How Does Your
SCHOOL GARDEN
GROW?

Best Practices for Growing, Harvesting, and Serving School Garden Produce

DEALING WITH
GARDEN PESTS
Tips for building healthy soil, and what to do about invasive species, including snails that might carry rat lungworm

SAFE FOOD PREP
AND TASTING
Guidelines on how to safely allow students to taste the produce they've grown

NO MORE
MYTHS!
Who regulates school gardens in Hawaii? Can produce be used in the cafeteria? Can we sell it or send it home with families?
How Does Your School Garden Grow?

Best Practices for Growing, Harvesting, and Serving School Garden Produce

Hawai‘i Farm to School and School Garden Hui

October 2016
This guide was made possible through the contributions of many.
The Hawai‘i Farm to School & School Garden Hui would like to thank:
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Integrated Pest Management Pest Identification (CTAHR)
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School gardens are not a new idea for Hawai‘i. In fact, until the late 1960’s, gardens were common in Hawai‘i schools: growing food for children and families, providing fresh air and physical activity, and helping to supply the school cafeteria. The gardens also connected children to the land by cultivating self-reliance, a sense of place, and a deep respect for the ʻāina.

For the past decade, principals, teachers, parents and communities across Hawai‘i have been reviving old garden spaces and investing in the creation of new school gardens, creating outdoor classrooms that incorporate place-based, experiential learning into multiple subject areas.

The purpose of this packet

Student health and safety should be a top priority in every school garden. The Hawai‘i Farm to School and School Garden Hui (“The Hui”) has developed this resource packet to give your garden program staff the skills and confidence they need to grow and use garden produce in the classroom setting.

How Does Your School Garden Grow? provides garden and food safety recommendations that should be observed for classroom tastings. It is not intended as a resource for the use of garden-grown produce in a school cafeteria.
Tips to help you get the most out of this resource

**ADD TO THIS BINDER!**

Although the focus of this guide is safety practices, we encourage you to add to this binder with other resources and reference documents, such as garden curricula, recipes, or guidance on building garden beds or aquaponics systems. Additional resources specific to Hawaii are available at the Hui website: kohalacenter.org/schoolgardenhui

**SHARE!**

The Hui recommends that you go through How Does Your School Garden Grow? with your school’s wellness or garden committee and make it available as a reference for anyone who might be working in your school’s garden: administrators, teachers, volunteers, students, custodial staff, and other school garden support staff. Please keep a copy of How Does Your School Garden Grow? in your school’s library.

**READ THE FAQ!**

How Does Your School Garden Grow? is a collection of resources from multiple sources, so you may notice inconsistencies across the documents. We have pooled the answers to commonly asked questions to try and bust myths and clarify some of the stickier points in the Frequently Asked Questions in the following pages.

**REACH OUT!**

Still have questions? The Hui is full of knowledgeable individuals who are eager to help school gardens grow! If you have a specific question about your school’s garden, or would like to request technical assistance or a consultation, please get in touch with the Hui coordinator for your island network using the contact info on the following page.

No two gardens are alike. And no set of health or safety guidelines can include every possibility. You are encouraged to read through these resources and fully evaluate what additional risks you may need to address for your garden program.
State Agencies

+ Kaua‘i School Garden Network
O‘ahu Farm to School Network
Moloka‘i School Garden Network
Maui School Garden Network
Hawai‘i Island School Garden Network

Statewide Partners
Kamehameha Schools
Hawaii Department of Health/
Healthy Hawai‘i Initiative
Hawaii Department of Agriculture/
Farm to School program
Hawaii State Department of
Education/Hawaii Child Nutrition
Program
Hawaii State Department of
Education/School Food Services

Hawai‘i Island
The Kohala Center/Hawai‘i Island
School Garden Network
FoodCorps Hawai‘i

Moloka‘i
Sust‘āinable Molokai

O‘ahu
O‘ahu Farm to School Network
Kōkua Hawai‘i Foundation/
ʻĀina in Schools program
University of Hawai‘i Master Gardeners
‘Iolani School
Farm to Keiki

Kaua‘i
Mālama Kaua‘i

Maui
Maui School Garden Network
Grow Some Good

Pacific Region
Pacific Resources for Education & Learning (PREL)

Contact a representative on your island to get involved in Hawai‘i’s Farm to School and School Garden movement!

hawaiischoolgardenhui.org
or email schoolgardenhui@kohalacenter.org
What is Farm to School?

Farm to school enriches the connection communities have with fresh, healthy food and local food producers by changing food purchasing and education practices at schools and preschools.

National Farm to School Network, www.farmtoschool.org

Benefits of Farm to School

Farm to School programs that include changes in both food purchasing and education practices have been shown to:

- Increase fruit and vegetable consumption and physical activity by students
- Increase academic achievement
- Improve student behavior
- Increase school meal participation
- Increase farmer income and expand markets
- Create jobs and strengthen local economies and community food security

Who’s Involved?

Farm to school programs exist in every state in the country and the District of Columbia in school districts of all sizes — large and small, rural and urban. The National Farm to School Network and the USDA Farm to School Program support farm to school efforts nationwide, while the Hawai‘i Farm to School and School Garden Hui works to build the movement locally. Hawai‘i’s first ever statewide school garden survey, conducted by the Hui in 2012, showed that at least 43% of all schools in Hawai‘i (K-12, public, charter, independent) have a school garden. According to the Hawai‘i Department of Health’s Safety and Wellness Survey (SAWS) for 2012-2013, 80% of Hawai‘i’s K-12 public schools have school gardens, and of those, 93% are used for instructional purposes.

Hawai‘i’s Farm to School Movement

The Hawai‘i Farm to School and School Garden Hui (HFSSGH) was formed in 2010 and includes Farm to School and School Garden Network leaders from six islands and representatives from the Hawai‘i Departments of Education, Agriculture, and Health.

Mission: To strengthen Hawai‘i’s statewide Farm to School and School Garden movement by supporting the island networks in the areas of capacity building, resource development and sharing, professional development, policy development and advocacy.

Vision: We envision a holistic education system that renews our relationship to food, farming, and the environment, improves health, and raises academic achievement. We envision Hawai‘i as a center for agro-ecological education and food production and as a model of regenerative community food systems for the Pacific and the world.

Goals:

1. Support the reestablishment of agricultural education pathways, P-20 (preschool through post secondary education)
2. Increase the procurement of locally grown and produced foods by Hawai‘i schools
3. Strengthen the statewide farm to school and school garden movement through the sustained organization and efforts of the island networks and the HFSSGH.

The Hawai‘i Farm to School and School Garden Hui is coordinated through The Kohala Center, an equal opportunity provider, employer, and lender.
FREQUENTLY ASKED QUESTIONS

These FAQs have been compiled and vetted through consultation with members of the Hawai‘i Farm to School & School Garden Hui and our agency partners. They are offered in conjunction with the resources in the How Does Your School Garden Grow? training packet. In many cases, the answers will refer to the other documents in the binder, so be sure to keep this whole packet as a reference. The answers provided are based on best practices. Please contact your school administrator to clarify your school’s specific requirements and internal policy.

1) Our school wants to start a learning garden, what should we consider?

School gardens can provide a rewarding experience for both students and teachers. Before starting a garden, consider the following:

- Be sure to get support from your school administration.
- Identify a garden coordinator, and form a school garden committee comprised of administration, teachers, students and community members.
- Each garden will need someone primarily responsible for managing garden efforts and activities on a day-to-day basis, often on weekends and school holidays.

- Have the garden committee develop a 5-year plan for the garden. Consider any future construction or landscaping that the school may have planned at your chosen garden site.
- Consider building relationships with community partners at the outset to help your program sustain and succeed.
- Identify ways to integrate curriculum into the school garden to ensure it is broadly used by teachers for learning. Hui partners have developed a curriculum map that can help you design lesson plans that meet educational standards in a number of subject areas.

2) What is a garden coordinator?

A "garden coordinator" communicates between the many stakeholders in a successful garden, and takes responsibility for necessary actions. Look for passionate individuals who can communicate well with others (school principal, an experienced teacher or an experienced gardener from the community).

3) Do I need to let parents know their child will be working in the school garden?

Yes, parents should know that the garden will be a part of their child’s school activities.

- BENEFITS: Communicating the dates can be very helpful for students to come prepared with the proper attire including close-toed shoes, sunscreen and hats. Communicating dates ahead of time have also shown to increase student attendance when they look forward to garden days.

- REQUIREMENTS: Check with your school’s administration about any required information about what you should be sharing with families, and if you need additional waivers.

4) Can students who have a cold or other communicable illness work in the garden?

Yes, if the student is well enough to be at school, they can still contribute to garden learning when not feeling well.

- Encourage ill students to be involved with non-food handling activities such as weeding, composting or raking.
- For safe food handling, a student that is ill should not be handling produce, whether it is at the time of harvesting, washing or preparing.
- Students who have symptoms including diarrhea, fever, vomiting, or jaundice, should not be at school and should not be near other students nor allowed to be in the garden. DOE policy requires students be fever free within past 24 hours. Check with your school administration for any additional guidance.

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FAQ

5) Does the Hawaii Department of Education (DOE) have a policy relating to school gardens?

At this time, the Hawaii DOE does not have a standardized school garden policy at the state level. However, many individual schools have developed their own garden policies if your school does not have a policy, consider speaking with the principal and sharing the resources in this packet to develop such a policy.

6) Which government agencies do provide food safety guidance for school garden programs?

In Hawaii, there are two State government agencies with recommendations that pertain to school gardens:

- The Hawaii Department of Health (DOH) recommends that all produce is washed thoroughly with potable water and that safe food handling guidelines be followed. DOH also investigates any pesticide contamination issues in gardens/farms.
- The Hawaii Department of Agriculture (DOA) has specific requirements for application of pesticides and compost systems (working with the EPA).

7) Is it okay for students to eat food from their school garden?

Yes, there is no better reward for students in the garden than eating the food they grow! Studies have shown that students are more likely to try new foods and consume more vegetables when they grow it themselves. The garden educator or teacher should be familiar with safe food handling and garden best practices as outlined in this packet.

8) Can our school serve school garden produce in the cafeteria and/or as part of a school meal program?

It depends. While incorporation of school garden produce in school meals is ultimately one goal of a Farm to School Program, there are several important criteria that must be met, depending on what type of school you work at.

- **HIDOE SCHOOLS**: Currently the School Food Authority does not allow any garden produce to be integrated into their meal programs. Requirements include GAP certification (Good Agricultural Practices) from the farm, with a HACCP (Hazard Analysis Critical Control Point) plan for processing and storing.
- **CHARTER OR PRIVATE SCHOOLS**: These schools can act as their own School Food Authority, and thus may have different rules for incorporating garden produce in school meals. Any procurement policies that allow for garden produce to be used in school meal programs should include their own risk management assessments and requirements. Check with your school administration for classification and explore opportunities.

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9) Can our school sell or distribute school-grown produce?
Yes! Your school may explore a number of different opportunities to distribute school-grown produce and raise money to support their garden program which comply with the school's internal policies.
- **CME (Community Supported Agriculture) PROGRAMS** are a positive way for schools to connect with their community, supplying school employees and student 'ohana.
- **FARMERS’ MARKETS** are an engaging way for the school community to recognize the garden's bounty and students to learn about marketing. Produce that is cut from the field and washed for sale does not require any Department of Health (DOH) permits. However, produce that is processed, such as a mixed salad, triggers DOH Temporary Food Permits.

11) Am I allowed to use pesticides in our school gardens?
Although technically allowed, pesticides should be avoided or used minimally in school gardens. Inevitably, garden coordinators will be faced with unwanted pests and diseases in a garden, and it is best to practice an integrated pest management (IPM) approach. If you are a Hawaii DOE school, your school’s lead custodian and groundskeeper will be the IPM lead and you should plan to work directly with him or her. See “Best Practices for Hawaii School Gardens,” containing an overview of common pests and beneficial insects is included in this packet.

12) What about “natural” pest remedies?
A “pesticide” is any chemical intended to kill or repel a pest such as unwanted insects, weeds, rats, germs, and fungi. While we think of them as highly-toxic substances used in agriculture, there are many pesticides used everyday in our households. However, “natural” applications i.e. spraying liquid dish soap, using powered borax bleach, pine-oil to kill pests are still considered pesticides. All pesticide products should be handled with care. Here are some tips to help you make informed decisions about these applications:

- **THE LABEL IS THE LAW.** Pesticide label directions must be followed (application for site, crop, mixing, dosage, safety equipment, etc.) to protect the environment and by law. There are civil penalties of up to $5,000 per offense, or criminal penalties of up to $25,000 or 1 year in prison or both.
- Do not use “experimental” pesticides on food crops that will be eaten.
- Do not allow children apply any pesticides.

10) What is the most important food safety practice to be aware of outside in the garden?
To prevent food-borne illnesses in the garden, students should wash hands thoroughly and properly BEFORE conducting any activity in which they may come into contact with the edible portion of plants. Make sure cutting tools are clean and sanitized prior to use. See “Best Practices for Hawai’i School Gardens” in this packet for a more thorough explanation on food safety practices in the garden.

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FAQ

13) What other methods can we use to prevent the presence of pests that cause problems in the garden?

Building healthy soil and using Integrated Pest Management (IPM) will go a long way toward avoiding many common pests and plant diseases. You can also try the following tips:

- Remove standing water from around the garden area, and avoid growing plants that trap water, to prevent the formation of mosquito habitats.
- Remove slug and snail hiding places and avoid over-watering and watering in the evening which could encourage their presence.
- Physically remove unwanted species from the garden area as soon as possible.
- Maintain healthy soil using composting techniques.

14) What should I do if I come across an invasive species?

Report invasive species pest issues to your IPM Manager (usually the lead custodian), who will coordinate with Department of Agriculture and Department of Health as necessary.

**LITTLE FIRE ANT:** For student safety, frequent tests for Little Fire Ants (LFA) should be conducted. Your island’s invasive species council should be able to provide test kits. If you ever encounter the Little Fire Ant on campus, take a photo of the fire ant and report the sighting to the Hawaii Invasive Species Council immediately. Please contact http://ldci.hawaii.edu/hsico/ for the contact number for your island.

**DRAIN IRRIGATION:** If the water is not from a city source, or not palatable, use drip irrigation to limit exposure to the edible portion of all food crops.

15) Is Rat Lungworm a concern in our school garden?

Yes, Rat Lungworm is a serious, potentially fatal disease that is spread through slugs and snails. Always thoroughly wash garden produce, and discard any leaves or items with visible slug or snail residue. See “Rat Lungworm Fact Sheet” in this packet for tips for making sure your school garden produce is safe from this pathogen.

16) Can we use rain catchment water to irrigate our edible gardens?

Yes, rain catchment water can be used to irrigate croplands. HOWEVER, it should not be applied to the edible portion of a crop. Water quality will affect edibility of your crops, and you should test your water sources to ensure your irrigation water is safe. EPA standards are less than 126 E. coli bacteria per 100 ml of irrigation water. See “Best Practices for Hawaii School Gardens,” in this packet, for a deeper discussion of garden watering.

- **TESTING** of irrigation water can be done through local testing agencies.
- **ONLY USE POTABLE WATER** on edible portions of crops and to rinse harvested produce.
- **DRAIN IRRIGATION:** If the water is not from a city source, or not palatable, use drip irrigation to limit exposure to the edible portion of all food crops.

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Healthy soil = healthy plants: when you build and maintain fertile soil rich in organic matter, you literally lay the groundwork for thriving plants that can develop quickly, resist pests and diseases, and yield a bountiful crop.

Can synthetic chemical fertilizers provide a shortcut to the healthy soil = healthy plants formula? After all, plants’ needs are fairly basic: air, water, light, warmth, and a balance of nutrients and minerals. So why not put some seeds in the ground, apply the appropriate chemicals, and reap the harvest?

That’s one possible approach to gardening—synthetic chemical fertilizers, such as the N-P-K (nitrogen-phosphorus-potassium) formulations sold in garden supply stores, do provide most of the nutrients plants need in an easy-to-use form. But these chemicals have a number of shortcomings. Because plants can only absorb a limited amount of nutrients at a time, much of these water-soluble products ends up as runoff during rain or watering (nitrogen fertilizers are a major source of water pollution). Many chemical fertilizers provide a quick burst of nutrients, but may leave little for the plants to draw on over the course of the growing season. And because petroleum products are needed to produce the fertilizers, they use up valuable non-renewable resources. Finally, chemical fertilizers don’t build or maintain healthy soil; much like taking a vitamin rather than eating your fruits and vegetables, they provide the chemicals but none of the added benefits that other soil inputs offer.

Fortunately, you can choose from a wide variety of inputs that will help you create healthy, fertile soil. Organic soil amendments such as compost, manure, cover crops, and fertilizers derived from non-synthetic sources can improve soil quality while providing a source of nutrients that last through the growing season. You can make or grow some of these amendments in your own garden to keep your costs low.

ORGANIC MATTER

Think of a natural system, such as a forest or meadow: it thrives year after year by recycling available nutrients. Leaves fall and break down; grasses and flowers grow; bloom; and fad; animals die and decompose—all life adds organic matter to the soil. This is the cycle you’re trying to recreate in your garden.

Each time you harvest crops or pull weeds, you make a “withdrawal” from the soil’s pool of nutrients and organic matter; if these aren’t replaced, the soil is eventually robbed of the resources plants need to flourish. Organic matter, made up of decomposed plant and animal material, can help replenish nutrients and at the same time improve soil structure, making it easier to work and a more hospitable place for plants to thrive. Here are some readily available sources:

- **Compost** is rich in organic matter, and making compost is a great way to recycle weeds, kitchen scraps, leaves, manure, and other material that would otherwise have to be hauled to the dump. If you don’t have a compost pile, consider starting one this fall, when there’s a lot of garden and yard waste available (see page 3 of this information sheet for tips on making compost). If making your own compost isn’t practical, there are commercial composts available at garden and landscape suppliers.

- **Manure** from cows, horses, poultry, and other livestock is another good source of organic matter and nutrients. It should be aged at least six months or put through the compost pile before being used in the garden. Some manures (especially poultry manure) generate too much heat when fresh and will damage plants if not aged.

- **Applying compost or manure** is a great way to recycle weeds, kitchen scraps, leaves, manure, and other materials that would otherwise have to be hauled to the dump. If you don’t have a compost pile, consider starting one this fall, when there’s a lot of garden and yard waste available (see page 3 of this information sheet for tips on making compost).

- **Cover crops** can develop quickly, resist pests and diseases, and yield a bountiful crop. Can synthetic chemical fertilizers provide a shortcut to the healthy soil = healthy plants formula? After all, plants’ needs are fairly basic: air, water, light, warmth, and a balance of nutrients and minerals. So why not put some seeds in the ground, apply the appropriate chemicals, and reap the harvest?

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Building Fertile Soil

be planted from October through early December. Between March and May, before they set seed, the plants should be harvested and composted or worked into the soil to break down. (Note: if you remove and compost your cover crops, be sure to add compost to the beds in which they were grown.)

Leguminous cover crops, such as fava beans and vetch, host a type of bacteria on their roots that fixes nitrogen from the air. These are "green manures" because they add this nitrogen to the soil when the crops break down. It takes from two to four weeks for cover crops to decompose once they're tilled in, depending on soil temperature (temperatures that decompose cover crops don't become active until the soil temperature rises to 55º F). Check with your garden supply store for seed mixes and seeding rates.

**Organic Fertilizers**

Although organic matter (especially compost) provides many of the nutrients plants need, other purchased organic fertilizers can further enrich the soil and correct nutrient deficiencies. You can find out what nutrients your soil needs by having a soil test done; be sure to find a lab that can recommend organic amendments. Organic fertilizers are available from garden and farm supply stores and mail order companies.

- **Nitrogen (N) sources:** Plants need nitrogen to develop leaves and stems. Nitrogen plants will look yellow and grow slowly. Blood and bone meals, fish meal and emulsion, hoof and horn meal, soybean, cottonseed, and kelp meal all contain significant percentages of nitrogen. These can be dug into the soil prior to planting or used as a side dressing to nourish heavy-feeding plants such as corn and brassicas. Because it escapes so readily from the soil, nitrogen should be replenished each year with organic matter and/or fertilizers.

- **Phosphorous (P) sources:** Plants need phosphorous to grow, flower, and develop healthy root systems. Rock and soft phosphites, bone meal, and cottonseed meal all provide high percentages of P. Unlike nitrogen, phosphorous lasts a long time once added to the soil.

- **Potassium (K) sources:** Plants need potassium to strengthen plant tissue, make vegetation more disease-resistant, and develop chlorophyll. Sources include wood ashes, cottonseed meal, granite dust, and greensand. Wood ashes should be "soaked" in "soil" by adding to the soil. Phosphorous (P) sources: matter and/or fertilizers.

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However, a random stacking of organic materials won’t
the soil creatures, from the tiniest bacteria to the longest
healthy, strong plants. By using compost, you are feeding
Making compost: the basics
or about as moist as a wrung-out sponge. The easiest way
inches thick, depending on the particle size and moisture
Greens + Browns

Browns = Carbon Materials
for gardeners, green weeds, green crop residues, and
vegetable trimmings are readily available sources of ni-
trogen materials. Young, green plants, such as new spring
grass, are very high in nitrogen. But as a grass plant
grows older and browner, it loses some of its nitrogen
or uses it to produce seeds. To capture the most nitrogen
for your compost pile: 1. Start with plenty of green
vegetables, green weeds) with the carbon-rich materials (fallen leaves,
sawdust). “Moisture + Air” reminds us that fast
decomposition requires both a good moisture content and
ample oxygen for the decomposer organisms in the pile.
Other variables that affect the composting process include
the particle size of the compost materials, the volume of
the pile, the time of year, and the position, a compost pile needs a good balance of the
Basic Four: Greens + Browns + Moisture + Air. “Greens +
Browns” is a simplified reference to balancing the nitro-
gen-requiring) bacteria. If a pile lacks oxygen—because it
is either too wet, too dense, or too big—anaerobic bacteria
will take over, producing their characteristic “rotten egg”
smell. Without oxygen, a pile will still decay, but aerobic
bacteria bring about faster decomposition that retains
more nutrients and creates a pleasant odor.

Build air into a large pile in the following ways:
1. Loosen the soil that will lie under the pile; 2. Add bulky
materials like cornstalks to the bottom of the pile; 3. If
using wet, finely textured materials such as grass clipp-
ings, layer them with bulky materials to avoid compac-
4. Turn the pile at least once.

Size of Materials
The size of your materials determines how fast they
will compost. Materials with small particle sizes, such as
glass clippings, have more overall surface area exposed
for bacteria and other decomposers to reach. For this
reason, chopping large materials (especially woody stalks)
will speed the composting process. Use a sharp spade to
chop garden weeds and crop residues. A lawn mower will
work for leaves, but you may need a shredder for woody
prunings that are thicker than a pencil. If all your materi-
als are very fine (for example, lawn clippings), however,
the layers can compact and become matted.

Volume and Containers
A large, properly built pile is self-insulating and can
sustain temperatures of 150ºF for one to two weeks. These high temperatures will kill most weed seeds
and diseases harmful to plants and humans.

To heat up properly, a pile must have at least three
feet square and three feet deep. Some experts say that
piles should be closer to four feet on a side, but not much
larger than five feet tall and five feet wide (and
any length). A pile that is 4 feet x 4 feet x 4 feet will
reach 140ºF for ten days to two weeks. These high temperatures will kill most weed seeds and
diseases harmful to plants and humans.

Moisture

A compost pile should ideally be 40% - 60% moisture, or
about as moist as a wrung-out sponge. The easiest way
to ensure consistent moisture throughout the pile is to
water each brown, dry layer as you go. Straw, leaves, and
sawdust can be moistened in a wheelbarrow and then
drained to remove excess water. If you water the pile it-
self, use a hose sprayer for good coverage and take special
care to wet the corners and the edges of the pile.

Make sure to cover the pile with a hole-free, plastic tarp
before heavy winter rains start. Rain will water the pile, and
it can also leach away nutrients. Too much moisture can
result in compaction and a loss of oxygen in the pile. If the
pile seems too wet, turn it to aerate it and add some bulky
materials.

Too little moisture can result in piles that decompose
slowly, or don’t heat up at all. To prevent this, look for
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**Organic Matter Fuels Decomposition**

Although it makes up only a small percentage of your soil, organic matter provides the fuel that drives the decomposition process. Invertebrate decomposers, such as earthworms and beetles, first reduce organic matter to smaller particles and incorporate it into the soil. Then bacteria, fungi, and other microorganisms break it down into its chemical constituents, which become available for plants to use as they develop.

Carbon dioxide released from the organic material combines with water to form carbonic acid, a weak acid that acts as a solvent to free calcium, potassium, magnesium, and other minerals from the soil for plant growth. Because decomposition is an ongoing process, the nutrients in organic matter are available over the course of the growing season, providing a long-lasting source for plants. But as you cultivate the soil and harvest plants, the soil’s organic matter levels decrease, which is why it’s critical to replace lost organic matter with compost, cover crops, or other sources in order to maintain productive soil.

Besides supplying nutrients, organic matter improves soil structure—the organisms that break down organic material secrete gluggy substances that bind soil particles together in a crumb-like structure, creating air spaces where roots and water can penetrate. The spongy quality that organic matter imparts to soil also helps it retain moisture, thereby reducing water needs.

Some people like to contain their piles in wood, wire, plastic, or brick enclosures. Check the Resources section for compost publications—they describe ways to build a variety of compost bins.

**Turning**

Turning, a compost pile speeds the composting process and produces a better end product. It reintroduces oxygen to the pile, remixes brown and green materials, and lets you troubleshoot any problems and remedy them immediately.

**When Is It Done?**

Signs that your compost pile is ready for use include a cool temperature inside the pile, the presence of worms, beetles, and sowbugs, and an earthy smell and rich brown color. Most pile take about four to six months to mature if they are not turned.

**Using Finished Compost**

Your finished compost may not look like the finely textured, stick-free stuff available in bags at the garden center. Fear not. Sticks and other materials that haven’t thoroughly composted will continue to decompose in the soil. There is no need to sift compost that is going into a garden bed. For propagation mixes and seed beds, however, always use fresh, finished, stable compost that has been sifted through a 1/4-inch screen.

**What Not to Compost and Why**

- **Meat, dairy products, and greasy foods are likely to attract pests.**
- **Cat, dog, and human feces can contain harmful pathogens.**
- **Pernicious weeds, especially those with rhizomonous roots** (e.g., Bermuda grass), may not be killed in the composting process.
- **Diseased or bug-infested plants should be kept out of slow, cool piles and should be added with discretion to the center of hot piles (when in doubt, keep it out).**

**RESOURCES**


**This material is written, produced and distributed by staff of the Center for Agroecology and Sustainable Food Systems at the University of California, Santa Cruz. For more information about CASFS resources, call 831-459-3240, email casfs@ucsc.edu, or write CASFS, UC Santa Cruz, CA 95064. The Center’s web address is casfs.ucsc.edu.**

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Aquaponic gardens in schools can serve as an extraordinary tool for educators to engage students in hands-on, project-based learning experiences. The integration of aquaponics in curricula can cover many subject areas at any grade level.

In addition to following best practices provided throughout this manual, food safety with school garden systems involving aquaponics poses unique challenges. The basic practices on the following pages should be followed at all times.
Growth & Maintenance

- Ensure that aquaponic water does not touch the edible portions of plants during growth
- Use potable water to fill aquaponics systems
- Prevent contamination by animal feces especially from birds
- Cover fish tanks or fence area to prevent drowning incidences
- Do not use aquaponics water to clean produce, tools or hands
- Avoid overhang that can allow animals over the system(s)
- Grow beds should be raised from the ground
- Wear protective gloves when handling fish or digging in growth media that might be sharp
- Maintain systems to be healthy at all times

Harvesting

- Harvest containers should never touch aquaponic water
- Throw away produce contaminated with animal feces, including bird feces
- Have a designated sink for hand washing only
- Include signage detailing the rules for the site. CTAHR has downloadable signs at their website: http://manoa.hawaii.edu/ctahr/farmfoodsafty/farm-signs/
- When harvesting do not allow produce to touch aquaponic water
- Follow general best practices for harvesting garden produce found in this packet

Consumption

- Wash cutting boards and knives with soap and hot water
- Pull apart produce and rinse it in cool, potable water.
- Examine leaves, stems, and other edible parts carefully for small snails and slugs that might be stuck deep down in the plant. Throw away any product that has snails, slugs or their slime on it as it could have come in contact with the rat lungworm pathogen.
- Avoid cross-contamination of fish and produce. Use a separate, dedicated cutting board when cutting fish
- Review and follow additional food handling guidelines found in this packet
Education

Aquaponic systems offer unique opportunities to engage students in hands-on learning by integrating multiple subject areas at any grade level. Suggested aquaponics-related topics include:

**Biology** - What is the importance of the nitrogen cycle and its role in both natural and deconstructed aquaponics? How does our school aquaponics system compare to natural systems such as a lof? What role does nitrifying bacteria play in aquaponics? How are plant growth and structures impacted by growth in aquaponics?

**Chemistry** - What happens to the uptake of iron in plants if pH gets too high? How is oxygen in the water affected by temperature? What is the carbon cycle in this system and how is it affected by pH?

**Physics** - How does water move throughout the system? What light spectrums grow plants best?

**Ecology** - What happens if an ecosystem becomes out of balance? What role do composting red worms play in aquaponics?

**Zoology** - What do fish need in order to grow properly? Fish physiology

**Horticulture** - What does a plant need in order to grow properly?

**Nutrition** - What is the difference between freshly picked food you grew yourself and food from the grocery store? How do foods grown in aquaponics systems compare in nutrient content, taste and growth rate with foods grown in other types of garden systems?

**Sustainability** - How do aquaponics demonstrate a sustainable method of agriculture for some environments? What are the energy and water needs of the system?

**Economics** - What are the costs/revenues from aquaponics farming?

More information

University of Hawaii College of Tropical Agriculture and Human Resources (CTAHR) Good Agricultural Practices website: http://manoa.hawaii.edu/ctahr/farmfoodsafty/

Food safety for aquaponics
# Integrated Pest Management

## Pest Identification: Common Pests

Proper identification and understanding the nature of the pest are the key steps in selecting the best pest management strategy.

<table>
<thead>
<tr>
<th>Chewing Pests</th>
<th>Ants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chewing pest feed on the foliage, stems, fruit or roots. Pests within this group include beetles, caterpillars, earwigs, leaf miners, etc.</td>
<td>Ants are honeydew consumers and protect pests from natural enemies. Honeydew secretions promote sooty mold development. There are: sugar vs. fat loving ants.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sucking Pests</th>
<th>Fruit Flies</th>
</tr>
</thead>
<tbody>
<tr>
<td>These pest pierce plant’s vascular tissue and withdraw plant sap. They cause plants to discolor, twist and distort. Pests within this group include aphids, whiteflies, mealy bugs, scales and leaf hoppers.</td>
<td>There are 4 fruit flies in Hawaii: Oriental fruit fly, Melon fly, Mediterranean fruit fly, Malaysian fruit fly. Adult females sting fruits and vegetables resulting in blemishes. Larvae tunnel within fruit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mites</th>
<th>Thrips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mites have rasping and sucking mouthparts. Damage results in a brown to russet discoloration of leaves, stems, fruit and flowers.</td>
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<th>Nematodes</th>
<th>Slugs and Snails</th>
</tr>
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<tr>
<td>Roundworms that attack the root system of plants and impair water and nutrient uptake. Symptoms: stunting, poor plant growth, narrow and weak stems, foliar chlorosis, root rotting and galling, plant toppling and poor root development.</td>
<td>Slugs and snail are a problem for low-growing vegetables. They are active in the evenings and are commonly associated with seedlings magically disappearing overnight.</td>
</tr>
</tbody>
</table>

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<tr>
<th>Plant Hoppers</th>
<th>Weeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant hoppers damage leaves, stems, fruits, and flowers. They also serve as vectors for plant diseases, especially phytoplasmas.</td>
<td>Weeds (annuals, biennials, perennials, etc.) often outcompete plants for food, sunlight, etc. They are fast growing, prolific seed producers, etc. Some weeds may be alternative hosts for crop pests (insects and diseases).</td>
</tr>
</tbody>
</table>
Integrated Pest Management
Pest Identification: Common Diseases

Plant diseases are the result of a physiological or morphological change in a plant that results in abnormal growth, appearance or development due to a pathogen. Pathogens are parasitic organisms that cause a disease. Pathogens include: fungi, bacteria, viruses, nematodes, phytoplasma.

The diagram to the right illustrates the three factors required for disease development: a host plant, a casual pathogen and a favorable environmental conditions. Managing these factors can also help prevent and suppress disease populations.

**Fungal Pathogens**
- Common plant disease composed of threadlike structures called hyphae. Reproduce and disperse by spores. Common fungal pathogen include: powdery mildew, downy mildew, Alternaria, Cercospora, Phytophthora, etc.

**Nematode Pathogens**
- Roundworms that attack the root system of plants and impair water and nutrient uptake. Symptoms: stunting, poor plant growth, narrow and weak stems, foliar chlorosis, root rotting and galling, plant toppling and poor root development.

**Viral Pathogens**
- Viruses have a nucleic acid surround by a protein coat. They can only survive on living plant tissue. Once infected there is no cure. They are mainly transmitted by insect vectors. Common plant viruses include: Banana Bunch Top Virus, Tomato Spotted Wilt Virus, etc.

**Bacterial Pathogens**
- Bacterial pathogens reproduce quickly and form masses called colonies. They are spread primarily via rain, or splashing water. They often enter plant tissue through natural openings or injury sites. Examples include: Xanthomonous, Pseudomonas, Erwinia, etc.

**Phytoplasma**
- Phytoplasma is a bacteria which parasitizes on the phloem of plant tissue via an insect vector. Symptoms range from yellowing of plant tissue, cupping of leaves and even death of infected plants. Leafhoppers are often associated with vectoring of phytoplasmas like the Watercress Aster Yellow (WAY)

**Example of a Plant Vector**
- Plant vectors are organisms that can transmit a pathogen such as a bacterium, virus, or phytoplasma into a plant.

**EXAMPLES:**
- Banana aphid → Banana Bunchy Top Virus (BBTV)
- Western flower thrips → Tomato Spotted Wilt Virus (TSWV)
- Aster Yellow Leaf Hopper → Watercress Aster Yellow Phytoplasma
- Onion thrips → Iris Yellow Spot Virus (IYSV)
Integrated Pest Management
Beneficial Insects & Insectary Plants

K.-H. Wang and J. Tavares
University of Hawai'i at Mānoa, College of Tropical Agriculture and Human Resources

Insectary plants are plants that produce pollen or nectar, or provide baits to attract arthropod predators including lady beetles, hoverflies, lacewing, spiders, parasitoid wasps etc.

Lady Beetle (Coccinellidae)

The lady beetle, both the larvae and adult, eat aphids, scales, and mealybugs.

Insectary plants for lady beetles:
- Cilantro, Buckwheat, dill, fennel
- Cowpea
- Marigolds, cosmos
- Oleander (globe lady beetle)
- Morning Glory (Convolvulus minor)

Hoverflies (Syrphidae)

Hoverflies: larva eat aphids and other soft bodied insects, and adults eat nectar and pollen.

Insectary plants for hoverflies:
- Cilantro
- Buckwheat
- Marigold, cosmos
- Basil
- Carrot

Green Lacewing (Chrysopidae)

The lacewings, the adult will eat pollen, nectar, and honeymed, and the larvae eat aphids, various larvae and the eggs of other insects.

Insectary plants for lacewings:
- Cowpea
- Bay Leaf
- Carrot (Daucus sp.)
- Oleander (Nerium oleander)
- Red Cosmos
- Wild Lettuce (Lactuca sp.)

Pirate or Assassin Bug

The pirate bug, adults feed on small arthropods like thrips, aphids and insect eggs. The assassin bug, adults will eat beetles, caterpillars and flies.

Insectary plants for pirate or assassin bugs:
- Macaranga (Macaranga tanarius)
- Carrot (Daucus carota)
- Oleander (Nerium oleander)
- Sunn hemp (Crotalaria juncea)
- Cowpea (Vigna unguiculata)
- Marigold, cosmos

Function of Insectary Plants

- Increase pollen and nectar resources required by the natural enemies of insect pests such as hoverflies and parasitoids (Cowgill et al., 1993; Lavandero et al., 2005; Hogg et al., 2011).
- Attract pollinators.
- Supply food source for spiders (Taylor and Pfannenstiel, 2008).
- Act as trap crops for insect pests.

Attracting Beneficials to Aquaponic System

- Devoting a grow bed of diverse insectary plants around your aquaponic system will draw a variety of beneficial insects and natural enemies of insect pests to your crops. Examples: fennels, marigolds, milkweeds, buckwheat, and cilantro.
- Plant an attractant crop like buckwheat around the border of hydroponic benches to serve as insectary plants that attract hoverflies and wasps. Sunn hemp can be planted on the borders to attract Trichogramma wasps.
- Wasp's nesting box can be constructed and placed around production areas to attract solitary wasps. Most solitary wasps are predators of beetle larva and caterpillars. Photos on the right (below) show how the predatory wasp use the nesting boxes to collect insect pest. Holes that are plugged with soil indicate mud wasps are present and they have laid their eggs (and insect catches) in the nesting boxes.

Spiders

Spiders are generalist that can attack many insect pests especially when no harmful broad-spectrum insecticides are used. They are frequently found wondering on the cinder grow beds, or building webs to catch their preys.

Reference and Photo Credit:
http://www.organicgardeninfo.com/beneficial-insectary-plants.html
Concept and photo by Koon-Hui Wang and Jane Tavares, unless specified otherwise in the photo.
What is Rat Lungworm Disease?

The rat lungworm can cause a disease called angiostrongyliasis (rat lungworm disease) which can affect the brain and spinal cord. Symptoms may include severe headache, stiffness of the neck and back, skin tingling and sensitivity, sensitivity to light, hallucinations, nausea and vomiting.

Foods such as raw produce, raw or undercooked snails, freshwater prawns, crabs and frogs can be contaminated by an unseen parasite *Angiostrongylus cantonensis* (rat lungworm). Fish do not spread this parasite. The rat lungworm is found most often in snails and slugs and has also been found in the flatworm. The worm infects rats, which pass the parasite to snails, slugs, freshwater prawns, crabs and frogs, not humans.

Prevention

*DO NOT* eat raw foods contaminated with the slime* from snails or slugs or visible snail or slugs. *RINSE PRODUCE* completely and boil snails, freshwater prawns, crabs, and frogs for *AT LEAST 3-5 MINUTES*. Do not handle snails and slugs with bare hands. Eliminate slugs and snails from your garden. Cover your catchment tanks to prevent slugs and snails from having access. Controlling rodents can also help control the rat lungworm. *If you think you may have angiostrongyliasis, see your health care provider and let him/her know of your exposures.*

*Scientists are not sure whether exposure to slime can make you sick*

For more information call the Hawai‘i District Health Office Disease Investigations office: 808-933-0912 or see CDC website: [http://www.dpd.cdc.gov/DPDx/HTML/Angiostrongyliasis.htm](http://www.dpd.cdc.gov/DPDx/HTML/Angiostrongyliasis.htm)
Little fire ants (LFA) are stinging ants that are new to Hawai‘i, and they have recently been discovered on Maui and in Kona. The public’s help is essential in detecting LFA and controlling infestations to protect the health of families and pets, the agriculture industry and local economy.

Are LFA Harmful?

LFA are serious pests that infest yards and agricultural fields, and they move into houses when their numbers are large. Initially, their stings hurt and burn and may cause welts, followed by intense itching that can last for two weeks or more. The ants occur on the ground and on plants and trees, where they easily fall off when the plants are disturbed. Pruning branches, harvesting fruit or picking flowers in an infested area can cause LFA to rain down in large numbers. Some orchard workers in East Hawai‘i have quit their jobs because of this. In the Galapagos Islands, workers can’t harvest coffee when LFA populations are large. LFA stings could cause an anaphylactic reaction in people allergic to stings.

Pets, livestock and wild animals are also at risk for LFA stings. Pets and outdoor animals in areas with heavy infestations have suffered multiple stings in the eyes, resulting in blindness. Small or newborn animals have died from stings.

LFA are transported to new sites in potted plants, plant materials, green waste and rubbish. LFA are native to Central and South America, but have spread around the Pacific. First reported in Hawai‘i in 1999 at Hawaiian Paradise Park in Puna, there are now 50 known infestations in East Hawai‘i, one infestation on Kaua‘i, and one on Maui.

Your Help is Needed!

Everyone is asked to test their property to see if LFA are present. New infestations should be reported to the Hawai‘i Department of Agriculture (HDOA) immediately by calling 643-PEST (643-7378), or HDOA in Hilo (16 E. Lanikaula St.) at (808) 989-9289.

Do You Have Little Fire Ants? Find Out Today!

Step 1: Smear a thin coat of peanut butter on one end of some wooden chopsticks (a thick coat isn’t better).
Step 2: Place the sticks around your property in the shade, in plants, and at bases of trees. Check the sticks after about an hour.
Step 3: Pick up chopsticks with ants—carefully or they will fall off—and put them in a sealable plastic bag. Several types of ants are attracted to peanut butter, so you must examine the ants and ask yourself these questions:

- Are they red-orange? If they are brown or black in color, they are not LFA.
- Are they no longer than 1/16 inch (the thickness of a penny)? If they are easily visible, more than 1/16 inch, they are not LFA.
- Are they slow-moving and do most of them fall off the chopstick easily when you tap the side of the stick? If they do not easily fall off, they are not LFA.

Step 4: If you can answer YES to ALL of these questions, then you may have LFA. Seal the plastic bag, write your name and phone number on the bag, and place it in the freezer overnight to kill the ants and contact HDOA at the numbers above. Do not transport live ants!

Student and Food Safety: Best Practices for Hawai‘i School Gardens

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There is a renaissance in school gardening in Hawai‘i. It is a great time for school children because many subjects can be taught in a garden, and it gives students time outside with exercise during their school day. Books such as Growing an Educational Garden at Your School, by Colleen Carroll (National Tropical Botanical Garden, 1998) or How to Grow a School Garden, by Arden Bucklin-Sporer and Rachel Kathleen Pringle (Timber Press, 2010) can help get a garden off to a good start.

Even with renewed enthusiasm for school gardening, it is important to note that gardens and gardening are different than in the past. For example, there are more human pathogens in the environment, and more children are affected by allergies and asthma. Therefore, schools need to be more mindful of legal liabilities than in the past. This publication contains checklists that teachers, volunteers, and students can use to reduce risks found in the garden. The document is divided into advice about the students, the garden, and the food. It also mentions certain regulations of the Hawai‘i departments of health and agriculture. Just like a pilot working through a printed “preflight” checklist before taking to the skies, going through these lists is a “best practice.” All of the best practices in the following lists can be easily turned into curriculum topics, as they relate to STEM: science, technology, engineering, and math.

The following pages contain references to the many gardening resources provided by the University of Hawai‘i at Mānoa, College of Tropical Agriculture and Human Resources (CTAHR). One is the companion to this guide, Best Food Safety Practices for Hawaii Gardeners (http://tinyurl.com/4s2e7cp). To find additional resources, visit www.ctahr.hawaii.edu/freepubs. Other resources are listed at the end of this publication.

FOR THE STUDENTS . . .

Sun sense and hydration
Hawai‘i students are often outside in the sun. They should take precautions to protect their skin from damaging UV sunlight and stay hydrated to prevent heat exhaustion or heat stroke. Protect students in the garden by having them follow these steps:

- Have cool, potable (drinkable, municipal) water on hand and let students drink all they want whenever they feel thirsty. Use and label one-time-use cups with names, or encourage the use of reusable water bottles.
- Wear wide-brimmed hats and long-sleeved shirts.
- Wear light-colored clothes to repel the sun, rather than black or other dark colors.
- Wear glasses to protect against sun and other garden hazards.
- Wear sunscreen with a high SPF that blocks UV A and UVB rays. Some types contain insect repellent.
- Wear wide-brimmed hats and long-sleeved shirts.
- Wear light-colored clothes to repel the sun, rather than black or other dark colors.
- Wear glasses to protect against sun and other garden hazards.
- Wear sunscreen with a high SPF that blocks UVA and UVB rays. Some types contain insect repellent.
- Create a shaded area where the students can rest.
- Watch students for signs of heat stroke or heat exhaustion: increased thirst, weakness, fainting, irritability, muscle cramps, sweating, or fever.
Safe handling of tools and supplies
Proper tools and supplies make gardening easier and often more productive. Be sure to demonstrate the correct, safe use of each tool. Make sure all tools are
- used only by students of an appropriate age and under adult supervision
- kept sharpened (as appropriate)
- stored properly in a locked container
- examined regularly for damage and replaced when needed
- placed on the ground in a safe manner
- put away properly when work is done.

Personal protective equipment (P.P.E.) for students
Gardening can be hazardous, so it is a best practice to equip students with the appropriate P.P.E.
- Wear clear safety glasses (or sunglasses) on projects where eyes need protection.
- Covered shoes should be worn while working in the garden. Students should not be allowed to go barefoot or wear slippers in the garden; there are too many ways for them to get hurt.
- A dust mask should be on hand for use during potentially dusty jobs, such as turning compost.
- Have water on hand to flush eyes, if necessary.
- Have sturdy work gloves available for use with tools such as shovels and rakes.

Animals that bite or sting in Hawai‘i’s gardens
There are beneficial animals in our gardens, many of them insects. The good ones help us control pests and break down plant materials to make soil and compost. The bad ones, however, can bite or sting us, or cause allergic reactions (just like poisonous plants). They can also attack our plants. What Bit Me? by Nishida and Tenorio (University of Hawai‘i Press, 1993) provides a good summary of “bugs” in Hawai‘i’s gardens. Some children are hypersensitive to the bites or stings of bees, ants, or fleas, so they should come to the garden with proper attire and a personal response kit. Because of this type of sensitivity, be mindful of the animals listed here in and around the garden. Also, make sure their is no standing water in the garden to reduce the chances of Dengue fever being transmitted by mosquitoes.

Watch out for other physical dangers
Students are not always aware of their surroundings. Therefore, it is important to scan the garden environment for any dangers and remove or minimize them. These dangers can include:
- Wood preservatives—If constructing a raised bed, be aware of what might have been applied to the framing material to keep it from rotting or being eaten by insects. Many chemical wood preservatives, especially older ones found on recycled wood, can come off on hands and leach into the soil, becoming hazardous to humans. Since 2003, the EPA has regulated the use of heavy-duty wood preservatives. EPA advises not to use wood treated with most preservatives for edible crop production and around children. See options at http://www.epa.gov/oppad001/reregistration/ccu/. Also avoid using rubber tires and granite as border materials. For raised bed borders in school gardens, its best to use untreated redwood or cedar lumber (naturally resistant to rot and insects), hollow tiles, stone, bricks, logs, or “plastic lumber” made of recycled plastic.
- Dry soil or compost can be full of molds and other fungi such as *Aspergillus fumigatus*. Small dust particles can also create problems for students with allergies or asthma. It is best if these dusty products are handled by an adult, or students whose parents have given permission to work with them.
- Students should wash their hands with soap and water after handling soil, compost, worms, or worm castings.
- Wooden poles, metal rebar, or anything sticking up or out can be tripped over or fallen on. Cover the tops of these hazards if they cannot be removed.
- Even if students wear covered shoes in and around the garden, their ankles are still exposed. Make sure short plant sticks, metal fence posts, rebar, and other discards are cleaned up.

IN THE GARDEN...

Fertilizers
Fertilizers and other soil amendments provide plants with nutrients they need to grow. Some fertilizers, both organic and non-organic, carry the warning “KEEP OUT
OF REACH OF CHILDREN.” This is because they can be hazardous. For a school garden, fertilizers should be
- Used only as necessary—avoid the use of manure and biosolids; some products are approved for certified organic production. See: http://www.omri.org.
- Stored safely and off the ground to reduce the chance of run-off into water sources in the case of flooding.

Pesticides
The EPA believes that children are significantly more sensitive to pesticides than adults. Pesticides, organic and synthetic, are applied to repel or kill pests. The suffix, -cide, means “to kill.” Spraying liquid dish soap to kill leafhoppers or using powered borax to kill ants is using pesticides. Students should not apply pesticides. Some pesticides, organic and non-organic, carry the warning “KEEP OUT OF REACH OF CHILDREN.” This is because they can be hazardous. Do not let anyone apply “experimental” pesticides on food crops that will be eaten. Check with your schools’ groundskeeper to see what and where any pesticides may be applied on school property. See the box below for more information. All pesticides should:
- be used avoided or used minimally in school gardens
- be labeled with a U.S. Environmental Protection Agency (EPA) registration number for commercial agriculture use (this is required for school gardens by the Hawai‘i Department of Agriculture); do not use household products, such as baking soda or milk, as they are not specifically labeled as a pesticide and thus do not have precautionary information on the label for safe use

Science-Based Knowledge: Organic vs. Non-Organic Chemicals and Pesticides
Confusion often arises when people speak of “chemicals,” “pesticides,” or ask what is allowed in “organic” production. Let’s try to clarify these three terms.

Chemicals. Humans consume chemicals to live. Merriam-Webster’s Medical Dictionary (2007) defines chemical as “a substance (as an element or chemical compound) obtained by a chemical process or used for producing a chemical effect.”

The Collins English Dictionary (2009) says chemicals are “any substance used in or resulting from a reaction involving changes to atoms or molecules, especially one derived artificially for practical use.”

Thus, the water we drink is a chemical. The foods we eat contain chemicals. In fact, the human body is made up of 60 basic elements and countless chemical compounds! In the case of garden production, all composts, soil amendments, fertilizers, and pesticides (used to manage pests: insects, weeds, slugs, etc.) are or contain chemicals. The US National Organic Program (NOP) must approve chemicals for use in organic production. The NOP is part of the USDA Agricultural Marketing Service.

Pesticides. The EPA defines a pesticide as “any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest.” Pests can be insects, slugs, mice and other animals, unwanted plants (weeds), and fungi or other microorganisms like bacteria and viruses. Under U.S. law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

So, what is the difference between a chemical pesticide or fertilizer labeled “organic” or “natural” and other chemicals called “synthetic” or “man-made”? The NOP defines synthetic as “a substance that is formulated or manufactured by a chemical process or by a process that chemically changes a substance extracted from naturally occurring plant, animal, or mineral sources, except that such term shall not apply to substances created by naturally occurring biological processes.”

Some physical actions act like pesticides; for example:
- using flames to burn weeds.
- using plastic to cover the ground and create heat that will kill soil-borne pests, such as nematodes.

Organic production. In organic production, synthetic chemicals are usually prohibited. In certified organic production, however, there are over 45 instances when synthetic chemicals are allowed “with restriction,” as approved by the NOP with input from the National Organic Standards Board (NOSB). For example, the synthetic chemical hydrogen peroxide (produced by a chemical reaction in a factory) is allowed, with restrictions, in organic production. The synthetic chemicals ferrous sulfate (iron), ozone, and sulfur dioxide also make the allowed-with-restriction list. The synthetic substances that can be used under some circumstances in organic production are listed on the “National List of Allowed and Prohibited Substances” (http://tinyurl.com/ylic9vw). Otherwise, gardeners can search for NOP-compliant pesticides by looking for the Organic Materials Review Institute (OMRI) designation on the label (http://www.omri.org).

When choosing a pesticide, use only those labeled by EPA. Searching for the OMRI designation on a product will guarantee that the pesticide is NOP-compliant. Do not use household chemicals in school gardens, because they are not EPA-labeled for “commercial” use (as required by the Hawai‘i Department of Agriculture).

Always read and follow the pesticide label.
Notice: Pesticides on Hawai‘i School Campuses

“Hawaii does not have any laws restricting pesticide use in or around schools and does not require schools to implement IPM. There are no posting requirement for indoor or outdoor pesticide applications near schools, nor are there any statewide laws regarding restricted spray zones near school property.” Source: http://www.epa.gov/region9/childhealth/pesticides-hawaii.html

However, school applicators MUST follow the label on the pesticide, as “the label is the law.”

Integrated Pest Management (IPM) is using a combination of methods, including pesticides (if necessary), to keep pest populations at or below an acceptable level. The U.S. EPA has advice on how to employ IPM on school properties: www.epa.gov/pesticides/ipm/schoolipm/index.html.

Plants as natural pest repellents
The following plant varieties are recommended to be planted as in-row or border plants to repel pests (and they are not considered poisonous to people and pests; see Danger: Toxic Garden Plants):

- basil
- borage
- catmint
- chives
- coriander
- garlic
- horseradish
- hyssop
- lavender
- marigold
- mint
- nasturtium
- oregano
- pot marigold
- rosemary
- rue
- sage
- santolina
- Southernwood
- tansy
- thyme

Source: http://gardening.about.com/od/naturalorganiccontrol/a/Companion.htm

Beneficial insects: attracting and cultivating “good bugs”
Not all insects in the garden are pests. In fact, many insects and other arthropods are considered “good bugs.” Biological control of insect pests is an extremely important component of an ecologically balanced garden.

In Hawai‘i, import of natural enemies (including ladybugs) from outside the state is highly restricted, and there is currently no commercial source of natural enemies in-state. Fortunately, many beneficial insects have naturalized here. The three most important strategies to conserve natural enemy populations are:
1. Cultivate flowering plants in and around production area.
2. Limit or avoid pesticide sprays (including organic pesticides).
3. Know who your insect friends are!
   - braconid wasps
   - encrytid wasps
   - hover flies
   - ichneumonid wasps
   - lacewings
   - lady beetles (bugs)
   - minute pirate bugs
   - predatory mites
   - pteromalid wasps
   - trichogramma wasps

See the CTAHR publication titled Integrated Pest Management and this UH CTAHR resource on beneficial insects, including plants that attract beneficial insects: www.ctahr.hawaii.edu/sustainag/links/production.html#pest.

Food allergies and home-made pesticides
Some books and websites suggest using items such as milk and seafood as natural pesticides. While they may seem harmless enough, a consumer with a particular food allergy might have a negative reaction when eating a sprayed product. Do not use homemade, unapproved (unless they are on the minimum-risk list below), and unlabeled (EPA label) pesticides in school gardens. See more information about food allergies at www.foodallergy.org.

Minimum-risk pesticides
If you need to spray something to control pests, consider organic products (http://www.omri.org) or these “minimum-risk pesticides”:

- 2-phenethyl propionate
- castor oil (U.S.P. or equivalent)*
- cedar oil
- cinnamon and cinnamon oil*
- citric acid*
- citronella and citronella oil
- cloves and clove oil*
- corn gluten meal*
- corn oil*
- cottonseed oil*
- dried blood
- eugenol
- garlic and garlic oil*
- geraniol
- geranium oil
- lauryl sulfate
- lemon grass oil
- linseed oil
- malic acid
- mint and mint oil
- peppermint and peppermint oil*
- potassium sorbate
- putrescent whole egg solids
- rosemary and rosemary oil*
- sesame (includes ground sesame plant) and sesame oil*
- sodium chloride (common salt)*
- sodium lauryl sulfate
- soybean oil
- thyme and thyme oil*
- white pepper
- zinc metal strips (zinc metal and impurities, only)

* indicates exempt active ingredients that are also exempt from pesticide residue tolerance requirements.

Source: EPA Minimum Risk Pesticides http://tinyurl.com/4gbfprq
Danger: Toxic Garden Plants

Plants have varying levels of natural toxicity. Toxicity is the degree to which something can cause harm to living things. It is important to caution students not to eat or touch unidentified plant material in the garden. Some plants on the following list are common on school grounds, and this is a good opportunity to inform students about toxic plants and plant parts. Each of the four toxicity levels has a number, in parenthesis. If a plant has an added toxicity issue, it will be followed by another number in parenthesis. Some of these plants, like taro, have their toxicity reduced/eliminated through thorough cooking.

(1) Major toxicity: Ingestion of these plants may cause serious illness or death. If eaten, immediately call 911.
- angel's trumpet (Brugmansia x candida) (4)
- azalea (Rhododendron sp.)
- be-still tree (Thevetia peruviana)
- black-eyed susan (Abras precatorius)
- cassava (Manihot esculenta)
- castor bean (Ricinus communis) (4)
- cerbera (Cerbera manghas) (4)
- cestrum (Cestrum sp.)
- chinaberry (Melia azedarach)
- gloriosa lily (Gloriosa superba)
- Hawaiian poppy/puka kala (Argemone glauca) (4)
- hydrangea (Hydrangea macrophylla)
- Japanese anemone (Anemone hupehensis) (4)
- jatropha (Jatropha sp.) (4)
- jimsonweed (Datura stramonium)
- lantana (Lantana camara) (4)
- mushrooms (Agaricales, not all species)
- nightshade (Solanum sp.)
- oleander (Nerium oleander) (4)
- pencil plant, crown of thorns, red spurge, and slipper flower (Euphorbia and Pedilanthus spp.) (4)
- periwinkle (Catharanthus roseus)
- pokeberry and coral berry (Phytolacca spp. and Rivina humilis)
- star-of-Bethlehem (Hippobroma longiflora) (4)
- tomato leaves (Solanum lycopersicum) (4)

(2) Minor toxicity: Ingestion of these plants may cause minor illnesses such as vomiting or diarrhea. If eaten, call 911.
- allamanda (Allamanda cathartica) (4)
- aloe (Aloe sp.) (4)
- amaryllis (Hippeastrum sp.) (4)
- candlenut (kukui) (Aleurites moluccana) (4)
- croton (Codiaeum variegatum) (4)
- cup of gold and silver cup (Solandra sp.)
- foxglove (Digitalis purpurea) (4)
- kava (Piper methysticum)
- plumeria (Plumeria sp.) (4)
- poinsettia (Euphorbia pulcherrima)

(3) Oxalates: The juice or sap of these plants contains oxalate crystals. Ingestion of these needle-like crystals can irritate the skin, mouth, tongue, and throat, resulting in throat swelling, breathing difficulties, burning pain, and stomach upset. Call 911 if any of these symptoms appear following ingestion of plants.
- anthurium (Anthurium sp.)
- crown flower (Calotropis gigantea) (4)
- dumb cane (Dieffenbachia sp.) (4)
- elephant ear (Alocasia and Xanthosoma sp.) (4)
- taro (Colocasia esculenta)
- peace lily (Spathiphyllum sp.)
- philodendron (Philodendron sp.) (4)

(4) Dermatitis and eye injury: Contact with the juice, sap, or thorns of these plants may cause a skin rash or irritation or eye injury. Wash the affected area of skin with soap and water as soon as possible after contact. The rash may be very serious and painful. Call 911 if symptoms appear following contact with the plants.
- aloe (Aloe sp.) (2)
- amaryllis (Hippeastrum sp.) (2)
- angel’s trumpet (Brugmansia x candida) (1)
- castor bean (Ricinus communis) (1)
- cerbera (Cerbera manghas) (1)
- croton (Codiaeum variegatum) (2)
- crown flower (Calotropis gigantea) (3)
- dumb cane (Dieffenbachia sp.) (3)
- elephant ear (Alocasia and Xanthosoma sp.) (3)
- foxglove (Digitalis purpurea) (2)
- Japanese anemone (Anemone hupehensis) (1)
- jatropha (Jatropha sp.) (1)
- kahiki flower and silky oak (Grevillea sp.)
- lantana (Lantana camara) (1)
- mango (Mangifera indica)
- oleander (Nerium oleander) (1)
- pencil plant, crown of thorns, red spurge, and slipper flower (Euphorbia and Pedilanthus spp.) (1)
- philodendron (Philodendron sp.) (3)
- plumeria (Plumeria sp.) (2)
- star-of-Bethlehem (Hippobroma longiflora) (1)
- tomato leaves (Solanum lycopersicum) (1)

Washington State Poison Control Center: www.wapc.org/poisons/plantlist.htm
http://hurthawaii.blogs.com/PoisonPlantsHawaii.pdf
www.ces.ncsu.edu/depts/hort/consumer/poison/indcoa_e.htm
• be used only per label instructions, under adult supervision, and with the custodian’s knowledge
• be used with appropriate personal protective equipment (P.P.E.) as required by the product’s label
• have a Material Safety Data Sheet (MSDS) (www.msds.com), which provides information in case of a spill or other accident occurring with that particular substance
• have warning signs and/or verbal warnings used in the garden as required by the label
• be stored in a posted, locked, well-ventilated facility.

Garden sanitation and protection
School properties are typically abandoned at night and on the weekends. People often have access to gardens, whether you know about it or not. Enclosing the garden with a fence and posting signs to limit trespassers provides some control over the site. Members of the community may want to help, but may unknowingly introduce pests or diseases. Inform the community that it is a school garden and ask them to contact the school if they have questions or concerns. A posted list of rules for a school garden might include the following:
• No dumping. All waste, even green material, should be thoroughly composted before it enters the garden. It is best to add compost to the soil between crops, or when the plots are fallow.
• Keep dogs and cats out. While many consider feces to be a “fertilizer,” animal dung can also contain human pathogens, such as Toxoplasmosis in cats.
• Keep food scraps out of the garden, as they can attract rodents and other animals. Compost them first.
• Minimize the presence of birds around food crops by using nets and/or bird deterrents (rotate frequently). Bird droppings can carry as many as 60 fungal, bacterial, and viral diseases, including West Nile virus and avian flu. Bird droppings can also contaminate aquaponic tanks and sources of human drinking water.

Managing rats, slugs, and snails and reducing the chance of rat lungworm
Hawaii, like other tropical areas, has a unique pest: the rat lungworm. This microscopic nematode (shaped like a worm and invisible to the naked eye) lives in the lungs of rats, and when it is excreted it can be eaten by slugs and snails. The photo of a semi-slug on p. 7 shows how small slugs can be. People can accidentally eat a slug or snail if they do not look carefully at what they harvest or eat. The disease can make people very sick: they can even die if the rat lungworm reaches their brain. Precautions must be taken to reduce the chance of selling or consuming contaminated produce. Best practices for managing this pest include:
• removing rodent, slug, and snail hiding places; trap...
and kill them in your garden
• not harvesting or eating produce
   with slugs or snails, or their
   feces or slime, on it.
If you suspect that slugs and snails
have been on your produce, con-
sider rinsing the produce in water
containing a sanitizer that has
been approved for food contact
by the FDA.

More information on rat lungworm
is found here:
Advice for consumers:
www.ctahr.hawaii.edu/oc/
freepubs/pdf/FST-35.pdf
Advice for commercial
producers:

Which water for what use?
Plants need water to grow, but water quality can vary
greatly. You need to choose the proper water for the task.

Irrigation. There are no national or state standards for
irrigation water quality. Therefore, the produce industry
has chosen the EPA Recreational Water Standard (www.epa.gov/waterscience/criteria/recreation) as a maximum
requirement. This standard says that E. coli in irrigation
water must be fewer than 126 bacteria per 100 ml. Some
Hawai'i rivers, ditches, and water catchment systems
(open reservoir and roof-top) can have E. coli numbers
in excess of this maximum, so care must be taken when
using these sources in your garden. If the water is not
from a city source (called “potable,” or drinkable), the
best practice is to use drip irrigation under plastic mulch.
At least this will keep the non-potable irrigation water
from touching the “edible portion of the crop” (unless it
is a root crop).

Produce rinse water. When a crop is harvested, the
cut surface of the crop can act as
an entry point for pathogens, just
like when we cut ourselves. Re-
cent science tells us that produce,
just like cut flowers in a vase, can
absorb water through the places
where it was cut for harvesting.
This process is called capillary
action. Thus, if the produce rinse
water contains pathogens, they might be sucked into
the edible portion of the crop. Capillary action is even
stronger when the core temperature of a plant is more
than 10 degrees warmer than the rinse water. This is
because water moves from cold parts to hot parts. The
best practice is to follow FDA’s Current Good Manufac-
turing Practices (cGMP, http://tinyurl.com/3jq6n5g) and
use only potable produce rinse water. This guidance also
follows Hawai'i Administrative Rules §11-11-8 (http://
gen.doh.hawaii.gov/sites/har/admrules/default.aspx) and
recommends that food manufacturers use water from an
approved source when rinsing produce. There are some
commercial “sanitizers” on the market, but they may not
be labeled for some of Hawai‘i’s crops.

Growing fish and produce together
Many of Hawai‘i’s families, farms, and schools are
trying a new farming method called aquaponics. It is
a combination of hydroponics (plants grown in water)
and aquaculture (fish farming). Having students near an
open water source is something to be careful of, espe-
cially with younger ones. Many of the precautions and
recommended production methods can be found in these
CTAHR publications on aquaponics and hydroponics.

On-Farm Food Safety
Small-Scale Lettuce Production with Hydroponics or
Aquaponics
More hydroponics publications are here:
www.ctahr.hawaii.edu/hawaii/Vegetable.aspx

What if your garden has been flooded?
Rain is the best source of water for growing plants. There
are concerns, however, about the safety of flood-damaged
vegetables and fruits for fresh consumption, especially
those crops grown close to the ground. Flood waters can
transfer fertilizers, pesticides, feces, pests and debris into
your garden from farms, lawns, septic and sewer systems,
parking lots, etc. If your garden has been inundated by
water, follow these recommendations from the FDA for
commercial crops:
• If the edible portion of a crop is exposed to flood
   waters, it is considered contaminated and should not
   be eaten. There is no practical method of sanitizing
   the edible portion of a vegetable or fruit that has been
   sitting in contaminated water. Therefore, gardeners are
   encouraged to reduce the risk by discarding affected
crops or incorporating the crops into the soil.

. . . continued on page 12
FOR THE STUDENTS

Sun sense and hydration (see “P.P.E” below)
✓ Provide drinking water.
✓ Provide sunscreen.
✓ Provide covered area where students can rest in the shade.
✓ Provide eye protection as needed; sun glasses are recommended.
✓ Wide-brim sun hats are recommended.
✓ Light-colored clothes and long-sleeved work shirts are recommended.

Safe handling of tools and supplies
✓ They should be age-appropriate and used under adult supervision.
✓ Maintain tools and store them in a locked container.
✓ Place them on the ground in a safe manner.

Personal protective equipment (P.P.E.) (see “Sun sense and hydration” above)
✓ Provide a well-stocked first-aid kit.
✓ Provide eye protection as needed.
✓ Provide work gloves for heavy jobs.
✓ Covered shoes are highly recommended.
✓ Dust masks should be available as needed.

Animals that bite and sting
✓ Be mindful of ants, bees, centipedes, scorpions, etc.
✓ Children who are hypersensitive to the bites or stings of bees, ants, or fleas should come to the garden with proper attire and a personal response kit.

Other physical dangers in the garden
✓ Don’t use treated lumber, granite or rubber tires for raised garden bed borders.
✓ Be mindful around compost and other dusty materials.
✓ Wash hands after handling compost and worm bins.
✓ Rid the garden of sharp objects, such as rebar or fence posts, or make sure stakes are capped.

Good Garden Guidance
Let your words and actions always reflect your aloha for your friends and the garden.
Covered shoes are highly recommended.
Seek adult permission before applying anything to plants.
Wash your hands after eating, touching your mouth, going to the bathroom, turning compost, working in the worm bin, and before handling produce.
To protect the plants, walk around rows, not through them.
Use garden tools and equipment carefully.
Keep the garden free of dangers and trash.
Keep animals and pets out of the garden.
In case of emergency, call 911.

IN THE GARDEN

Fertilizers
✓ Use only under adult supervision.
✓ Use as needed to meet plants’ nutritional needs.
✓ Use organic materials listed at www.ORMI.org.
✓ Follow all label precautions, as some fertilizers can be dangerous for children.
✓ Keep always stored in a locked container.

Pesticides
✓ Avoid using if possible.
✓ Use only under adult supervision.
✓ Read and follow the label.
✓ Understand that children are more sensitive to pesticides than adults.
✓ Grow plants that naturally repel pests.
✓ Do not use “home-made” or experimental pesticides; rather, use only ones approved by EPA for commercial farms and listed at www.ORMI.org.
✓ Always keep stored in a locked, labeled, well-ventilated storage container.

Animals and pests
✓ Take active steps to keep pets, wild animals, and insect pests out of an active growing area.
✓ Do not leave food discards uncovered in compost piles.
✓ Remove rats, slugs, and snails, as they can carry the rat lungworm pathogen.
✓ Do not use raw manure with a growing crop.
✓ Livestock should be housed down-slope from garden areas to avoid run-off of fecal matter into food-growing areas.

Garden care and maintenance
✓ Water garden with potable water (or use drip irrigation with non-potable water and apply water at the soil surface and never on the edible portion of the crop).
✓ Use science-based composting techniques that create pathogen-free finished compost.
✓ All manure and kitchen discards should be properly composted for at least 90 days.
✓ Be mindful that many plants found in Hawai‘i can be toxic. Children should ask before eating.
### ABOUT FOOD HANDLING

**Food safety supplies**
- Use only city/county-supplied drinkable water.
- Provide:
  - clean sink for washing hands and produce
  - non-antibacterial soap in a pump-type dispenser
  - single-use towels (do not wipe hands on clothes)
  - trash can with lid
  - a well-stocked first-aid kit
  - water to flush eyes if needed.

**Harvesting, cleaning and handling**
- Wash hands (at least 20 sec.) with soap before and after harvesting or handling produce.
- Do not harvest or handle produce when sick.
- Do not harvest damaged plants, especially ones with slug/snail slime or damage, or ones with feces on them.
- Use disposable gloves properly for harvesting (or handling) (or both).
- Use clean, food-grade harvest containers to hold harvested produce.
- Make sure cutting tools are sharp, cleaned, and sanitized (according to manufacturer’s label) before use.
- Harvest containers should be kept off the ground in a clean wheelbarrow, tarp or pallet, to avoid contaminating produce with soil and pathogens.
- Food contact surfaces should be non-porous and cleaned.
- Make sure knives and cutting boards are clean.

**Rinsing and preparing fresh produce**
- Wash hands (at least 20 sec.) before handling produce.
- Inspect all harvested produce and discard and compost damaged products.
- All food served to the public, must be prepared in a kitchen with a Food Establishment permit from the Hawai‘i Department of Health.
- Washing fruits and vegetables with soap or detergent is NOT recommended because soap is not approved for use on food.
- Scrub firm produce, such as melons or potatoes, with a clean produce brush.
- All cut, peeled, or cooked fruits and vegetables must be eaten or refrigerated within 2 hours. Cut produce left at room temperature longer than 2 hours should be discarded or composted.
- Refrigerate any other produce that is not going to be consumed immediately.

**Seller displays**
- Wash hands (at least 20 sec.) with soap before handling produce.
- Use food-grade bags for any pre-packaged produce.
- Un-packaged produce needs to be displayed on clean, sanitized tables or in clean containers, preferably with a cover. Plastic or stainless steel surfaces are preferred over porous wood surfaces.
- Loose leafy greens should be kept at 45°F or lower.
- Display packages chilled, or have a display sample with packages for purchase kept in a cooler or refrigerator.
- If you are providing food samples, a Hawai‘i Department of Health Temporary Food Permit is required.
- Store and display samples in a covered container to avoid environmental contaminants like dust and pests. To prevent cross-contamination, serve samples in single-use containers or have toothpicks for one-time sampling from a “dish.” With sauces or dips, prevent “double-dipping” by using a squeeze bottle.
- Do not serve unpasteurized juice or milk.

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**Interested in agricultural science?**
If you are a student interested in exploring a degree in the agricultural sciences, in one of dozens of agriculture-related fields, then the College of Tropical Agriculture and Human Resources at the University of Hawai‘i at Mānoa has a program for you! Visit us at www.ctahr.hawaii.edu.

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* Authors are James Hollyer, Fred Brooks, Lynn Nakamura-Tengan, Luisa Castro, Jayme Grzebik, Maile Sacarob, Vanessa Troegner, Donna Meyer, the Hawaii School Garden Network, Theodore Radovich, Lydi Morgan-Bernal, and Dexter Kishida

These critical points summarize the contents of “Student and Food Safety: Best Practices for Hawai‘i School Gardens”* published by the College of Tropical Agriculture and Human Resources, University of Hawai‘i at Mānoa. The publication is available online: www.ctahr.hawaii.edu/oc/freepubs/FST-45.pdf.
Planning your school garden

OUR TO-DOs:

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Operating Your Garden Like a National Organic Program–Certified Farm

Here are basics of the USDA’s National Organic Program (NOP), if you want to run your garden as “certified organic.”

1. Research the site’s history

   Transitional
   a. The garden site must be 36 months without the use of “prohibited” substances.
   b. If prohibited substances were applied, determine the date and obtain something in writing that describes them.
   c. Pick a transition starting date and work toward certification.

   Immediate eligibility
   Newly planted, previously fallow land may be eligible immediately for certification—check into this.

2. Know the regulations

   Get a copy of the USDA National Organic Program (NOP) regulations, read them, and find someone to answer your questions about what they mean. (www.ams.usda.gov/nop)

3. Exemptions from certification

   A producer or handler that sells agricultural products as “organic” but whose gross annual agricultural income from organic sales is $5,000 or less is exempt from certification. But, that non-certified operation must follow all the NOP guidelines, just like a certified farm.

4. Certification

   Develop an early relationship with an organic certification agency to ensure that you are making good decisions and using only appropriate and allowed substances.

5. Develop an Organic System Plan (see USDA NOP Section 205.201)

   a. Monitoring plan
   Describe practices and procedures to be performed and maintained, including frequency.

   b. Soil amendments
   Develop a list of fertility needs for your crop and find organically approved materials allowed under USDA NOP Sections 205.203 and 205.601. (www.omri.org / www.agr.wsda.gov)

   c. Soil biodiversity
   Develop a program to enhance soil biodiversity with organic matter (USDA NOP Section 205.203).

   d. Pest, disease, and weed management plan
   A comprehensive plan listing each approved organic pesticide used in production or handling.

   e. Seeds and planting stock
   Document that seeds and annual transplants are certified organic; for any non-organic seed or planting stock used, you will need to document your search.

   f. Physical barriers
   Describe management practices and physical barriers that prevent commingling of organic/non-organic products on a split (organic and non-organic) operation and also describe practices that prevent contact with prohibited substances (i.e., aerial sprays, drift from neighboring farms, runoff).

   g. Recordkeeping practices (USDA NOP Section 205.103)
   Auditing documents that track products from the origin in the field to final use or sale is critical. A random audit is part of the inspection procedure. It may require the following.
   • field, planting, and production records
   • harvest and yield records
   • postharvest handling records
   • storage and transport records
   • sales or final use records

Helpful links
www.ams.usda.gov/nop USDA National Organic Program
www.ifoam.org International Federation of Organic Agricultural Movements
www.omri.org Resource for approved substances
www.ncat.org Helpful tools, publications, workbooks
• Crops in proximity to but less exposed to flooding, where the edible portion of the crop has NOT come in contact with flood waters, need to be evaluated on a case-by-case basis. Factors to consider in the evaluation include:
  • What was the source of the flood waters and were there potential upstream contributors of bacterial and/or chemical contaminants?
  • The type of crop and stage of growth. For example, was the edible portion of the crop still developing? How far above the ground was the lowest edible portion?
  • Were conditions such that the crop may have been exposed to prolonged periods of moisture and stress that could foster fungal growth and, possibly, development of mycotoxins?

Source: EPA: http://tinyurl.com/3o6744q

THE FOOD . . .

Food safety supplies
Garden products are eaten both raw and cooked. To protect produce from non-production contamination, you will need the following supplies:
  • potable (drinkable, municipal) water for hand washing and produce rinsing
  • sinks: one exclusively for hand washing, a separate one for produce rinsing, and, if necessary, a third for washing tools and equipment.
  • non-antibacterial soap in a pump-type dispenser (no bar soap)
  • single-use paper towels (no cloth towels)
  • covered trash can
  • a well-stocked, up-to-date, first aid kit that is easily accessible by everyone at all times.

Allow No Animals (or Uncomposted Manures) in the Production Area

There have been produce and food recalls, sicknesses, and deaths due to contamination with animal feces containing human pathogens. The pathogens have been found in raw produce and in processed foods. Keep animals and their uncomposted manures out of the garden at all times. For example, the American Public Health Association’s Compendium of Methods for the Microbiological Examination of Foods says, “E. coli is not part of the normal microflora of fresh produce, therefore their presence can be related to the use of polluted water for irrigation or washing, presence of animal feces, unclean hands, or contaminated surfaces of harvesters and containers.”

Follow these best food-safety practices:
Animals, including pets, should be kept out of growing areas and buffer zones at all times (http://tinyurl.com/4qfajku). Any production animals should be humanely housed in an enclosed area down-slope from the produce production area. This will help keep manures from getting into the garden during heavy rains.
If feces are occasionally found in the garden, use a trowel or shovel to pick them up, place them in a plastic bag, and discard them in a trash can. Alternatively, bury feces in a hole downhill and well away from the garden. Sanitize the trowel or shovel when done.
Avoiding manure will minimize risk of microbial contamination. If manure is used to amend soil in a produce production area, it must be processed according the EPA 503 practices (http://tinyurl.com/3wqahn3) and Hawai‘i State regulations. Purchase compost from a reputable supplier. See also the CTAHR publication titled Composted Animal Manures: Precautions and Processing. [AWM-1]
Worm castings collected from worm bins must never be applied to the edible portion of the crop. Side-dress plants with castings or incorporate them into the soil as an amendment.

All compost piles containing manure should be located down-slope from the produce production area. No raw manure or compost leachate (water at the bottom of the pile) should run into open bodies of water (EPA Clean Water Act: http://tinyurl.com/yhlsgyf).
Change boots (i.e., “animal-only” or “produce-only” boots) and/or have a sanitizing boot bath if people are moving from an area with animal feces to a produce production area.
Keep birds away by using bird deterrents and changing types frequently. (The Internet has many homemade ideas.) Bury all food discards (garbage) in a hole or in a compost pile. When raw food is exposed, it can attract dogs, cats, rodents, mongooses, birds, and other undesirable animals.
Wash hands with soap and water after being in an animal area and going back into the produce production area. Allow NO raw manure or animals in a garden during the production season, especially at harvest time!
Harvest, clean, and handle produce with food safety in mind

It is important that you not contaminate recently harvested produce. Contamination can come from unclean hands, animal feces on or in containers, from contaminated rinse water, and so forth. Follow these best practices:

- Make sure that everyone washes his or her hands with soap and water before handling or eating produce.
- If someone is ill, they should not be handling produce (harvesting, rinsing, or any preparation). Find a non-food contact project for ill students, like weeding.
- Make sure cutting tools are sharp, cleaned, and sanitized (according to manufacturer’s label) before use.
- Harvest containers should be made of materials approved for food use (plastic, stainless steel, etc.).
- Harvest containers and tools should be washed with soap and water and an approved sanitizer before each use.
- Harvest containers should be kept off the ground in a clean wheelbarrow or on a tarp or pallet to avoid contaminating produce with soil and pathogens.

Rinsing and preparing fresh produce (also known as “raw agricultural produce”)

- All food contact surfaces, utensils, and equipment should be clean and sanitized (according to the manufacturer’s label) before each use.
- Food served to the public (as free samples or at a group food event) must be prepared in a kitchen with a Food Establishment Permit from the Hawai`i Department of Health (http://tinyurl.com/3sqbo6w).
- Cut away damaged or bruised areas on fresh fruits and vegetables before preparing and/or eating. Produce that looks rotten should be discarded or composted.
- All produce should be inspected and rinsed thoroughly with clean running water before preparing, cooking, and eating. This applies to both conventionally- and organically-grown produce.
- If a produce rinse or sanitizer is used, use a clean container and follow the label instructions.
- Even if you plan to peel the produce before eating, it is still important to rinse it first.
- Soap and detergent are not approved for use on food, so do not use them to wash fruits or vegetables.
- Scrub firm produce, such as melons or potatoes, with a clean produce brush.
- Drying produce thoroughly with a clean cloth towel or paper towel may further reduce surface bacteria.

Dude! Wash Your Hands

Here’s how to do it right:
1. Wet your hands with potable running water.
2. Apply liquid or powder soap.
3. Rub your hands vigorously for at least 20 seconds. Remember to scrub all surfaces, including the backs of your hands, wrists, between your fingers and under your fingernails. (Sing the “ABC” song while washing to ensure at least 20 seconds.)
4. Rinse well.
5. Dry your hands with a clean or disposable towel or air dryer.
6. If possible, use your towel to turn off the faucet.
7. If possible, use your towel to open the door.
8. Dispose of your towel responsibly.

Note: Antibacterial soap is not more effective than regular soap for cleaning hands. Antibacterial soap does have an additional bacteria kill ingredient but may also lead to the development of more resistant bacteria. Waterless antibacterial hand gels with at least 60% alcohol can kill bacteria but are not effective for heavily soiled hands.

Source: Centers for Disease Control and Prevention
www.cdc.gov/handwashing

Proper Disposable Glove Use

Disposable gloves can be an effective safety measure if used properly. If gloves are not used properly, the chance of cross contamination is similar to bare-hand contact. The National Restaurant Association has stated in a report that they have found the key to improved food safety is proper hand washing technique. Because the 2009 FDA Food Code mandates no-bare-hand contact with ready-to-eat foods, proper glove use is essential when working with food.

Rules of proper glove use:
1. Use powder-free, non-latex gloves to reduce the chance of an allergic reaction.
2. Do not re-use gloves.
3. Gloves should be changed whenever an activity change occurs or when there is contact with face or hair.
4. Proper hand washing should be done prior to putting on new gloves, and between activity changes.

- Refrigerate all produce that is not going to be immediately consumed.
- All cut, peeled, or cooked fruits and vegetables must be eaten or refrigerated within 2 hours. Cut produce left at room temperature longer than 2 hours should be discarded in the trash or composted.

Source: www.ctahr.hawaii.edu/NEW/foodsafety/forms/FIGHTBAC_saferFV.pdf
Setting up a seller display and best food handling practices

Setting up a good seller display, such as you would find in a professional farmers’ market, always requires good food handling practices. Remember, people are paying for a safe, quality product. To prevent cross-contamination from the environment or people:

- Have easily accessible hand washing and toilet facilities for students, teachers, and other participants.
- Hands must be washed with soap before handling produce. Avoid bare-hand contact, by using gloves after washing hands. Hand sanitizer can also be made available to clean unsoiled hands than may contain contaminants.
- Use food-grade bags for any pre-packaged produce.
- Un-packaged produce needs to be displayed on clean, sanitized tables or in clean containers, preferably with a cover. Plastic or stainless steel surfaces are preferred over porous wood surfaces.
- If using tablecloths, wash them before each use.
- Loose leafy greens should be kept at 45°F or lower. Display packages chilled, or have a display sample with packages for purchase kept in a cooler or refrigerator.
- If you are providing food samples, a Hawai’i Department of Health (DOH) Temporary Food Permit is required (http://tinyurl.com/3sqbo6w).
- Samples of cut produce must be prepared in a DOH-certified kitchen (http://tinyurl.com/3sqbo6w). Cut fresh produce left at room temperature for more than 2 hours should be discarded.
- Store and display samples in a covered container to avoid environmental contaminants like dust and pests. To prevent cross-contamination, serve samples in single-use containers or have toothpicks for one-time sampling from a “dish”. With sauces or dips, prevent “double-dipping” by using a squeeze bottle.
- Have a trash can handy to minimize rubbish around your display.
- Do not serve unpasteurized juice or milk.

Wanting to provide food for the school cafeteria?

At the current time, the Hawai’i Department of Education’s School Food Services Branch requires that all produce in cafeterias must:

- have a food safety line of liability; for example, through an approved produce vendor, or by means of procurement
- be available (equity) for all students participating in the meal program.

Content for this publication is original and was adapted from the following sources and other best school-garden practices publications

UHM CTAHR’s Farm Food Safety Website, which contains information for school gardens under “client services”: http://manoa.hawaii.edu/ctahr/farmfoodsafety


University of Florida school garden website: http://gardeningsolutions.ifas.ufl.edu/schoolgardens/hot_topics/garden_safety.shtml

University of New Hampshire: Garden to Table: Five Steps to Food Safe Fruit and Vegetable Home Gardening http://gardeningsolutions.ifas.ufl.edu/schoolgardens/hot_topics/garden_safety.shtml

University of Maryland: Food Safety in the School Garden (great page!) www.growit.umd.edu/Youth%20Gardening/Garden%20and%20Food%20Safety.cfm

Is it okay to use a public school cafeteria’s kitchen for garden produce?

This is a complex question! Please contact the Hawaii Department of Education’s School Food Services Branch on Oahu at 808-733-8400 for more information on this matter.
## Hawai‘i School Garden Hui Contacts

### Hawai‘i
- Hawai‘i Island School Garden Network
  - The Kohala Center
  - Nancy Redfeather, Program Director
  - Phone: (808) 322-2801
  - nredfeather@kohalacenter.org
  - www.kohalacenter.org/HISGN/about.html

### Maui
- Maui School Garden Network
  - Day: Monday–Saturday
  - Time: 8 am–5 pm
  - Phone: (808) 250-8323
  - msgn@hawaii.rr.com
  - Place: Ha‘ikū, Maui
  - www.mauischoolgardennetwork.org

- Community Work Day Program
  - Day: Monday–Saturday
  - Time: 8 am–5 pm
  - Phone: (808) 877-2524
  - rm_lane@hotmail.com
  - Place: Pu‘unēnē, Maui

- South Maui School Gardens Project
  - Day: Monday–Saturday
  - Time: 9 am–4 pm
  - Phone: (808) 269-6300
  - kirsurry@yahoo.com
  - Place: Kihei, Maui

### Kaua‘i
- Kaua‘i School Garden Network
  - Tiana Kamen, Director
  - Malama Kaua‘i
  - (808) 828-0685 ext. 12
  - tiana@malamakauai.org
  - www.malamakauai.org/aboutSchoolGardens.php

### O‘ahu
- ‘AINA In Schools Program
  - Kokua Hawai‘i Foundation
    - aina@kokuaahawaiifoundation.org
    - www.kokuaahawaiifoundation.org/aina

- Grow Hawai‘i (Hawaii Association of Independent Schools)
  - Phone: (808) 973.1538
  - growhi@hais.org
  - www.growhi.org
  - Place: 1585 Kapiolani Blvd. #1212, Honolulu, HI 96814

## UHM CTAHR Master Gardener Program Contacts

### Hawai‘i (East) Master Gardener Helpline
- Day: Monday, Tuesday, Friday
- Time: 9 am–noon
- Phone: (808) 981-5199
- himga@hawaii.edu
- Place: Komohana Research and Extension Complex, 875 Komohana St., Hilo

### Hawai‘i (West) Master Gardener Helpline
- Day: Thursday
- Time: 9 am–noon
- Phone: (808) 322-4892

### Maui Master Gardener Helpline
- Day: Monday–Saturday
- Time: 8 am–5 pm
- Phone: (808) 244-3242 ext. 228
- MauiMg@ctahr.hawaii.edu
- Place: Kahului Cooperative Extension Service Office, 310 Ka‘ahumanu Ave., Bldg 214

### Kaua‘i Master Gardener Helpline
- Day: Monday–Friday
- Time: 1 pm–4:30 pm
- Phone: (808) 274-3471
- rebesu@hawaii.edu
- Place: Kaua‘i Cooperative Extension Service Office, 3060 Eiwa St. (State Office Bldg. Rm 210) in Līhue

### O‘ahu Master Gardener Helpline
- Day: Monday–Friday
- Time: 9 am–noon
- Phone: (808) 453.6055
- OahuMg@ctahr.hawaii.edu
- Place: Pearl City Urban Garden Center, 955 Kamehameha Hwy.

CTAHR Master Gardener site:
www.ctahr.hawaii.edu/site/extprograms.aspx

Complete School Garden Hui listing:
http://www.hawaiischoolgardenhui.org

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Complete School Garden Hui listing:
http://www.hawaiischoolgardenhui.org
Preparing for and Passing an Annual Third-Party Good Agricultural Practices Audit (a.k.a. Food Safety Audit)

School gardens do not usually sell produce or provide food for the cafeteria. Cafeteria procurement regulations for reimbursed costs by USDA have rules on what produce can be used in a school cafeteria and may exclude produce from school gardens, unless, perhaps, they are GAP-audited (http://www.fns.usda.gov/cnd/governance/regulations.htm). However, operating under Good Agricultural Practices (GAPs), the produce industry’s best practices, is a good choice at any time. GAPs include, but are not limited to, the following:

Make sure the farm/garden has well-maintained toilets and hand-washing facilities with potable water, liquid hand soap, and single-use towels for hand washing.
Make sure employees/students are washing their hands before harvesting and handling produce.
Make sure sick or injured/bleeding employees/students are reassigned to non-food tasks, and that any blood-tainted produce is thrown away.
Use ONLY the right pesticides, fertilizers, and composts (organic or non-organic) according to their labeled (legal) directions, and record every use. This includes following the pesticides’ pre-harvest interval (PHI) precisely in order to protect consumers from pesticide residues that exceed EPA allowable amounts.
Make sure that workers/students who handle or are exposed to pesticides are trained and protected based on the EPA Worker Protection Standard (WPS) rules.
Use proactive pest management strategies for rodents, birds, deer, pigs, slugs, and snails, and purposefully keep animals, including pets, and their fresh manures away from fields, orchards, and school gardens that are in production.
Make sure that produce that has feces contamination (from birds, rats, or other pests), or signs of being eaten by an animal, is not harvested and is only removed from the field after all other produce is harvested.
Use appropriate quality water for irrigation and crop rinsing as required by federal and state regulations or industry best practices. Farm/garden water should be tested for microbial content at an approved laboratory.
Make sure the packing shed or area, food-contact surfaces, and refrigerators are well maintained and not a potential source of food contamination.

More information
http://manoa.hawaii.edu/ctahr/farmfoodsafety/?page_id=240

Disclaimer
Reference to a supplemental information source is not intended as an endorsement or recommendation in preference to other sources that may also be suitable.

Acknowledgments
The authors thank Dale Evans for editing and layout services. Hand drawings are by Nancie McCormish, Drawn by Design. The development of this publication was funded by USDA #2008-38826-19179, “Agricultural Development in the American Pacific.”
# Student and Food Safety: Best Practices for Hawai‘i School Gardens Checklist

## School Garden Information

<table>
<thead>
<tr>
<th>School Name:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Name of person to oversee food safety:</td>
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</tr>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>Phone:</td>
<td>E-mail:</td>
</tr>
<tr>
<td>Preferred method of communication:</td>
<td></td>
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<tr>
<td>Expected products for sale/use:</td>
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<tr>
<td>Total area farmed:</td>
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</tbody>
</table>

## Production Information & Garden Self-Assessment

### Personal Hygiene

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
<tbody>
<tr>
<td>Potable water is available for all students</td>
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<tr>
<td>Training and supervision on proper sanitation, hand washing and hygiene practices is provided and implemented for all students.</td>
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<tr>
<td>All toilet, rest room and field sanitation facilities are clean.</td>
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<tr>
<td>Clean sink for washing hands and produce is provided.</td>
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<tr>
<td>Non-antibacterial soap in a pump-type dispenser is provided.</td>
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<tr>
<td>Single-use towels (do not wipe hands on clothes) are provided.</td>
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<tr>
<td>Trashcan with lid is provided.</td>
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<tr>
<td>A well-stocked first-aid kit is provided.</td>
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<tr>
<td>Water to flush eyes if needed is provided.</td>
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<tr>
<td>Students are instructed to not work if they exhibit any sign(s) of infection such as fever, diarrhea, etc.</td>
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</tbody>
</table>

### Water/Irrigation

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<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
<tbody>
<tr>
<td>Test for the presence of: <em>E. coli</em> bacteria. Contact Hawai‘i-state-approved laboratories for their costs and testing supplies (link above).</td>
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<tr>
<td>Rinse or wash water for produce must be potable according to State of Hawai‘i regulations.</td>
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</table>

### Chemicals

<table>
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<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
<tbody>
<tr>
<td>Stored in a locked container and off the ground to reduce the chance of run-off into water sources in the case of flooding.</td>
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<tr>
<td>Pesticides should be avoided or used minimally in school gardens. If used, only under adult supervision.</td>
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</tr>
<tr>
<td>Used only per label instructions, under adult supervision, and with the custodian’s knowledge.</td>
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<tr>
<td>Used with appropriate personal protective equipment (P.P.E.) as required by the product’s label.</td>
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<tr>
<td>Have a Material Safety Data Sheet (MSDS) (<a href="http://www">www</a>. msds.com), which provides information in case of a spill or other accident occurring with that particular substance</td>
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<tr>
<td>Have warning signs and/or verbal.</td>
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<tr>
<td>Organic materials used are listed at <a href="http://www.ORMI.org">www.ORMI.org</a>.</td>
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<tr>
<td>Do not use “home-made” or experimental pesticides; rather, use only ones approved by EPA for commercial farms and listed at <a href="http://www.ORMI.org">www.ORMI.org</a>.</td>
<td></td>
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</tr>
</tbody>
</table>
### Fertilizers

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow all label precautions, as some fertilizers can be dangerous for children.</td>
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<tr>
<td>Use only under adult supervision.</td>
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<tr>
<td>Use as needed to meet plants’ nutritional needs.</td>
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<tr>
<td>Use organic materials listed at <a href="http://www.ORMI.org">www.ORMI.org</a>.</td>
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<tr>
<td>Keep always stored in a locked container.</td>
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</tbody>
</table>

### Animals and Pests

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active steps are being taken to keep pets, wild animals, and insect pests out of an active growing area.</td>
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<tr>
<td>Food discards are not left uncovered in compost piles.</td>
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<tr>
<td>Remove rats, slugs, and snails, as they can carry the rat lungworm pathogen.</td>
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<tr>
<td>Do not use raw manure with a growing crop.</td>
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<tr>
<td>Livestock should be housed down-slope from garden areas to avoid run-off of fecal matter into food-growing areas.</td>
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</tbody>
</table>

### Garden Care and Maintenance

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water garden with potable water (or use drip irrigation with non-potable water and apply water at the soil surface and never on the edible portion of the crop).</td>
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<tr>
<td>Use science-based composting techniques that create pathogen-free finished compost.</td>
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<tr>
<td>All manure and kitchen discards should be properly composted for at least 90 days.</td>
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<tr>
<td>Be mindful that many plants found in Hawai‘i can be toxic. Children should ask before eating.</td>
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</tbody>
</table>

### Safe Handling of Tools and Supplies

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
<tbody>
<tr>
<td>Used only by students of an appropriate age and under adult supervision.</td>
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<tr>
<td>Kept sharpened (as appropriate).</td>
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<tr>
<td>Stored properly in a locked container.</td>
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<tr>
<td>Examined regularly for damage and replaced when needed.</td>
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<tr>
<td>Placed on the ground in a safe manner.</td>
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<tr>
<td>Properly stored when work is done.</td>
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</tbody>
</table>

### Harvesting, Cleaning and Handling

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash hands (at least 20 sec.) with soap before and after harvesting or handling produce.</td>
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<tr>
<td>Do not harvest damaged plants, especially ones with slug/snail slime or damage, or ones with feces on them.</td>
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<tr>
<td>Use disposable gloves properly for harvesting (or handling) (or both).</td>
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<tr>
<td>Use clean, food-grade harvest containers to hold harvested produce.</td>
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<tr>
<td>Make sure cutting tools are sharp, cleaned, and sanitized (according to manufacturer’s label) before use.</td>
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<tr>
<td>Harvest containers should be kept off the ground in a clean wheelbarrow, tarp or pallet, to avoid contaminating produce with soil and pathogens.</td>
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<tr>
<td>Food contact surfaces should be non-porous and cleaned.</td>
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<tr>
<td>Make sure knives and cutting boards are clean.</td>
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</table>

### Rinsing and Preparing Fresh Produce

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<tr>
<th>Instruction</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
<tbody>
<tr>
<td>Wash hands (at least 20 sec.) before handling produce.</td>
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<tr>
<td>Inspect all harvested produce and discard and compost damaged products.</td>
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<tr>
<td>All food served to the public, must be prepared in a kitchen with a Food Establishment permit from the Hawai‘i Department of Health.</td>
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<tr>
<td>Washing fruits and vegetables with soap or detergent is NOT recommended because soap is not approved for use on food.</td>
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<tr>
<td>Scrub firm produce, such as melons or potatoes, with a clean produce brush.</td>
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<tr>
<td>All cut, peeled, or cooked fruits and vegetables must be eaten or refrigerated within 2 hours. Cut produce left at room temperature longer than 2 hours should be discarded or composted.</td>
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<tr>
<td>Refrigerate any other produce that is not going to be consumed immediately.</td>
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</table>

Fruits and vegetables are an important part of a healthy diet. Introducing children to them in schools will improve their present and future health. Fresh produce must be handled safely to reduce the risks of foodborne illness. There are a number of steps that foodservice employees can take to minimize the chances for fruits and vegetables they handle to become contaminated. Best practices for handling all types of produce are described in this fact sheet, along with practices specific to leafy greens, tomatoes, melons, and sprouts.

Contamination of produce with harmful microorganisms can occur at all stages of production, processing, transportation, storage, preparation, and service. To prevent foodborne illness, fresh produce needs to be handled with care at each step from farm to table.
Recommendations For Handling Fresh Produce

**PURCHASING AND RECEIVING**
- Use purchasing specifications that include food safety requirements, such as maintaining produce at the proper temperature, maintaining clean and pest-free storage areas and delivery vehicles, and complying with federal and state food safety laws and regulations.
- Ensure suppliers are getting produce from licensed, reputable sources.
- Check storage and handling practices of vendors.
- Establish procedures for inspecting and accepting or rejecting incoming deliveries. Procedures should include checking the condition of the fresh produce and the transportation vehicles to make sure specifications are met.

**WASHING AND PREPARATION**
- Inspect produce for obvious signs of soil or damage prior to cutting, slicing, or dicing. When in doubt about damaged produce, either cut away the affected areas or do not use the item.
- Wash produce before serving or cutting using either:
  - Continuous running water.
  - Chemical disinfectants, used according to the manufacturer’s label instructions for recommended concentration and contact time. *Note: Do not soak produce or store in standing water.*
- Do not rewash packaged produce labeled “ready-to-eat,” “washed,” or “triple washed.”
- Wash thoroughly with hot soapy water all equipment, utensils, and food contact surfaces that come into contact with cut produce. Rinse, sanitize, and air-dry before use.

**HAND HYGIENE**
- Wash hands thoroughly with soap and water before handling or cutting fresh produce. Rewash hands after breaks, visiting restrooms, sneezing, coughing, handling trash or money, or anytime hands become soiled or otherwise contaminated.
- Use a barrier such as gloves, deli paper, or an appropriate utensil to touch ready-to-eat produce. *Note: This does not eliminate the need for frequent proper handwashing.*
- Always wash hands before putting on disposable gloves.
- Change disposable gloves anytime the gloves may have been contaminated or when changing tasks.
- Do not wash or reuse disposable gloves.
- Change disposable gloves if they are torn or damaged.
Recommendations For Handling Fresh Produce

- Inspect produce for obvious signs of soil or damage prior to cutting, slicing, or dicing. When in doubt about damaged produce, either cut away the affected areas or do not use the item.
- Wash produce before serving or cutting using either: Continuous running water. Chemical disinfectants, used according to the manufacturer’s label instructions for recommended concentration and contact time. Note: Do not soak produce or store in standing water.
- Do not rewash packaged produce labeled “ready-to-eat,” “washed,” or “triple washed.”
- Wash thoroughly with hot soapy water all equipment, utensils, and food contact surfaces that come into contact with cut produce. Rinse, sanitize, and air-dry before use.

WASHING AND PREPARATION

- Use purchasing specifications that include food safety requirements, such as maintaining produce at the proper temperature, maintaining clean and pest-free storage areas and delivery vehicles, and complying with federal and state food safety laws and regulations.
- Ensure suppliers are getting produce from licensed, reputable sources.
- Check storage and handling practices of vendors.
- Establish procedures for inspecting and accepting or rejecting incoming deliveries. Procedures should include checking the condition of the fresh produce and the transportation vehicles to make sure specifications are met.

TRAINING AND GENERAL FOOD SAFETY PRACTICES

- Develop training programs to teach the importance of food safety and proper handling of produce to all food handlers.
- Practice good food safety and food handling techniques to prevent cross-contamination.

SERVING

- Do not store produce in direct contact with ice or water while on display on serving lines and salad bars.
- Mark the time when cut produce is displayed without refrigeration. Display cut produce for a maximum of 4 hours if not in a refrigeration unit or containers surrounded by ice. Discard any uneaten produce at the end of 4 hours.
- Create safe salad bars and self-service lines by taking the following actions:
  - Protect food with sneeze guards or food shields in a direct line between the food and the mouth or nose, usually 14 to 18 inches above the food.
  - Use cleaned and sanitized long-handled tongs, spoons, and ladles so bare hands do not touch food and the utensils do not drop into the serving pans.
  - Change utensils periodically.
  - Set up the salad bar or self-service line as close to mealtime as possible to reduce the time that produce sits out.
  - Keep cold foods at or below 41°F in a refrigeration unit or surrounded by ice.
  - Monitor and document the internal temperature of self-service items every 30 minutes as with other foods on the service lines.
  - Clean up spills promptly. Wiping cloths should be stored in sanitizing solution and laundered daily.
  - Teach children salad bar etiquette. Assign an adult to monitor the salad bar and self-service line to make sure the customers—especially children—are not touching food with their hands, tasting food while in line, putting their heads under the sneeze guard, or returning food items.
    - Clearly label all salad dressings and other containers to discourage tasting.
    - Never add freshly prepared food to food already on salad bars and self-service lines.

STORAGE

- Maintain produce at the temperature recommended for the variety and particular stage of ripeness.
- Store produce at least 6 inches off the floor, including in walk-in refrigerators.
- Store produce in a covered container and above other items that might cause contamination.
- Follow manufacturer’s instructions for the product such as “keep refrigerated” or “best if used by.”
- Establish a policy for produce that is cut in-house to specify how long the refrigerated cut product may be used. Mark the product with “prepared on” or “use by” date.
- Wash produce just before preparation, not before storage.
## Recommendations For Specific Types Of Produce

### Melons
- Avoid using whole melons that have visible signs of decay or damaged rinds (such as mechanical damage or cracking) due to the increased risk that harmful bacteria may have contaminated the melons.
- Wash the outer surface of the melon thoroughly under running cool tap water to remove surface dirt. Scrub melons with a clean produce brush before cutting. Cut away any bruised or damaged areas before serving.
- Discard cut melons after 4 hours if maintained at 41°F or above. If possible, display cut melons in a refrigerated case, not just on top of ice.
- Display cut melons for a maximum of 4 hours without being kept cool with refrigeration or ice and discard uneaten melons at the end of 4 hours.
- Mark the date on refrigerated cut melons to indicate that they must be consumed or discarded within 7 days.

### Tomatoes
- Do not wash tomatoes in cold water. Use wash water temperatures that are at least 10°F warmer than the internal tomato temperature to prevent exterior bacteria from entering the interior of the tomato during washing.
- Ensure whole tomatoes are free from obvious signs of soil and skin damage, such as punctures, prior to cutting, slicing, or dicing. Either cut away any bruised or damaged areas, or do not use the tomato.
- Hold tomatoes at 41°F or below after cutting, including during display on serving lines and salad bars.
- Ensure the temperature of tomatoes purchased as fresh-cut (i.e., sliced, diced, or chopped) is 41°F or lower upon delivery and the tomatoes were kept cool continuously during transport. Reject fresh-cut tomatoes delivered at a temperature higher than 41°F.
- Mark the date on refrigerated cut tomatoes to indicate that they must be consumed or discarded within 7 days.
- Do not store cut tomatoes in direct contact with ice or water.

### Leafy Greens
- Do not use leafy greens with visible signs of decay or damage because there is an increased risk of the presence of harmful bacteria. When in doubt about the use of decayed or damaged product, either remove the unusable portions or do not use the leafy greens.
- Do not rewash packaged produce labeled "ready-to-eat," "washed," or "triple washed."

### Sprouts
- Due to the increasing number of illnesses associated with eating raw sprouts, the Food and Drug Administration has advised all consumers—especially children, pregnant women, the elderly, and persons with weakened immune systems—to not eat raw sprouts as a way to reduce the risk of foodborne illness. All sprouts should be cooked thoroughly before eating to reduce the risk of illness.

## Resources


Food and Drug Administration. Safe Handling of Raw Produce and Fresh-Squeezed Fruit and Vegetable Juices. Available at http://www.cfsan.fda.gov/~dms/prodsafe.html


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