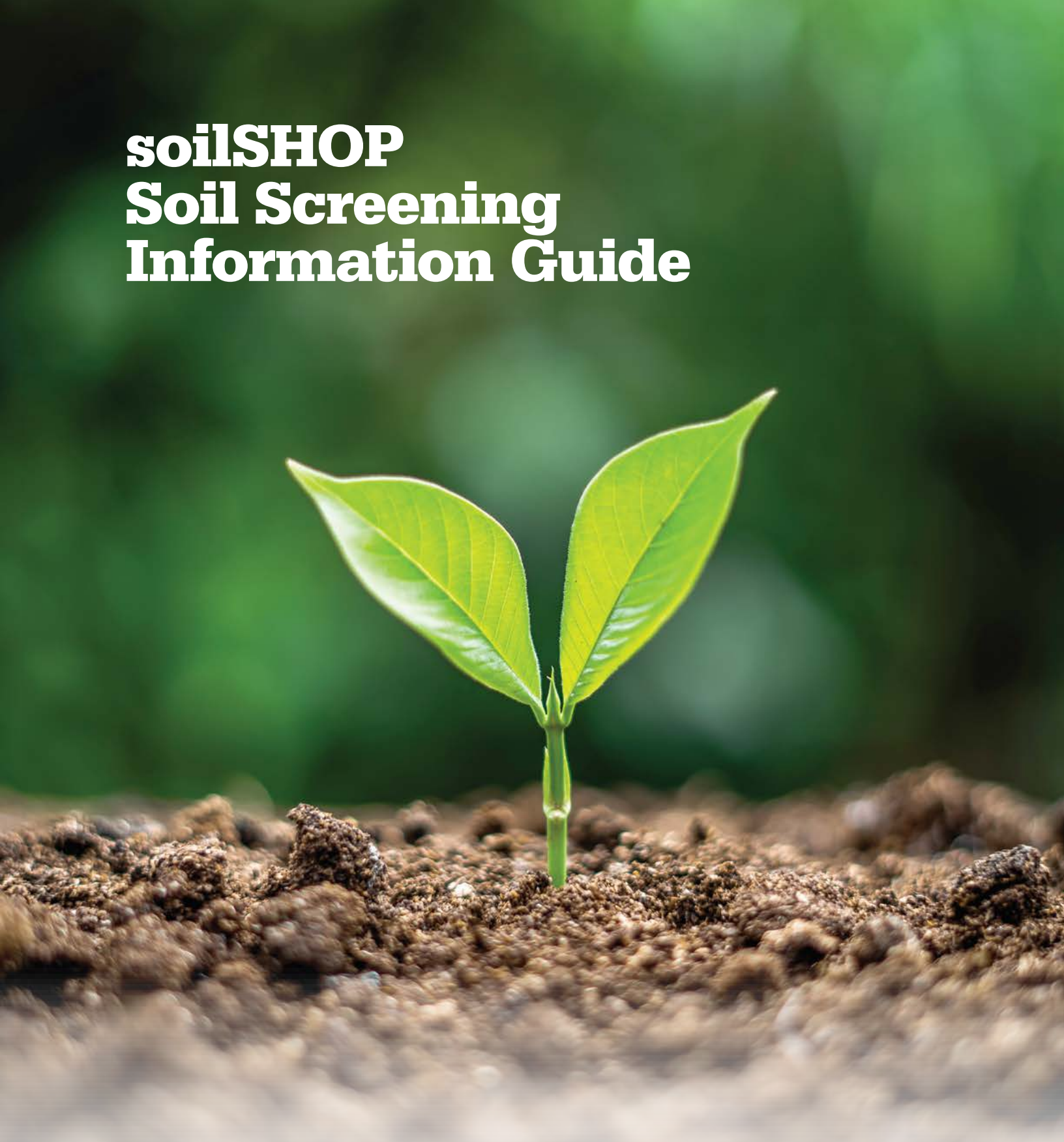
soilSHOP Soil Screening Information Guide



Last Updated: December 2019

soilSHOP

Screening, **H**ealth, **O**utreach, and **P**artnership

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

soilSHOP

Screening, Health, Outreach and Partnership

Soil Screening Information Guide

How is the manual organized?

SoilSHOPs and Soil Screening

This soilSHOP Soil Screening Manual is intended for technicians and other soilSHOP soil screening staff. This manual should be reviewed, modified, and applied by qualified staff to meet the needs and operational guidelines/procedures of their representative agencies and organizations.

What is a soilSHOP?

A soilSHOP is an event that provides rapid screening analysis of chemical elements (like lead and arsenic) in soil and targeted one-on-one health education. It is an innovative approach to meet community-specific health education and outreach needs related to addressing potential soil contamination of lead and other heavy metals. Overall, soilSHOPs unite the expertise of environmental scientists and health educators to reduce and prevent potential exposures.

How does a soilSHOP work?

1. Community members collect a soil sample and bring it to the soilSHOP event (see Figure 1).
2. Samples are screened for lead, arsenic and other metals, at no cost to participants. Participants receive screening results on the same day.
3. Health educators engage one-on-one with participants about their specific soil results.

Screening Limitations

While the soilSHOP screening approach is helpful in characterizing soil lead levels, it does have limitations:

- The soilSHOP soil screening procedure used are not designed to identify sources of lead or to characterize an entire yard or area of soil.
- Field-based XRF screening is not as accurate as laboratory analysis.
- The screening level data from the soilSHOP may not be scientifically or legally defensible.
- Sample interpretations and screening data are not designed, or of an appropriate data quality, to drive public health decisions.

Despite these limitations, soilSHOP events provide a positive, interactive, and informative activity that supports one-on-one communication between health educators and residents regarding lead health concerns and best practices to reduce exposures.

Participants may wish to seek further laboratory testing to confirm their soil screening results. soilSHOP staff will help explain soil screening results and share information on ways to reduce potential exposures to lead and other harmful substances in soil.

Figure 1: Soil sampling cartoon—color on soilshop website.

Soil Screening in Action

This section of the manual outlines example steps that have been applied at past soilSHOP events. These steps listed below represent different areas for the screening team to consider when preparing for their event and station. General approaches and tips for successful soil screening are provided.

Information regarding Event Planning, Setup, and Sample Log In (implemented before Step 1) and Health Education (following Step 2) are provided in the soilSHOP Toolkit. The Soil Screening Team is one group supporting the overall soilSHOP event. The various roles and responsibilities for a soilSHOP are provided on the Example Staff Roles and Functions doc.

Step 1. Plan/Set Up

Planning for the Event

Because soil screening is a key component of soilSHOP events, the role of the soil screener is crucial. It's important to plan ahead. The soilSHOP soil screening team should meet several times before the event to discuss event location, processes, goals, statiwon preparation, additional safety requirements, and XRF equipment training. During this planning phase, the team should consider the following:

- Event location
- Number of expected participants
- Equipment and materials needed
- Trainings needed
- Resources available (i.e. soilSHOP Toolkit)
- Screening and follow-up procedures
- Soil sample disposal and management

Checklists are available in the Appendix of this manual (p. 11) that can help teams stay organized when preparing for events.

Event Setup

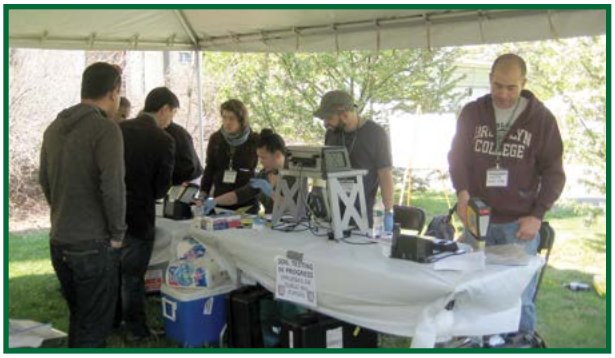
Setup for each soilSHOP event will vary by venue and number of tents available. Below is basic information about potential event setups and soil screening stations. Descriptions and images are based on tent and soil screening station layouts used in past soilSHOP events.

Small: Single-Tent Setup

In this setup, tables for log-in staff, health educators, and snacks surround the perimeter of the tent. The soil screening station is inside the tent towards the back, away from participant traffic. A sign on the table informs staff and participants that screening is in progress.

Large: Single-Tent Setup

The log-in/registration area and informational event signs are outside the tent area. Inside the tent, the health educator station is located closer to the front and center of the tent. The soil screening station is farther back within the tent. Signs around the soil screening area indicate screening is in progress to caution participants waiting for results.



Multiple-Tent Setup

If the venue or location allows multiple tents, the soil screening team should have its own tent. As pictured below, the soil screening station is away from participant traffic, with signs indicating that screening is in progress. The Agency for Toxic Substances and Disease Registry recommends this setup for soilSHOPs as it provides the most safety for participants and staff.

No-Tent Setup

In some cases, tents may not be needed or available. For this setup, arrange table stations with ample space between. If possible, place ropes or cones around the soil screening table and display signs indicating caution.

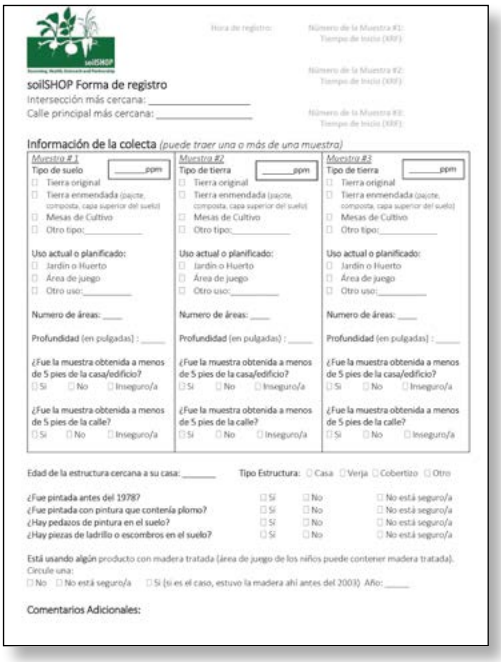
In all setups, screening team members should assist with their station setup before the event. They should also consider conducting a safety briefing on event day for all soilSHOP staff.

Soil Screening Materials and Equipment Overview

This section describes materials that have been identified as needed in past soilSHOP events, and general information on XRF equipment, use, and safety. The soilSHOP Equipment and Material Checklist provides more information on the materials. For further instructions on XRF equipment calibration, and equipment standards, please refer to the manufacturer's manual.

Log-In Form

The Log-In Form is used to collect information about each soil sample. Participants provide details about the nature of the soil sample they have brought for screening.



soilSHOP Forma de registro

Intersección más cercana: _____

Calle principal más cercana: _____

Información de la colecta *(puede traer una o más de una muestra)*

Muestra # 1	Muestra #2	Muestra #3
Tipo de suelo _____ppm	Tipo de tierra _____ppm	Tipo de tierra _____ppm
☐ Tierra original	☐ Tierra original	☐ Tierra original
☐ Tierra enmendada (pacote, composta, capa superior del suelo)	☐ Tierra enmendada (pacote, composta, capa superior del suelo)	☐ Tierra enmendada (pacote, composta, capa superior del suelo)
☐ Mesas de Cultivo	☐ Mesas de Cultivo	☐ Mesas de Cultivo
☐ Otro tipo:_____	☐ Otro tipo:_____	☐ Otro tipo:_____
Uso actual o planificado:	Uso actual o planificado:	Uso actual o planificado:
☐ Jardín o Huerto	☐ Jardín o Huerto	☐ Jardín o Huerto
☐ Área de juego	☐ Área de juego	☐ Área de juego
☐ Otro uso:_____	☐ Otro uso:_____	☐ Otro uso:_____
Numero de áreas: ____	Numero de áreas: ____	Numero de áreas: ____
Profundidad (en pulgadas) : ____	Profundidad (en pulgadas) : ____	Profundidad (en pulgadas) : ____
¿Fue la muestra obtenida a menos de 5 pies de la casa/edificio? ☐ Si ☐ No ☐ Inseguro/a	¿Fue la muestra obtenida a menos de 5 pies de la casa/edificio? ☐ Si ☐ No ☐ Inseguro/a	¿Fue la muestra obtenida a menos de 5 pies de la casa/edificio? ☐ Si ☐ No ☐ Inseguro/a
¿Fue la muestra obtenida a menos de 5 pies de la calle? ☐ Si ☐ No ☐ Inseguro/a	¿Fue la muestra obtenida a menos de 5 pies de la calle? ☐ Si ☐ No ☐ Inseguro/a	¿Fue la muestra obtenida a menos de 5 pies de la calle? ☐ Si ☐ No ☐ Inseguro/a

Edad de la estructura cercana a su casa: _____ Tipo Estructura: ☐ Casa ☐ Verja ☐ Cobertizo ☐ Otro

¿Fue pintada antes del 1978?	☐ Si	☐ No	☐ No está seguro/a
¿Fue pintada con pintura que contenía plomo?	☐ Si	☐ No	☐ No está seguro/a
¿Hay pedazos de pintura en el suelo?	☐ Si	☐ No	☐ No está seguro/a
¿Hay piezas de ladrillo o escombros en el suelo?	☐ Si	☐ No	☐ No está seguro/a

Está usando algún producto con madera tratada (área de juego de los niños puede contener madera tratada). Circule una:

☐ No ☐ No está seguro/a ☐ Si (si es el caso, estuvo la madera ahí antes del 2003) Año: _____

Comentarios Adicionales:

Soil Screening Result Card

A result card is one of many options that can be used to provide residents a hard-copy report of their soil sample results.

Log Books

Log books are for internal use. They are used to document the readings for each sample screened.

Caution Tape/Orange Traffic Cones

Use these items to delineate the screening area and advise participants/staff to use caution.

Decontamination Equipment

Use decontamination equipment to clean equipment after use, and to maintain a clean station throughout event (paper towels, disinfecting wipes, trash cans, and bags).

Disposable Gloves

Screeners should wear gloves when handling soil samples.

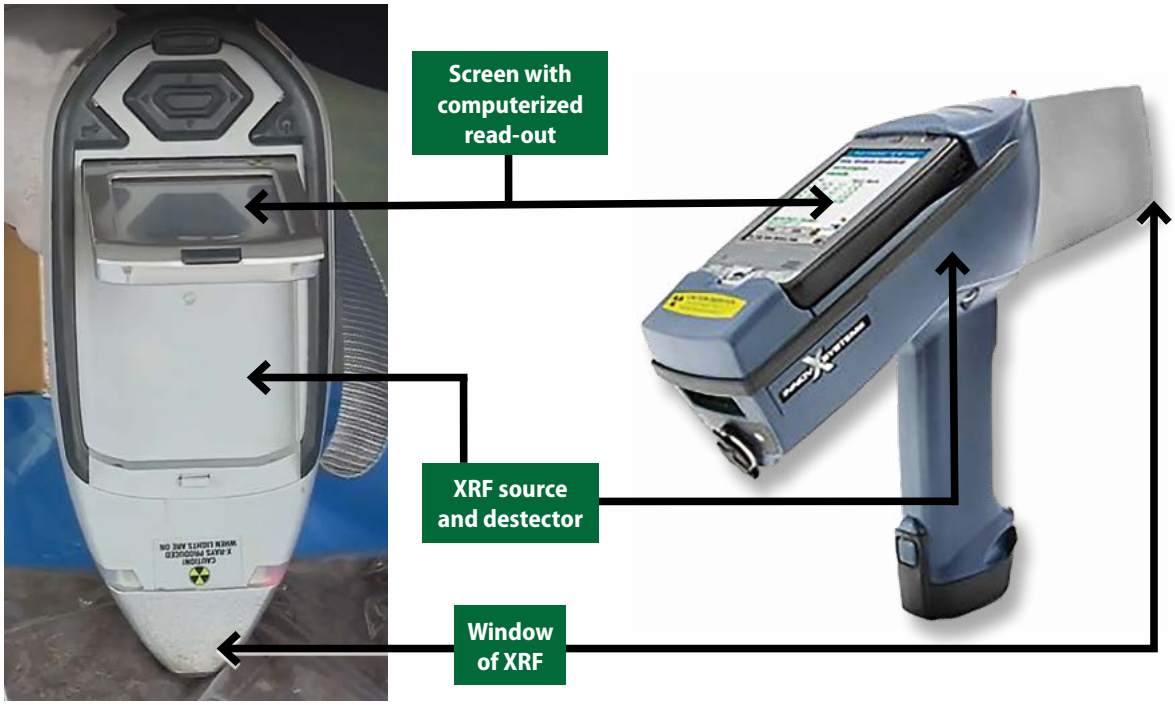
XRF Equipment

Further discussed in the next section, this handheld instrument measures the concentration of an element in a soil sample. It is used during soilSHOPs to provide reliable and rapid screening for lead and other heavy metals.

How does the XRF instrument work?

XRF works by ionizing the atoms found in samples such as lead, arsenic and other metals. This causes a release of energy in the form of characteristic x-rays, which is then detected by the instrument's detector. Here is a step-by-step breakdown of the process:

4. The operator exposes the soil sample to x-rays from the XRF sampling window.
5. As the x-rays interact with the sample material, the ionized atoms release energy in the form of characteristic x-rays, known as x-ray fluorescence (XRF).
6. The characteristic x-rays enter the sampling window of the XRF instrument. These characteristic x-rays are converted to electronic pulses and assessed by software in the instrument (this all occurs in seconds). The readings/results are displayed on the screen for the operator to log.



Important Safety Information

Safe, proper use of XRF units is a priority. These instruments produce radiation and should be operated by individuals who have been properly trained. Improper use could harm the user and others nearby. Efforts should be made to implement and communicate safety precautions with all soilSHOP staff.

The following are recommended safety precautions for XRF units:

- Proper training in the use and safety of XRF is necessary.
- Never point the unit, energized or de-energized, at anyone or any body part.
- Do not hold the sample in your hand. Perform measurements and open the shutter only when the sample is on a table.
- Do not operate the instrument while you are sitting down. This position may expose your lower body to radiation. Stand to the rear or side of the XRF when the shutter is open.
- Handle and use the unit with caution and follow all manufacturers' training and instructions.

XRF equipment vendors also provide operational information and procedures, and soilSHOP partners may have XRF standard operating procedures. These general recommendations do not replace the requirement to understand and comply with the specific policies of any state, manufacturer, or organization. Check with state agencies or organizations in your soilSHOP location, as applicable. The soilSHOP does not recommend any equipment vendors.

Research equipment that suits the needs of your organization and be sure to acquire the appropriate safety training before operating any XRF units.

Step 2. Screen Soil

General Soil Screening Directions

This guidance assumes the data will be used only as a screening level sample result to provide a basis for health education (versus being used to identify or delineate sources or evaluate contamination for a given area).

General directions for soil screening are provided here. Although soilSHOP events use the same process for screening, it is not a one-size-fits-all. The screening team may want to review the general steps and modify the Soil Sampling Procedure Event Worksheet, located in the Appendix, to address specific organizational, data quality, equipment, and event goals before the event.

Step 1

The Log-In Team will package each soil sample with a completed Sample Log-In Form and blank Screening Result Card (or other mechanism for reporting results to participants) and deliver to the Soil Screening Team. These materials should be kept together.

> **Note:** The soil sample will be screened in the original Ziploc plastic bag, unless the bag is damaged. If the bag is damaged or the soil sample is provided in a non-Ziploc style container, transfer the sample to a new bag before screening. Large debris (sticks or rocks) may need to be removed (this step should be infrequent if participants followed the sampling directions).

Step 2

Confirm that the soil is dry. Residents are asked to bring dry soil, but some samples may be wet. Moist soil can be screened but screening very damp soil can affect the quality of the screening result (distorting results). If the soil sample is wet, set it aside to dry in the sun (or a specialized heating unit) to be screened later.

Step 3

Mix the soil in the bag to homogenize it (that is, move the soil around in the bag, shake the bag, etc.). You do not need to open the bag to mix it.

Step 4

Screen the sample through the bag in three places using the XRF unit. Ensure soil in the bag is at least 1 inch thick at each point you are screening; inadequate thickness could skew the results. For each screening, hold the XRF in place for at least 30 seconds until the reading is obtained.

Note: 30 seconds is on the low end for individual readings but has been found effective by soil scientists supporting soilSHOP events (with little impact on screening results). If you wish to screen for a longer period, you can do 3 readings of 60 to 120 seconds each. Whatever time-period you choose, make sure to repeat it consistently for all soil sample screenings.

Step 5

Document screening results in the log book. Note the sample number and the three XRF readings [lead result and units, usually milligram/kilogram (mg/kg) and +/- range (error)]. If the 3 screening values obtained vary significantly (generally by greater than +/-20%), discuss the error range with the rest of the screening team or with the Screening Team Leader. Based on the result [low (less than 100), medium (100 to 200), or high (over 200) range in parts per million] and the error range, you may be asked to rescreen one, two, or three of the previous screenings. After obtaining three acceptable readings, calculate the average screening result. Record the average screening result and sample number in the log book. Also, record the average screening result and sample number on the Screening Result Card. If the sample is unusual in any way (e.g., excessively moist, rocky, or full of paint chips), note the unusual characteristic(s).

Step 6

The Screening team member passes the completed Log In Form, Screening Result Card (see materials and equipment section), and soil sample to the appropriate soilSHOP team member. That team member will take the soil sample for disposal, storage, or return to the owner and deliver the Log In Form and Screening Result Card to the Health Educator Team.

Step 3. Debrief/Follow up

Follow-Up Overview

At the end of your soilSHOP event, the screening team and other soilSHOP team members may meet to review any follow-up actions. The group may need to make a final plan to screen any samples that were not screened during the event because of issues such as late arrival, wet soil samples, or too many soil samples. If necessary, outline this step in the Soil Sampling Procedure Event Worksheet (Appendix, pg. 11) or discuss with the team.

For samples that were not screened, provide participants with the name and phone number of an agency contact who will follow up about screening results and health education. The goal is to provide one-on-one consultation to each participant, rather than just posting a soil screening result.

Debriefing (Internal) Overview

Debriefing is an opportunity to reflect on the event and evaluate its success. This step helps identify areas for improvement throughout the event. Within two weeks of a soilSHOP event, soilSHOP teams should conduct an after-action meeting/call to discuss what worked, lessons learned, and opportunities for further community relationship building and education.

Teams should also consider conducting their own station evaluations to identify areas for improvement and creating a plan to scan and consolidate (for example, in an Excel format table) results collected from the Log in Forms and Log Books. See the Appendix for an example of data consolidation. The Soil Sampling Procedure Event Worksheet contains a section for outlining a data management plan.

Appendix

Step 1. Plan/Set Up

Planning for soilSHOP event checklist (modify checklist as needed with additional tasks):

Check Off	Completed Tasks
	Screening team members are trained and properly educated on soil screening and XRF unit.
	Appropriate organization and equipment health and safety requirements and procedures have been identified.
	Screening team members have met with the rest of the soilSHOP team and reviewed sample log in form, soil screening area , health education areas, and sample flow procedures.
	Screening team members have reviewed Soil Screening Procedure and modified it, as necessary, based on each event's XRF equipment, host organization protocols, and goals.
	Screening team members have discussed and proposed follow-up and data management plans.
	Screening station materials have been identified, and appropriate requests have been made for missing items (i.e. XRF units, logging materials).
	Soil screening team leader has been identified for the team; this person will address any questions or issues that arise from the XRF screening team members or others about the screening process and results.

During soilSHOP event checklist (modify checklist as needed with additional tasks):

Check Off	Completed Tasks
	Screening team has conducted a health and safety in-briefing and set-up the sample screening area.
	Screening station is roped off and away from designated eating and drinking areas. Disinfecting wipes, paper towels, and trash cans with bags are handy or nearby.
	XRF batteries and any backup batteries are fully charged.
	XRF units are calibrated in line with equipment manufacturer instructions (e.g., 30 minutes before event).
	Screening team members have protective gloves available for screening.
	Screening team members are equipped with XRF units, log book, pen, watch or phone (to monitor screening time), and calculators.

Step 2. Screen Soil

Soil Sampling Procedures (modify this document for your event needs)

EVENT NAME:_____ EVENT DATE: _____MODIFIED BY: _____

Soil sample and logging

Organization of samples

Item	Ex: outline order and organization of samples based on metals being tested, station organization, etc.
1	
2	
3	
4	
5	
6	

Sample logging format

Item	Ex: outline how screening team should log readings for internal interpretation.
1	
2	
3	
4	
5	
6	

Participant reporting

Item	Ex: outline participant reporting materials and how to report for participant and health educators review.
1	
2	
3	
4	
5	
6	

Soil analysis and data management

Soil analysis equipment

Item	Ex: outline information on XRF equipment here (where it came from, who will be operating it, key points to highlight from the manual it came with, calibration of xrf units based on metals being tested, etc.…). If multiple XRF units are available, the screening team should consider whether and how to calibrate these units before and after soil screening using the manufactures blanks.
1	
2	
3	
4	
5	
6	

Soil analysis procedure

Item	Ex: outline specific steps to take before and during soil screening analysis that relate to the equipment, location, and event.
1	
2	
3	
4	
5	
6	

Data quality and internal reporting management

Item	Ex: outline limitations of method use and how readings collected will be used internally and evaluated (follow-up actions). Some screening teams have even run lab samples on 10% of the screened soils for quality assurance and quality control of screening values.
1	
2	
3	
4	
5	
6	

Sample disposal

Disposing of samples after analysis and consultation

Item	Ex: outline if disposal bins are available, will you be collecting elevated samples for further analysis, or if you will be expecting participants to keep their samples after.
1	
2	
3	
4	
5	
6	

Sample management if soil is wet or with debris

Item	Ex: outline what steps staff should take if the samples are wet or found to have debris in it.
1	
2	
3	
4	
5	
6	

Sample management if unable to scan at event

Item	Ex: outline the steps staff should take if samples were not screened due to time limits.
1	
2	
3	
4	
5	
6	

Example Excel Format Table/Data Collection

Figure 2. Sample of table to be created with Microsoft Excel and meant for internal use to maintain data collected from soilshop events. Body rows 1–3 are example entries; blank cells from body rows 4 on illustrate the cells to be filled out by the end user in Excel.

For "Indicator/Notes" entries enter:
1 for **HIGH LEVELS FOUND**;
2 for **NEEDS TO BE CONTACTED**;
3 for **FURTHER ANALYSIS NEEDED**.

UNITS	SAMPLE #	Indicator/ Notes	Sample Location (Garden, Play Area, Other)	Age of Structure/ Building Nearby	Any Major Road Nearby	Metal Screened	Reading #1	Reading #2	Reading #3	Average Screening Level for Resident Soil
ppm	1.1	**2**	Garden	1963	No	Lead	46.1	40.8	52.5	46.5
ppm	1.2	**3**	Garden	1963	No	Arsenic	100.5	121.8	23.2	81.8
ppm	2	**1**	Play Area	1950	Yes	Lead	900	950	850	900

Resources

soilSHOP Toolkit:

http://www.atsdr.cdc.gov/soilshop/index.html

Soil Screening Resources:

- soilSHOP Log In Form
- Example Soil Screening Result Card
- Event staff list: Example Staff Roles and Functions
- Materials and Equipment List: Example soilSHOP Equipment Checklist

Email Box

Reach representatives who can help you with soil screening planning questions at: soilSHOP@cdc.gov.

Regional soilSHOP Expertise

Locate your ATSDR regional office here: www.atsdr.cdc.gov/dro

XRF Resources

For more information on XRF, it's uses, and safety recommendations please seek guidance from your XRF manufacturer, the Environmental Protection Agency (EPA), local or state environmental entities.

Using XRF Equipment at soilSHOP: https://www.atsdr.cdc.gov/soilshop/docs/305762_XRFFactSheet-508.pdf

U.S. Environmental Protection Agency (EPA). 2007. EPA Method 6200: Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediments. Revision 0. February. Accessed in August 2019 at: https://www.epa.gov/hw-sw846/sw-846-test-method-6200-field-portable-x-ray-fluorescence-spectrometry-determination

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