



The **Hazard Evaluation and Emergency Response (HEER) Office** is part of the Hawai'i Department of Health's Environmental Health Administration whose mission is to protect human health and the environment. The HEER Office provides leadership, support, and partnership in preventing, planning for, responding to, and enforcing environmental laws relating to releases or threats of releases of hazardous substances.

Clean Soil: A Building Block for Creating a Safe Garden at Your School

If you are considering starting a garden at your school or your school has a garden already, this fact sheet will provide you with an overview of how to minimize any potential risk for exposure to lead, arsenic, or organochlorine pesticide (OCP) contamination in the soil. Additional resources are provided at the end of this fact sheet.

School gardens have grown in popularity nationwide, as well as in Hawai'i. The nutritional and educational benefits from school gardens are well-documented. However, making sure that the soil you are using for your garden is safe is critical to reap the full benefits of a school garden.

The Hawai'i Department of Education (HDOE) conducted soil sampling in certain areas at 23 schools on the eastern side of the Hawai'i Island. Analytical results showed that approximately 60% of the schools had areas with elevated soil lead levels, 20% had areas with elevated soil arsenic levels, and 20% had areas with elevated soil OCP levels. These chemicals were predominantly found within a narrow strip of 3 to 4 feet along older building foundations. Only rarely were elevated concentrations of these contaminants found in the soil samples collected from other areas of the schools. Lead around the building perimeters is likely associated with the past use of lead-based paint on building exteriors prior to 1978. Arsenic was commonly used for weed control in the 1910s through 1940s, which included use along building perimeters. OCPs were used for termite control at building foundations from the mid-1940s to the 1980s. Ensuring that gardens are located away from building perimeters and foundations is one of the simple methods described in this fact sheet that can greatly reduce the potential exposure to these contaminants.

The potential occurrence of lead, arsenic, and/or OCPs in (pre-1990) building perimeter soils is not unique to school sites.

The HEER Office and other published research have documented similar concerns for older structures in residential and commercial settings. The background information and recommendations provided in this fact sheet can also be used to reduce potential exposure for these contaminants in garden soils near homes or businesses. As noted in the information below, the only way to specifically determine the occurrence and magnitude of any soil contaminants in building perimeter areas is to conduct soil testing.



Ensure your school garden has soil that is suitable for growing crops. Contaminated soil can outweigh the health benefits of fresh, local produce. (Photo Credit: Collective School Garden Network)



Three Components to Creating a Safer Garden

There are three main components to consider for creating a safe garden at your school: (1) location of the garden, (2) soil quality, and (3) construction materials.

Location

- Plant your garden away from building foundations, fence lines, and property lines where arsenic-containing herbicides or other pesticides may have been previously applied.
- Locate your garden away from or on higher ground than potential contamination sources, which may include garbage bins, animals, parking lots, busy roadways, septic systems, or underground storage tanks. Run-off during rainstorms could carry contaminants from these sources into the garden.
- Do not plant your garden over septic systems or leach fields.

Soil Quality

- If possible, test the soil to determine if there are any contaminants present at elevated levels. It is important to test for lead, arsenic, and OCPs. If the garden is near a busy roadway or industrial area, other heavy metals or persistent contaminants specific to the industrial operations should be considered for testing.
- As an alternative to testing the garden soil, consider purchasing soil for the garden area that has been commercially packaged and labeled for growing food crops. This ensures greater soil quality and safety. Other options include obtaining garden soil from an area where no historical chemical use can be reliably documented or purchasing soil from a local source if they can document that their soil has been adequately tested for potential contaminants. Gardens built with “clean” soil still need to be located away from building perimeters and foundations. In addition, because garden plant roots can extend over a foot below the ground, it is important to have a raised garden bed with clean soils at enough depth to prevent the roots from reaching the untested soil below. A permeable geotextile fabric (from hardware or garden stores) can be placed between the untested soil and overlying clean soils to help identify and maintain the boundary between the two layers.
- Do not use any pesticides or herbicides in your school garden due to potential health hazards that may exist for children.
- Contact the Hawai‘i Department of Agriculture for guidance on fertilizer and compost use and application.



Prevent exposure to contaminated soil by locating school gardens away from building foundations, fence lines and property lines, do not use pressure treated wood, and if possible, test the soil for lead, arsenic, and OCPs.

Construction Materials

- Use non-toxic, non-leaching materials for raised garden beds, containers, stakes or trellises. Do not use pressure-treated wood which can contain arsenic. Additionally, used tires, single-use plastics, old railroad ties, and other similar materials should not be used because of the potential for contaminants.



How do I know if our school garden's soil is contaminated?

Soil testing is the only way to know for certain if the levels of contaminants such as lead, arsenic and OCPs in the soil are high enough to pose a potential health risk. School buildings built before 1978 are more likely to have elevated lead in the soil surrounding the foundations due to the past use of lead-based paint on the structures. In addition, schools located near busy roadways may have elevated lead in the soil from the past use of lead-containing gasoline. Schools constructed on former agricultural land, especially sugar cane plantations in use before 1950, could have elevated levels of arsenic in the soil due to the past use of arsenic-based herbicides to control weeds. Soil around the perimeters and beneath wooden school buildings constructed prior to 1990 may contain high levels of OCPs, such as chlordane. It is important to locate gardens away from these high-risk areas. If you suspect your school may have elevated lead, arsenic, or OCP levels in the soil, you may want to have the soil in the garden tested. Check with your school officials and district administrators regarding assistance with testing of school garden soils. The Hawai'i Department of Health's HEER Office can also provide advice and resources.

What are lead and arsenic, and how did they get in the soil near some schools?

Lead and arsenic are naturally occurring elements that are present at low levels in all soils, including soils in Hawai'i. However, elevated levels of both these contaminants in soils are most likely related to past human activities. Current human activities can affect exposure to these contaminants if the soils or building materials are disturbed.

There are two main human-caused sources of **lead** in soils: the past use of lead-based paint, and the past use of leaded gasoline. The use of lead in house paint was banned by 1978 but it still exists in the interior and/or exterior paint of many older buildings in Hawai'i. Soil around the perimeter of buildings can become contaminated with lead as paint chips off of exterior walls and falls to the ground. In addition, some types of older roofing nails can contain lead. Similar to the paint chips, lead can be leached from the nails that have fallen to the ground and contaminate the soil. Elevated levels of lead in soil can also be related to the past use of lead in gasoline. Although lead in gasoline was phased out starting in the 1970s and completely banned in 1995, decades of leaded gasoline use often contaminated soils adjacent to highways and roads with lead. Lead does not degrade in soils but can be dispersed through natural or human soil disturbances over time or could be transported by erosion to adjacent areas.



Soil contaminants from historic practices (e.g. use of lead paint or pesticides) can be suspect in building perimeter areas.

The main source of the elevated levels of **arsenic** predominantly found along building foundations was likely the use of arsenic-based herbicides, insecticides and/or rodenticides in the 1920s through 1940s. These chemicals may have also been used along fence lines or property lines for weed control during that same time period. Generally, the HDOE sampling at East Hawai'i schools did not identify levels of arsenic above human health risk levels in open areas and playfields at schools. However, only surface soils (the top 4 to 6 inches of soil) were



tested. Therefore, it is unknown whether deeper soils may be contaminated without further testing. Since inorganic arsenic is stable in the environment, it can remain in soil for many years.

What are OCPs and how did they get in the soil near some school buildings?

OCPs are a group of pesticides that were primarily used for termite control in and around wooden buildings from the mid-1940s to the late 1980s. They were also used in agricultural fields to control insects. OCPs commonly used in Hawaii included chlordane, aldrin, dieldrin, heptachlor, and dichlorodiphenyltrichloroethane (DDT). In the 1970s and 1980s, the U.S. Environmental Protection Agency (EPA) banned all uses of these OCPs except for heptachlor, which can only be used today to control fire ants in underground power transformers. OCPs were commonly applied to soil beneath buildings or beneath slab foundations, and around foundation perimeters. The highest concentrations of OCPs in soil are typically found in the top 1 to 2 feet of soil and up to 1 to 3 feet away from the building perimeter. OCPs break down very slowly in the environment and are not detectable by smell or sight. Additionally, application rates were relatively high, and the applications may have been repeated over time. As a result, these OCPs may still be found in treated soils at levels of concern to human health.

How are people exposed to lead, arsenic and OCPs in soil?

Unintentional ingestion of contaminated soil is the primary source of exposure to lead, arsenic, and OCPs in soil. Dirt on hands from normal play activities, working in a school garden, or from residual dirt on produce grown in the school gardens can result in accidental ingestion of contaminated soil. Children frequently put their hands or other objects in their mouths, and these can often have small amounts of soil and dust on them that the child then swallows. Small soil particles can be also carried into schools on hands, shoes and clothing, or as airborne dust. Once inside the school, the contaminated soil can be deposited on floors, furniture, or other objects that children come in contact with. Neither lead nor arsenic is absorbed through bare skin in significant amounts. Although OCPs can be absorbed through the skin during and immediately after they are applied, the main means of exposure long after application is primarily through ingestion of contaminated soil or contaminated residues.

Produce grown in soil with elevated arsenic and lead levels is generally considered safe to eat as long as it has been thoroughly washed to remove contaminated soil and dust. Arsenic and lead are not generally absorbed by edible plants. Thorough washing with clean, running water is especially important for root crops such as taro, carrots, and sweet potatoes, as well as for leafy vegetables, like fern heads, kale, and lettuce because of the tendency for soil and dust to stick to the surface of the produce. However, OCPs can be absorbed into plants grown in contaminated soil. Therefore, it is very important to grow produce in clean soil free from contamination.



Thoroughly washing produce from school gardens is one of the best and most important ways to limit any exposure to contaminants in the soil.



What can I do to prevent exposure to contaminated soil?

Accidentally swallowing small amounts of soil is the main way students, teachers, and staff would be exposed to lead, arsenic or OCPs in soil. This type of exposure can occur at schools with contaminated soils, and also at people's homes or businesses if contaminants are present. If testing reveals elevated levels of these or other contaminants on your property, or if you suspect your school may have elevated soil contaminant levels, the potential for exposure can be minimized through the following actions:

- Wash hands thoroughly after playing outside, after working in the school garden, and prior to eating.
- Avoid tracking soil into the school and clean up right away if soil is tracked in. Use door mats and boot scrapers. Leave shoes outside whenever possible.
- Maintain dense landscaping, gravel, or permanent cover, such as asphalt or concrete, close to building foundations, roads, and driveways to prevent children from playing in soil where higher contaminant levels can be found.
- Keep children from playing in bare dirt.
- If the school garden area has not been tested for lead, arsenic, and OCPs to determine the soil is OK for use, consider using planter boxes or raised garden beds filled with soil known to be free of contamination. If the soil for the garden beds is from the school property it should be sampled and tested to make sure it is clean. If the soil is brought in from an outside area, ask the person providing the soil to have the soil tested or otherwise provide evidence that it is unlikely to be contaminated. Refer to the HEER Office's "Clean Fill Guidance" for additional information on testing of imported soil (see Further Information, below).
- Plant gardens at least 10 feet away from building foundations, roads, and driveways. Busier roads or highways may require a larger buffer zone.
- Bring in clean sand for sandboxes.
- Wash all fruits and vegetables from the garden with clean, running water before bringing them into the school. Wash again carefully with a 1% vinegar solution or soapy water to remove any remaining soil particles. Discard outer leaves before eating leafy vegetables. Peel and remove the outer skin of root and tuber vegetables before eating. Do not compost the produce peelings and unused plant parts for use back in the school garden.



Further Information

For questions related to lead, arsenic and OCPs in soils at schools, contact:

Hawai'i Department of Health
Hazard Evaluation and Emergency Response Office (HEER)
2385 Waimano Home Road
Pearl City, Hawai'i 96782

Telephone: (808) 586-4249
Website: <http://hawaii.gov/doh/heer>

If you have questions about having your child tested for lead contact:

Hawai'i Childhood Lead Poisoning Prevention Program (HI-CLPPP)
741 Sunset Avenue
Honolulu, Hawai'i 96816

Telephone: 808-586-4345
Website: <http://lead.hawaii.gov>

State of Hawai'i Children with Special Health Needs Branch manages the Hawai'i Childhood Lead Poisoning Prevention Program (HI-CLPPP). HI-CLPPP is a joint program with the Centers for Disease Control (CDC) aimed at preventing childhood lead poisoning. HI-CLPPP monitors all elevated blood lead levels and supports families and health care providers to prevent or minimize the health effects from lead exposure: <http://lead.hawaii.gov>

Hawai'i Department of Health's HEER Office Fact Sheet for guidance on proper collection of soil samples, "A Guide to Soil Testing for Organochlorine Termiticides at Residential Sites in Hawai'i"
<http://eha-web.doh.hawaii.gov/eha-cma/documents/c1578f33-2d86-43f1-8655-64862c45f642>

Hawai'i Department of Health's HEER Office Soil Arsenic Guidance and Information:
<http://eha-web.doh.hawaii.gov/eha-cma/Leaders/HEER/soil-arsenic-guidance-and-information>

Hawai'i Department of Health's HEER Office Clean Fill Guidance:
<http://eha-web.doh.hawaii.gov/eha-cma/documents/ee9cfe45-347c-4258-863f-2eebbaadc75f>

Hawai'i Department of Health's Indoor and Radiological Health Branch's lead program helps: (1) prevent exposure to lead and lead-based paint, and (2) maintains the State of Hawai'i lead abatement accreditation, certification, and registration systems for lead abatement entities and individuals: <http://health.hawaii.gov/irhb/lead/>

USDA's Professional Standards for School Gardens: This website provides links to local, state, regional and national programs to assist with school gardens. <https://professionalstandards.fns.usda.gov/nutrition-1000-nutrition-education-1200/school-gardens-1230?page=2>

USDA's Peoples' Garden: This website provides resources including short videos for starting and registering your school garden. <https://peoplesgarden.usda.gov/>

University of Hawai'i at Mānoa's College of Tropical Agriculture and Human Resources: This website provides tools and resources from its Farm Food Safety program as well as local partners. <http://manoa.hawaii.edu/ctahr/farmfoodsafety/school-home-gardens/>

The Edible Schoolyard: The mission of the Edible Schoolyard Project is to build and share a national edible education curriculum for pre-kindergarten through high school. <http://edibleschoolyard.org/>

Other Resources for Exposure to Lead, Arsenic and OCPs:

Agency for Toxic Substances and Disease Registry's ToxFAQs website is a federal government website providing information and recommendations regarding lead, arsenic and OCPs: <http://www.atsdr.cdc.gov/toxfaqs/index.asp>

