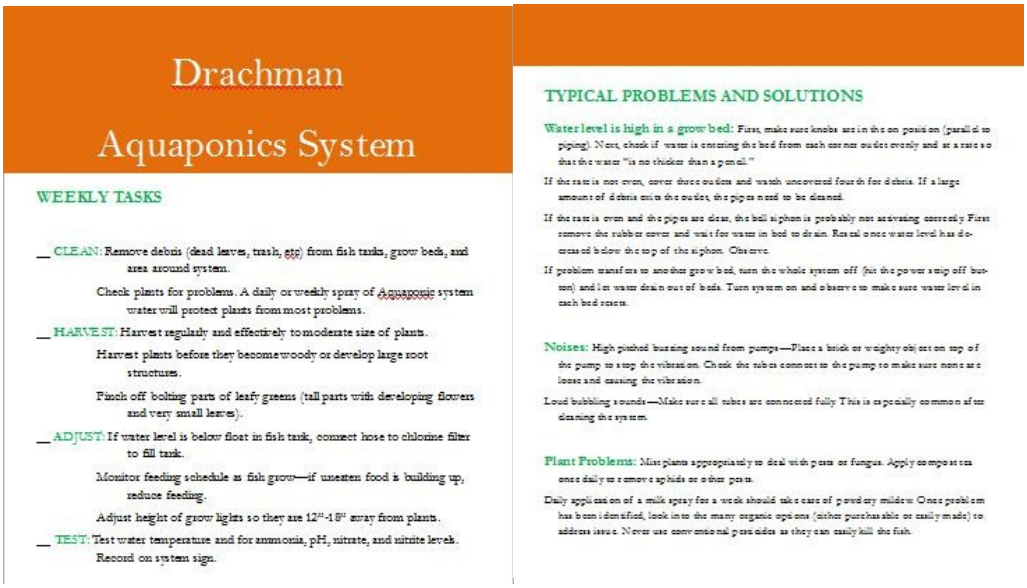
Tilapia Feed Suppliers

Theaquaponicstore.com/AquaOrganic-Organic-Fish-Food-s/126.htm

Premiumfishfood.com/aquaculture-aquaponics-fish-food/tilapia-food.html

These signs were developed for Drachman School, a Montessori magnet school in TUSD. These can be found in the companion file. Feel free to modify them as you need for your school community. We recommend laminating these so students can use dry erase markers on these, like the compost signs.

This first sign outlines the weekly maintenance tasks for an aquaponics system. The reverse highlights typical problems and solutions.



Drachman

Aquaponics System

WEEKLY TASKS

__ CLEAN: Remove debris (dead leaves, trash, etc) from fish tanks, grow beds, and area around system.

Check plants for problems. A daily or weekly spray of Aquaponic system water will protect plants from most problems.

__ HARVEST: Harvest regularly and effectively to moderate size of plants.

Harvest plants before they become woody or develop large root structures.

Pinch off bolting parts of leafy greens (tall parts with developing flowers and very small leaves).

__ ADJUST: If water level is below float in fish tank, connect hose to chlorine filter to fill tank.

Monitor feeding schedule as fish grow—if uneaten food is building up, reduce feeding.

Adjust height of grow lights so they are 12"-18" away from plants.

__ TEST: Test water temperature and for ammonia, pH, nitrate, and nitrite levels. Record on system sign.

TYPICAL PROBLEMS AND SOLUTIONS

Water level is high in a grow bed: First, make sure knobs are in the on position (parallel to piping). Next, check if water is entering the bed from each corner outlet evenly and at a rate so that the water "is no thicker than a pencil."

If the rate is not even, cover three outlets and watch uncovered fourth for debris. If a large amount of debris exits the outlet, the pipes need to be cleaned.

If the rate is even and the pipes are clear, the bell siphon is probably not activating correctly. First remove the rubber cover and wait for water in bed to drain. Recall once water level has decreased below the top of the siphon. Observe.

If problem transfers to another grow bed, turn the whole system off (hit the power strip off button) and let water drain out of beds. Turn system on and observe to make sure water level in each bed resets.

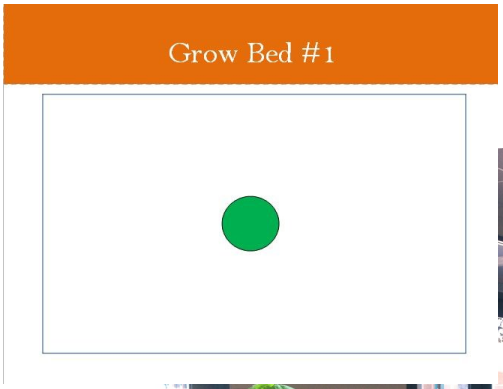
Noises: High pitched buzzing sound from pumps—Place a brick or weighty object on top of the pump to stop the vibration. Check the tubes connect to the pump to make sure none are loose and causing the vibration.

Loud bubbling sounds—Make sure all tubes are connected fully. This is especially common after cleaning the system.

Plant Problems: Mist plants appropriately to deal with pests or fungus. Apply compost tea once daily to remove aphids or other pests.

Daily application of a milk spray for a week should take care of powdery mildew. Once problem has been identified, look into the many organic options (either purchasable or easily made) to address issue. Never use conventional pesticides as they can easily kill the fish.

This sign was developed so students could easily label what is growing in each grow bed, without the labels getting wet or lost. At Drachman, we have four signs, one for each grow bed. This is a very simple sign but indicates where the central pump is and the boundaries of the grow bed. As shown, it is laminated and hangs on the outside of the grow bed for ease of access and use.



Grow Bed #1

This sign is the main repository for weekly data collection. There is a column for students to assess whether the data indicates the water is in the ideal range and how it compares to the previous weeks data. This will help you monitor and anticipate any problems or changes in your system.

Drachman Aquaponics System

Date		Ideal	Low? High? Good?	Compared to Last Week?
Temperature		77-86 °F		
Ammonia		0-0.25ppm		
pH		6.8-7.5		
Nitrate		0-100 ppm		
Nitrite		0-0.45ppm		

These signs are student friendly checklists to help them test the aquaponics system water. These signs can be kept with the water testing kits or in the classroom.

Drachman Aquaponics System
pH Card

_____ Collect 5ml of water from fish tank in tube
_____ Add 3 drops from [pH Test Solution]
_____ Put cap on tube and shake for 5 seconds
_____ Wait 5 minutes
_____ Compare water color to [Freshwater pH Color Card]
_____ Write pH number on main sign
_____ Pour out tube in sink and rinse. Return pH bottle, tube, and color card to test kit box

Drachman Aquaponics System
Nitrite Card

_____ Collect 5ml of water from fish tank in tube
_____ Add 5 drops from [Nitrite Test Solution]
_____ Put cap on tube and shake for 5 seconds
_____ Wait 5 minutes
_____ Compare water color to [Fresh and Saltwater Nitrite (NO_2) Color Card]
_____ Write ppm number on main sign
_____ Pour out tube in sink and rinse. Return Nitrite bottle, tube, and color card to test kit box

Drachman Aquaponics System
Temperature Card

_____ Hold thermometer in fish tank
_____ Read temperature after the numbers stop changing
_____ Write temperature on main sign
_____ Return thermometer to top of the fish tank

Drachman Aquaponics System
Ammonia Card

_____ Collect 5ml of water from fish tank in tube
_____ Add 8 drops from [Ammonia Bottle #1] and [Ammonia Bottle #2]
_____ Put cap on tube and shake for 5 seconds
_____ Wait 5 minutes
_____ Compare water color to [Freshwater Ammonia (NH_3/NH_4) Color Card]
_____ Write ppm number on main sign
_____ Pour out tube in sink and rinse. Return Ammonia bottles, tube, and color card to test kit box

Drachman Aquaponics System
Nitrate Card

_____ Collect 5ml of water from fish tank in tube
_____ Add 10 drops from [Nitrate Bottle #1]
_____ Put cap on tube and shake for 30 seconds
_____ Add 10 drops from [Nitrate Bottle #2]
_____ Put cap on tube and shake for 1 minute.
_____ Wait 5 minutes
_____ Compare water color to [Freshwater Nitrate NO_3 Color Card]
_____ Write ppm number on main sign
_____ Pour out tube in sink and rinse. Return Nitrate bottles, tube, and color card to test kit box

Safety on the Farm Considerations

Equipment

- Do not use building materials from questionable sources. For the fish, in particular, be sure to use either plastic barrels or tubs safe for storing food products. Make sure to know past uses of barrels or tubs before installing them into the system.
- Use a colored (e.g. blue or green) barrel or tub to cut down on algae growth. Avoid black barrels as they are used primarily for chemical storage.
- In constructing the system, be sure to take necessary safety precautions and wear safety gear especially when using power tools.
- Before adding water into the system, fish tanks, in particular, should be sterilized with Hydrogen Peroxide or bleach. The system should run with water, but without fish or plants, for at least 2 days to ensure the sterilizing agent has been removed from the system.
- Use durable grow bed media that will not break down over time. Expanded clay, though sometimes more expensive, is recommended as it is pH neutral, easy to plant in, and keep clean

Fish

- If necessary, apply for a permit and/or request permission to raise fish (we recommend Oreochromis aureus, commonly known as Blue Tilapia) from your state and/or local officials
- Fish from aquaponics system will not be introduced into local ecosystems. They will remain in aquaponics system for the duration of their life.
- Maintaining a stress free or low stress environment for the fish culture is key.
- Introduce only healthy fish to the system. This will cut down on potential health problems in the future.
- Maintain a constant water temperature at which it is optimal for fish to grow and live. (Optimal temperature for tilapia, for example, is between 82-86*F (28-30*C). Growth rate will decrease and death rate will increase if water temperature drops below 68*F (20*C). Cold water will affect the immune system of the fish and increase stress in the environment.)
- Watch feed levels. If the fish are being overfed, the water will turn cloudy unless there is a toxin problem.
- Stocking: Optimal stock density is dependent on fish and system size. As a general rule, the higher the stocking density, the higher the stress in the environment. One recommendations suggests optimal stocking is around 20-25 tilapia fish for every 500L of growbed media in system, assuming growbeds are around 25-30cm deep.[3]

- Diseases: Diseases are somewhat fish specific and result in aquaponics system if fish are already infected or live in high-stress environments. Close monitoring of a system will most likely prevent a high-stress environment from developing and thus prevent disease outbreaks. If an outbreak does occur, reexamine and adjust environment to decrease stress first, before resorting to vaccines, which are only proven to stop disease from progressing and are not a permanent solution or cure.

Water

- Use potable water from city. For the health of the fish and the beneficial microbes, it is ideal the potable water flow through a chlorine filter before entering fish tank. If using catchment rainwater, follow guidelines to keep the rainwater free of contamination, especially from rooftop debris or fecal matter.
- Test water pH,ammonia, nitrite, and nitrate levels before adding water to system and daily until system stabilizes. After stabilization, test water weekly. Record all test results in a log book.
- If necessary, use un-iodized salt (preferably sea salt) to raise pH and vinegar to lower it. Until the system stabilizes, there is a high likelihood of fish death. Using cheap feeder fish (i.e. goldfish) and easy growing seeds in grow beds (e.g. beans or lettuce) first will help system stabilize quickly and cheaply.
- Beginning stage 1: High levels of ammonia will quickly occur within system as the fish will be producing it before the nitrifying bacteria have built up. (Nitrosomonas bacteria oxidize ammonia into nitrite.) If fish deaths occur, remove some water and add fresh, de-chlorinated, filtered or sterilized water to the system. The ammonia level will reach zero once the nitrifying

Safety on the Farm Considerations

bacteria population has reached equilibrium.
- Beginning stage 2: Nitrite levels will then increase until the Nitrobacter population has built up and reduces the nitrite level roughly to zero. (Nitrobacter oxidize nitrite into nitrate as part of the nitrogen cycle.) This stage can take up to a month to stabilize. After stabilization, if nitrite levels start to rise, the system needs more plants growing in the beds to return to stable state.
- Once system has stabilized, remove feeder fish and replace with Tilapia. Feeder fish should not enter local ecosystem, but disposed of (ideally fed to chickens).
- Ammonia levels under 1.0 ppm are ideal. If it goes above 2.0 ppm, there is a problem within the system and will most likely result in a high-stress environment for fish which will cause disease and deaths.
- Sharp fluctuations of pH will also create a high-stress environment for the system.
- pH Levels should remain above 7.0 but below 8.0 for ideal conditions for bacteria life and system health.
- Lowered water flow into the system may be due to biofilm or algal build-up in the piping, pump inlet, and/or siphon. Removal of biofilm and algae if necessary is recommended. For well monitored systems, it is ideal to return biofilm to the grow beds as it is part of the biological system and beneficial to the bacterial life. Excessive build-up of algae should be removed from the system as needed. To prevent algal build-up, direct water flow directly into media in grow beds and keep the level below the top of media. Additionally, adding composting worms to the system will help consume algae and old root matter. If root growth restricts drains and water outlets, bend one end of a thin, sturdy wire into a cork screw, and insert into the piping to rip out root ends.
- Keep an extra pump or rebuild kit on hand in case of pump failure.

Harvesting
- Persons feeling ill or having stay home sick within the last two weeks should not participate in the harvest. Follow harvest, cleaning, and storage sections of Garden-to-Cafeteria guidelines. It is highly important and mandatory that all surfaces that touch the produce or fish (knives, containers, hands, etc) be sanitized and washed thoroughly prior to contact.
- Plants: Harvest as needed. Do not use or touch water within aquaponic system while harvesting. Use clean (preferably sterilized) tools to harvest. Wash plants immediately after harvest with fresh water and before consumption.
- Fish: To harvest and process fish, it is ideal to have a trained harvester/processor on site. Harvesters must not be immune-compromised.
- Prior to harvest date, it is recommended that the aquaponics coordinator withhold feed for 1 to 3 days to clear the intestinal tract of any potentially harvestable fish. This will cut down problems in processing.
- Care should be taken so that no harvesters accidentally puncture prior to or during harvest/processing. Topical infections of zoonotic diseases (diseases from animals to humans) occur as a result of injuries from a fish's spines, knife accidents, and through contamination of open wounds.
- Basic requirements for a processing set-up involve a room with proper ventilation, cutting tables at height comfortable for a person filleting the fish, hot and cold potable water, ice, waste disposal system, cleaning system (including an area for people to wash properly), proper drainage, refrigerated storage for processed and iced fish, freezer, scales if necessary to weigh fillets, and dry storage for packaging materials.[4] In addition to materials available from the F.D.A, detailed Arizona and Tucson-specific information for processing facilities can be found with the Pima County Health Department[5] and the Arizona Department of Health's office of Environmental Health.[6]
- Proper procedures for processing fish are detailed in the paper "Processing and Marketing Aquacultured Fish" (Regenstein, Cornell University. Can be found in Note 2.)

Student Farmers' Markets

Student Farmers' Markets can be a great way to connect with your school community and generate a little income for your garden efforts.

We recommend hosting the market at a time when parents will be on their way to school, like at dismissal or at a community event.

Any produce you sell should be harvested within 24 hours or less of the market.

Work with your students to decide what to sell and corresponding prices and amounts. This can be an excellent way to reinforce basic arithmetic skills.

This Market Log was developed for the Student Farmers Market at Drachman Montessori School. It is set up so the students are able to record their involvement (set up or sales), goods with unit quantity and unit price, and each sale. The log requires them to do basic a multiplication for each sale. Selling to customers and totaling their sales at the end of the market are two ways the market helps to reinforce your students addition and subtraction skills.

Keep these logs in a single binder, organized by date, so students can track the success of the market for another math project.

FARMERS MARKET LOG

Farmers (Set Up):			Farmers (Sales):			
Starting Cash:				Ending Cash: (Starting $$ +Total Sales)		
Starting Produce:	Basil	Eggs	Chard	Lettuce		
Starting Unit Quantity:	18 bags/1 ounce	4 eggs/1 carton	4 leaves	10 bags/4 ounces		
Unit Price:	$0.50	$1	$1	$1		

#	Item		Amount		Unit Price	Total
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
TOTALS		Remaining Basil	Remaining Eggs	Remaining Chard	Remaining Lettuce	$ Sum of Lines 1-12

(Page) 1 of 3 School: Grade: Class Date

Students are buying and selling garden produce at Manzo's biweekly Student Farmers Market.

Help! Students are in the Garden!

Sometimes having a students in the garden can be an overwhelming experience. Here are some recommendations for working with your students in the garden.

SMALL GROUPS

It is much easier to work with students if they are in small groups. If you know you will have a large group in the garden, think about ways to break the students up into different tasks (like described in the Tips for Transplanting section).

Talk with your schools teachers about ways to have smaller groups and/or more supervising adults in the garden at one time.

STUDENT INTERESTS

Pay attention to what your students are drawn to in the garden. Some may be focused on composting, while others may always want to observe and draw plants as they grow. The great thing about involving students in the garden is that there are countless learning opportunities.

As often as possible, ask your students what they would like to see growing in the garden and find those seeds. Following through with a students requests will most likely increase their involvement in the garden and could change their eating behavior.

CONNECTIONS

Connect your students experiences in the garden with what they are learning in the classroom. Use the garden time to pose or answer questions, Help your students connect their academics with their environment often. Resources for garden based curriculum are provided in the next chapter.

EXPLORATION

Time in the garden can be time for exploration. So much of the school day is regimented and predetermined. Make space for your students to think about what they would like to do in the garden, Older students, in particular, may have ideas for projects or experiments they would like to run. Giving them space to take initiative and follow through on their own project is a skill often lost or undervalued in traditional educational systems.

EVENTS

Students can help plan events in the garden or to benefit the garden. They may want to have a music performance or a work day to replant a bed.

RESPONSIBILITY

Many school garden initiatives try to involve as many students as possible into each garden activity. While there is enormous merit to this process, the garden will then need extra and regular support from many adults. Students, beginning around 4th grade, can be responsible for running the garden. Like with the compost system, we highly recommend that you involve the same students in the same activities multiple times a week for at least an entire semester or longer.

While this may reduce the immediate number of students involved, it will help in two key ways: 1) the garden will be better maintained and will have the ability to grow, and 2) students will learn essential life skills, like discipline, team work, and responsibility within a community.

Increasing a students' sense of ownership over a project and providing ways for them to share their success will bolster their confidence and sense of self. Gardens provide a totally different outlet for students to shine at school. Supporting student involvement in this way could effect the student's success in the long run.

Grow Your Garden in New Exciting Ways

There are so many other possible components to a school garden. Assess what your school community would like and would benefit from having. There may be school community members with hidden talents and passions that you could utilize in your garden. Think about ways to partner with other organizations in Tucson that might not be typical garden partners.

Here some additional garden ideas:

- Bee Keeping
- Art in the Garden
- A greenhouse
- Hoop Houses
- Container Gardens
- Desert food/Native plants Garden
- Kino Heritage Garden
- Butterfly Garden
- Herb Garden
- Solar Oven
- Outdoor sink
- Greywater system
- Seed Saving
- Community Garden plots
- Natural habitat or Wildlife Observation stations

Theme Gardens:

For more ideas on themes for your garden or garden beds, check out the School Garden Wizard website—schoolgardenwizard.org/wizard/learn/teach_themes.html

Alternative PE: It took an entire class at Manzo to pull out this squash vine during a game of tug-of-war.

Reference Guide

1. Potter, Beatrice. *The Complete Tales of Beatrix Potter*. London,England: Frederick Warne Publishers, 1989.
2. Rainwater Harvesting Resources for Schools, Handout from the Community Food Resource Center.
3. Backyard Aquaponics. "The IBC of Aquaponics" Edition 1, 2011. backyardaquaponics.com/Travis/IBCofAquaponics1.pdf (12)
4. Regenstein, Joe M. "Processing and Marketing Aquacultured Fish" Notheastern Regional Aquiculture Center. aqua.ucdavis.edu/DatabaseRoot/pdf/NRAC140.PDF (1)
5. Pima County Health Department. "Consumer Health & Food Safety." pimahealth.org/healthfood/
6. Arizona Department of Health Services. "Office of Environmental Health: Food Safety and Environmental Services." azdhs.gov/phs/oeh/fses/index.htm

COMMUNITY FOOD BANK
OF SOUTHERN ARIZONA

Garden Bridges

Connect with Garden Curriculum

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What good is a school garden if the garden doesn't connect with the school? Hopefully, you have built your garden with the help of teachers, parents, school staff, and students. Now it's time to connect the garden with formal classroom instruction.

At Davis Bilingual School, the librarian is in charge of the aquaponics system and has used it as a focal point for many of her lessons. For older students, the aquaponics tanks are the perfect hands on example to understand the concept of volume. Teachers in charge of the student farmers market can use the data from the market for math lessons. Art teachers can take students out to the garden for observation and drawing. Chemistry and Biology teachers can use the compost system, the aquaponics system, or the garden beds themselves to discuss scientific processes like photosynthesis, nutrients, and the role of bacteria on earth. When working on writing skills, teachers can use any aspect of the garden as a writing prompt, from the aquaponics fish to the ladybugs to the plants themselves. Additionally, volunteers interested in working with students can use garden-based curriculum while students spends time in the garden during the school day or in an afterschool program. The possibilities are endless.

Teachers, we know you are incredibly busy and currently have an immense amount of curriculum to cover in a single year. We hope that the garden-based learning resources provided in this section will be used to supplement or substitute more standardized topics. Parents and volunteers, talk with your teachers about ways you can help them incorporate garden-based curriculum into their school year. And remember, start small. Try for one garden-based lesson once every couple of months, before moving to once a month, once a week, or everyday. School gardens are a learning and growing process for everyone involved.

Borton has a display board full of photos and stories about the insects students have found in the garden.

Garden Based Learning Resources

These resources can be accessed online:

Arizona Cooperative Extension's Agricultural Literacy Program for Maricopa County—Available on this site are lessons written by Arizona Teachers, activities, and programs.—cals.arizona.edu/agliteracy/

One notable program is the Project Food, Land and People. This project has produced 55 comprehensive lesson plans which have been aligned with Arizona's Academic Standards. The lesson plans can be ordered through Project Food, Land, and People (foodlandpeople.org/ordering/) or found here on the Cooperative Extensions website—cals.arizona.edu/agliteracy.flp.htm

Arizona Farm Bureau Ag in the Classroom—Curriculum resources and help coordinating farm field trips—

azfb.org/public/483/programs/aitc_field_trips

California Department of Education

Nutrition to Grow On curriculum—cde.ca.gov/ls/nu/he/nrttogrow.asp

Kids Cook Farm-Fresh Foods curriculum—cde.ca.gov/ls/nu/he/kidscook.asp

California Foundation for Agriculture in the Classroom,

All Lesson Plans—learnaboutag.org/lessonplans/

WE Garden Resources—cfaitc.org/wegarden/

California School Garden Network—Gardens for Learning Guidebook, free downloadable pdf—

csgn.org/store/gardens-learning

Center for Ecoliteracy—ecoliteracy.org

Center for Environmental Education—ceeonline.org

Classroom Earth: A National Environmental Education Foundation Program—The Classroom Earth Resource Library provides resources to integrate environmental education into K-12 education in the following subject matters: Foreign Languages, Language Arts, Mathematics, Science, Social Studies, and The Arts—

classroomearth.org/node/29

Cooking with Kids Inc—Based in Santa Fe, NM, Cooking with Kids works with public school students and teaches hands-on classes about cooking, nutrition, and food—Full curriculum and free educational materials available—cookingwithkids.net

Cornell Garden Based Learning—blogs.cornell.edu/garden/get-activities/signature-projects/

Eat Think Grow—An organization the provides support and K-5 curriculum for Farm to School programs in the Pacific Northwest—eatthinkgrow.org

Edible Schoolyard—edibleschoolyard.org/reources-tools

GardenABCs Lesson Plans and Curricula—gardenabcs.com/Lessons.html

George Watts Montessori Edible Garden—Lessons for Classroom and Garden aligned with North Carolina curriuculm standards for Lower and Upper Elementary grades

Lower Elementary—growinggardeners.files.wordpress.com/2010/09/lcng_lower_el.pdf

Upper Elementary—growinggardeners.files.wordpress.com/2010/09/lcng_upper_el.pdf

Granny's Garden School—Lesson guides aligned with Ohio curriculum standards—

grannysgardenschool.org/600-0-00-a-about-Lesson-plans.html

Green Teacher—A magazine that produces environmentally-minded educational resources. Sample activities and lesson plans can be found at—greenteacher.com/articles.html

and in Spanish at—greenteacher.com/espanol5-12.html

Growing Minds, Farm to School—Applacahian Sustainable Agriculture Project program—Provides database of garden-based curriculum and literature—growing-minds.org/childrens-literature/

The Huntington Library—Library, Art Collections, and Botanical Gardens in San Marino, CA—Garden Lesson plans can be found at—huntington.org/huntingtonlinrary.aspx?id=1710

Junior Master Gardener—jmgkids.us

Kids in Need Foundation Award Winning Classroom Projects—This collection of award winning classroom projects has curriculum available by subject and divided by grade. There are garden-related or garden-based projects in every subject, except for History.—kinf.org/projects/

LifeLab—An organization dedicated to garden-based education—

lifelab.org/for-educators/schoolgardens/

Lifelab.org/for-educators/gene/

Lifelab.org/2010/02/free-garden-science-exploration-units

Life Learning Academy—Organic Opportunities curriculum on Gardening and Entrepreneurship, Culinary Arts, and Math/Construction—

lifelearningacademysf.org/pdf/curricula/6.5_EarthCurricula_OrganicOpportunities.pdf

National Environmental Education Foundation, Environmental Education Week—K-12 School Garden Curricula selected due to alignment with state, national, and/or NAAEE educational standards—

Eeweek.org/resources/garden_curricula.htm

National Gardening Association, Kids Gardening—

Classroom projects—kidsgardening.org/classroom-projects

School Garden Activities—kidsgardening.org/school-gardening-activities

Lessons and Activity Ideas index—kidsgardening.org/lesson-and-activity-ideas#

National Organization Agriculture in the Classroom—AITC has provided a number of resources including lesson plans and quizzes about agriculture on their website. Under "Teacher Center," lesson plans and quizzes (under "Ag-Knowledge" are available—agclassroom.org/teacher/

Nature's Partners, Pollinators, Plants, and You—Pollinator curriculum for 3-6—

pollinator.org/nappc/PDFs/curriculum.pdf

Network for a Healthy California- Northcoast Region—

Garden-based nutrition education initiative lessons—

northcoastnutrtition.org/garden=based-nutrition-education-27

Harvest of the Month—harvestofthemonth.cdph.ca.gov/download.asp

Nourish—A food literacy initiative based in California. Middle School Curriculum guide aligned to national standards for Social Science, Science, Health, and Language Arts—Spanish Handouts available—Nourislife.org/teach

Outdoor Biology Instructional Strategies–Inquiry-based science curriculum—outdoorbiolody.com/search/site

Smithsonian Education—Not all of the lesson plans provided by the Smithsonian are garden-based or garden-related, however, you can search for curriculum by subject matter, grade, and Arizona Standards or Arizona Mathematics Common Core Standards.—smithosnianeducation.org/educators/index.html

USDA Food and Nutrion Service

Farm to School Program—fns.usda.gov/cnd/F2S/school_gardens_and_garden)curriculum.htm

Resource Library—Grow It, Try It, Like It! Preschool Fun with Fruits and Vegetables garden-themed nutrition education—teamnutrition.usda.gov/Resources/growit.html

University of Arizona, Department of Biochemistry and Molecular Biophysics—General Biology Lesson Plans—biology.arizona.edu/sciconn/lessons2/lessons.html

Vermont FEED—An organization dedicated to Farm to School food education, based in Vermont—Classroom resources can be found at—vtfeed.org/tools (select "Classroom")

Wisconsin Department of Health Services—Got Veggies? Garden-based nutrition education curriculum created to increase student consumption of fresh fruits and vegetables—dhs.wisconsin.gov/health/physicalactivity/gotveggies.htm

Books Available on Garden-Based Curriculum and Gardening with Students

Backyard Composting: Your Complete Guide to Recycling Yard Clippings—
betterworldbooks.com/9780962976834-id-9780962976834.aspx

Beyond the Bean and Seed: Gardening Activities for Grads K-6—
acornnaturalists.com/store/basket.aspx?UserID=56303516&SessionID=iOylUzYA42JMGLvC5HMU

The Book of Gardening Projects for Kids: 101 ways to get KIDS outside, DIRTY, and having FUN—
lifelab.org/store/curriculum/#mag

Compost Stew—A children's' storybook—amazon.com/Compost-Stew-Mary-McKenna-Siddals/dp/1582463166

Digging Deeper: Integrating Youth gardens into Schools and Communities—communitygarden.org/acga-store.php

French Fries and the Food System: A Year Round Curriculum Connecting Youth with Farming and Food—
thefoodproject.org/books-manuals

Green Thumbs: A Kids Activity Guide to Indoor and Outdoor Gardening—
betterworldbooks.com/9781556522383-id-9781556522383.aspx

Grow Your Own Pizza: Gardening Plans and Resipes for Kids—
amazon.com/Grow-Your-Own-Pizza-Gardening/dp/1555913989

The Growing Classroom—lifelab.org/store/curriculum/

Growing Food: Inquiry-based Science and Nutrition Program (Teachers College)—gardeningwithkids.org/11-3345.html

Growing A Garden City: How Farmers, First Graders, Counselors, Troubled Teens, Foodies, a homeless shelter chef, single mothers, and more are transforming themselves and their neighborhoods through the intersection of local agriculture and community--and how you can, too—betterworldbooks.com/9781616081089-id-9781616081089.aspx

Growing Together: A Guide to Building Inspired, Diverse and Productive Youth Communities—
thefoodproject.org/books-manuals

GrowLab: A complete Guide to Gardening in the Classroom—gardeningwithkids.org/10-4009.html

GrowLab: Growing Activites for Growing Minds—gardeningwithkids.org/10-4008.html

Junior Master Gardener—gardeningwithkids.org/junmasgarpro.html

Kids' Garden Activity Cards: 40 Fun Indoor and Outdoor Activites and Games—lifelab.org/store/curriculum/#mag

Kid's Gardening: A Kids Guide to Messign Around in the Dirt—
betterworldbooks.com/9780932592255-id-9780932592255.aspx

Learn and Play in the Garden: Games, Crafts, and Activities for Children—
barnesandnoble.com/w/learn-and-play-in-the-garden-meg-herd/1003116628

LiFE Series Curriculum Set—gardening withkids.org/life-series-curriculum-set.html

LifeLab Science K-5 Garden-Based Curriculum—One book for each grade—lifelab.org/store/curriculum/#mag

Maize Activity Gude for 5th to 8th Graders—lifelab.org/store/curriculum/#mag

Math in the Garden—gardeningwithkids.org/11-3111.html

Nourishing Choices—gardeningwithkids.org/11-3410.html

Patty's Pumpkin Patch—A children's storybook— amazon.com/exec/obidos/ASIN/0399230106/wwwterisloaco20

Planting Seeds: Practicing Mindfulness with Children—parallax.org/cgi-bin/shopper.cgi?preadd=action&key=BOOKPS

Project Food, Land, & People—foodlandpeople.org/resources/new_order_form_2011.html

Ready, Set, Grow: A Kids Guide to Gardening—betterworldbooks.com/9781596471320-id-9781596471320.aspx

Using Live Insects in Elementary Classrooms for Early Lessons in Life (University of Arizona)—insected.arizona.edu/uli.htm

Cafeteria Eats

A few ways beyond curriculum to connect to the garden include encouraging your school or school districts food service to source cafeteria food locally, establish a regular salad bar (hopefully with fresh produce from your school's garden), and establish a model eating program.

A model eating program is a simple way for adults (teachers, staff, parents, or volunteers) to demonstrate healthy eating habits. This kind of a program would require an adult to eat lunch with students in the cafeteria, as often as possible. The "model eater" will bring a healthy lunch to the cafeteria or pick the healthiest options from the school lunch. They can use the time to bond with students and encourage them to try or finish the vegetables and fruit on their plate.

These kinds of programs can help to reinforce good eating behaviors and the importance of fresh food in one's diet.

Manzo students regularly enjoy days when they pick produce and add it to the juicer. Combining harvesting and eating (or drinking) in a non-traditional way encourages students to consume healthy foods, while providing an exciting way to strengthen their knowledge of nutrition and balanced meals.

Model School Gardens in Tucson

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This toolkit is based on of research and experience working with school gardens here in Tucson. Some of our schools have developed remarkable school garden programs. If you have the opportunity, please visit any of the following schools to get a sense of how successful your school garden can be.

Manzo Elementary School

Manzo has received a great deal of media attention recently, and rightfully so. The school has focused its entire curriculum on ecology and uses the garden's many components to reinforce the academic learning. Manzo has raised more than $100,000 to support and build its reconciliation ecology program and garden. The garden has brought the school community closer which allowed them to successfully organize and save the school during the last round of TUSD school closings.

Students are involved in every aspect of the garden. Slowly but surely more parents are regularly involved as well as teachers and school staff.

There are countless reasons to get involved in the garden but here are few of the main features.

Tortoise habitat

Students helped build this desert habitat in one of their school's courtyards. The students carried in the stones for the habitat's wall as part of their PE class for a few weeks. The habitat is designed to be like a native desert habitat. The resident tortoise does not receive additional feed or water, as it survives off the native plants installed by students and rain water.

Compost system

Students volunteer to be on compost shift teams. They give up part of their recess to do it. When the system first started up, the students took forty minutes (all of their recess and some class time) to run a shift. Now they are down to an average of 6 minutes. There are three shifts a day with a team of three or four students each who operate the compost system. Giovani (age 10)and Johncarlos (11) irrigate the compost during morning recess everyday. Elizabeth (10) and Zamantha (10) collect food scraps during lunch three times a week. Melissa (11) works two days a week, weighing food scraps after lunch. Then she and her team add the food scraps to the compost pile or feed it to the chickens. The system we described in "Student Run Composting System suggestions" is based off the Manzo model. Currently, Manzo produces more safe compost than they are able to use, with inputs only coming from their cafeteria.

Farmers Market

The student run farmers market provides fresh vegetables for the families at Manzo during their biweekly Farmers Market. Melissa is

Manzo

one of the students who runs the market. They make approximately $30 in sales each market. This generally covers the cost of their chicken feed. Students regularly collect the data and analyze the data from the market.

Aquaponics

Currently, the Aquaponics System is housed in the Ecology Lab, but will be moved to the newly built on-site Greenhouse. Their system also has four beds and two tanks. They've harvested, smoked, and sold their Tilapia at school events.

Chicken coop

The chicken coop houses 16 free range chickens. The Manzo production garden is fenced off, though sometimes the chickens still make it over into the garden. The chickens roam into the compost and vermicompost bins, which helps aerate and manage the system. To keep their chickens, Manzo spends about $40 a month for feed (supplementing their meals a third of the time with food scraps from the cafeteria). Students keep track of eggs layed, which are then sold in the student farmers market. As noted earlier in this toolkit, the Manzo chicken coop is designed with permaculture principles. It operates as a tool shed, a weather station, and a structure from which they can harvest rainwater, in addition to their 4000-gallon rainwater harvesting system (which collects from the roof of the school).

Davis Bilingual School

Davis Bilingual School has a long history of community involvement in Tucson. Generations within single families have attended Davis and provide the school with a very specific cultural context. The school garden fully embraces the bilingual nature of it's community. All of the signs and much of the garden instruction are in both Spanish and English.

Davis's Mariposa Garden is split between a classroom plot area and a production garden area. The production garden is operated predominately by the Afterschool Program with the help of parents and the University of Arizona community and school garden interns. They classroom plots, one even for a first grade class, are attended to daily.

The Garden incorporates a number of Desert Native plants and Kino Heritage plants in addition to the more common vegetable and herb crops.

They have a chicken coop for their free-range chickens, a toolshed, an outdoor sink, compost bins, a vermicompost bin, a gathering area under a large mesquite tree, and a ramada which helps to collect rainwater in a cistern.

Their aquaponics system is housed in their library. Their librarian uses the aquaponics system to teach students about nutrition and bacteria cycles. In the fall, she had her students hold an aquaponics presentation fair, where they worked in teams and developed presentations on the various aspects of the aquaponics system.

Parents are regularly involved in the Garden Work Days and the Garden Team tries to be present at all of the major school events, like holding a salad booth with games and free salad at their Mariachi festival.

Borton Primary Magnet School

Borton is a great example of a school garden program that has begun to successfully integrate garden-based learning school wide. With the great skills and dedication of their Garden Coordinator, the Borton garden has started small projects and expanded as they mastered one project. They have a school wide plan with themes for garden integration for each grade.

Borton initially focused on container gardens, before building in-ground garden beds. The garden now is designed with production plots, classroom plots, rain water harvesting cistern, chicken coop, and compost bins.

Recently, they have successfully started up a regular compost system. After introducing composting to the school, they have scaled up to a three day a week compost system. The students collect food waste from the cafeteria, compost, and regularly record data using the compost signs we developed. Additionally, they have added a vermicomposting bin.

Borton's school garden has experienced changes in productivity over the years. But their enthusiasm for their garden is stronger than ever.

This is was Borton's original container garden and here is a current picture of the in-ground production beds.

This is one of Borton's classroom plots

Community Support

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Community Food Bank of Southern Arizona

Since its founding in 1976, the Community Food Bank of Arizona has worked tirelessly to meet the needs of those hungry in Tucson, Amado, Green Valley/Sahuarita, Marana, and Nogales. Currently, through TEFAP food boxes and other programs, the Community Food Bank distributes nearly 30 million pounds. It is one of the largest and most successful Food Banks in the United States.

The Community Food Bank serves its community in multiple ways including the Agency Market, Caridad Community Kitchen, Child Nutrition Programs, the Community Food Resource Center, the Food Plus program, and the Gabrielle Giffords Family Assitance Center. CFB strives to reach the entirety of its community by offering its publications in both English and Spanish and having bilingual staff members and translators available. CFB is a leading institution in the fight against hunger and poverty.

Community Food Resource Center

The Community Food Resource Center's vision is to "improve community food security for the people of Pima County by promoting, demonstrating, advocating for, and collaboratively building an equitable and regional food system, which supports food production and strengthens communities." It provides support through three main components: Education and Advocacy, Food Production and Desert Gardening Education, and Farmers' Markets.

This toolkit was produced as part of the Farm to Child program, which was recently awarded the USDA Farm to School Grant. This grant will help provide School Gardening and Farm to School resources at eleven Tucson Unified School District schools and one school within the San Xavier School District. The project will focus on food production and garden-based education; district-level changes to work with local producers; and a farm to school partnership on Tohono O'odham Nation. This program is the only awarded program in Arizona and was part of the first class of grantees.

The Community Food Resource Center's work is one of the ways the Community Food Bank has become a leading Food Bank in the country, The innovative programs developed as part of the CFRC work not only to meet the immediate needs of the food insecure community in this region, but also the long term needs. The CFRC's approach focuses on structural issues that cause hunger and poverty in Arizona. Their programs actively work to better the livelihood of all Arizonans.

Acknowledgments

This toolkit would not have been possible without the entirety of the Community Food Resource Center, particularly the Home Gardening and the Youth Farm Project programs. The information found in this toolkit was pulled together predominantly from their workshops and resources.

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