What is Soil?

The skin of the Earth. Soil exists as the exterior surface layer of our planet. The first living organisms may have originated in Earth's oceans billions of years ago, but for at least 500 million years life has been evolving on land. Soil provides the substrate for all five kingdoms of life to thrive on land, to take up nutrients, to grow in place and move through the world.

Soil allows for new forms of life to come into being, as they incorporate the nutrients left there by organisms of the past. It supplies the space for nutrients locked in living organisms to break down, while microbes like bacteria and fungi facilitate the decomposition of life. In soil, nutrients are released, stored in the Earth, and made available for new forms of life to continue to emerge.

Soil functions to protect the Earth and keep its many processes going, almost like organs in the body. As the Earth's surface it protects the land like skin and as gases move through soil it breathes like lungs. Water circulates materials through the soil system and like a digestive tract, soil releases nutrients and supplies energy to the organisms of our planet.

Soil performs a number of essential life-supporting functions:

- **Habitat for soil organisms:** Sustaining biological activity, diversity, and productivity
- **Water supply and purification:** Regulating and partitioning water and solute flow
- **Recycling nutrients and organic wastes:** Filtering, buffering, degrading, immobilizing and detoxifying organic and inorganic materials
- **Medium for plant growth:** Storing and cycling nutrients and other elements
- **Engineering Medium:** Providing support for our built environment

Learn more about soil health:
Natural Resources Conservation Service, United States Department of Agriculture (NRCS)
www.soils.usda.gov/

NRCS *Soil Health*
www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/

Cornell *Soil Health Assessment Training Manual*
www.soilhealth.cals.cornell.edu/training-manual/

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New York Hall of Science

The **New York Hall of Science's (NYSCI)** mission is to nurture generations of passionate learners, critical thinkers, and active citizens through an approach we call Design Make Play. Through the Designers in Residence (DiR) program we paired explainers, NYSCI's signature youth development program, with creators, makers, educators, artists, technicians, architects, and engineers working in and around the design community.

www.nysci.org

Learn more about the DiR program
www.nysci.org/home/programs/designers-in-residence

The **Newtown Creek Alliance** is a community-based organization dedicated to restoring, revealing and revitalizing Newtown Creek. Since 2002, the Alliance has served as a catalyst for effective community action to restore community health, water quality, habitat, access, and vibrant commerce along Newtown Creek.

Find out more about Bioremediation
www.newtowncreekalliance.org/bioremediation

The Urban Soils Lab at **Brooklyn College's** Environmental Sciences Analytical Center provides research, education, and soil testing services to NYC communities and beyond.

For more information Soil Testing
http://testmysoil.brooklyn.edu

Books on soil and soil biology:

> *Teaming with Microbes: The Organic Gardener's Guide to the Soil Food Web*, by Jeff Lowenfels & Wayne Lewis
> *Soil Biology Primer,* by Natural Resources Conservation Service and Soil and Water Conservation Society
> *The Hidden Half of Nature: The Microbial Roots of Life and Health,* by David R. Montgomery and Anne Biklé
> *Dirt: The Erosion of Civilizations*, by David R. Montgomery

Books on bioremediation:

> *Organic Mushroom Farming and Mycoremediation: Simple to Advanced and Experimental Techniques for Indoor and Outdoor Cultivation*, by Tradd Cotter
> *Earth Repair: A Grassroots Guide to Healing Toxic and Damaged Landscapes*, by Leila Darwish
> *Fungi in the Environment*, edited by Geoffrey Michael Gadd, Sarah C. Watkinson, Paul S. Dyer
> *Fungi in Bioremediation*, edited by Geoffrey Michael Gadd
> *Radical Mycology: A Treatise On Seeing & Working With Fungi*, by Peter McCoy
> *Mycelium Running: How Mushrooms Can Help Save the World*, by Paul Stamets

Source Notes:
1. Cornell Waste Management Institute. *Sources and Impacts of Contaminants in Soils*. http://cwmi.css.cornell.edu/sourcesandimpacts.pdf. Accessed April 1, 2017.
2. Ingham, Elaine R. *Soil Biology Primer*. Soil and Water Conservation Society, in cooperation with the USDA Natural Resources Conservation Service. 2000.
3. Darwish, Leila. *Earth Repair: A Grassroots Guide to Healing Toxic and Damaged Landscapes*, 7th Edition. New Society Publishers. 2013.
4. Lowenfels, Jeff and Lewis, Wayne. *Teaming with Microbes: The Organic Gardener's Guide to the Soil Food Web*, Timber Press; Revised edition 2010.

Why Should We Care About Our City Soils?

Soil is alive and (hopefully) well in our cities! Although we generally think of soil in 'natural' fields and forests, it also exists beneath and between all the cracks of our paved and built environments. Some of our city soils have been formed by naturally occurring parent materials, while the rest of have developed on human-altered or transported materials.

Urban soil is capable of performing all of the essential life-supporting functions that its suburban and rural counterparts provide, such as cleaning water, supporting plant growth, and storing carbon and other greenhouse gases. But our urban soils are often highly disturbed by human activities and land use.

While overall quality is an important concern for urban soils, an evaluation of soil quality wouldn't be complete without assessing soil contamination. The concept of **contamination** refers to a particularly high concentration of naturally occurring elements or human-made compounds that have the potential to negatively impact health. Humans can contaminate soils in any area, but our particularly high population density and industrial activities in cities have left a legacy of contamination that we still contribute to in the present day.[1]

Where do we find soil in the city?

→ Gardens
→ Front and back yards
→ Athletic fields
→ Playgrounds
→ Parks
→ Woods
→ Tree pits
→ Traffic islands
→ School yards
→ Rooftops
→ Vacant lots
→ Planting pots
→ Air particulates (e.g. dust)
→ Beneath buildings and roads

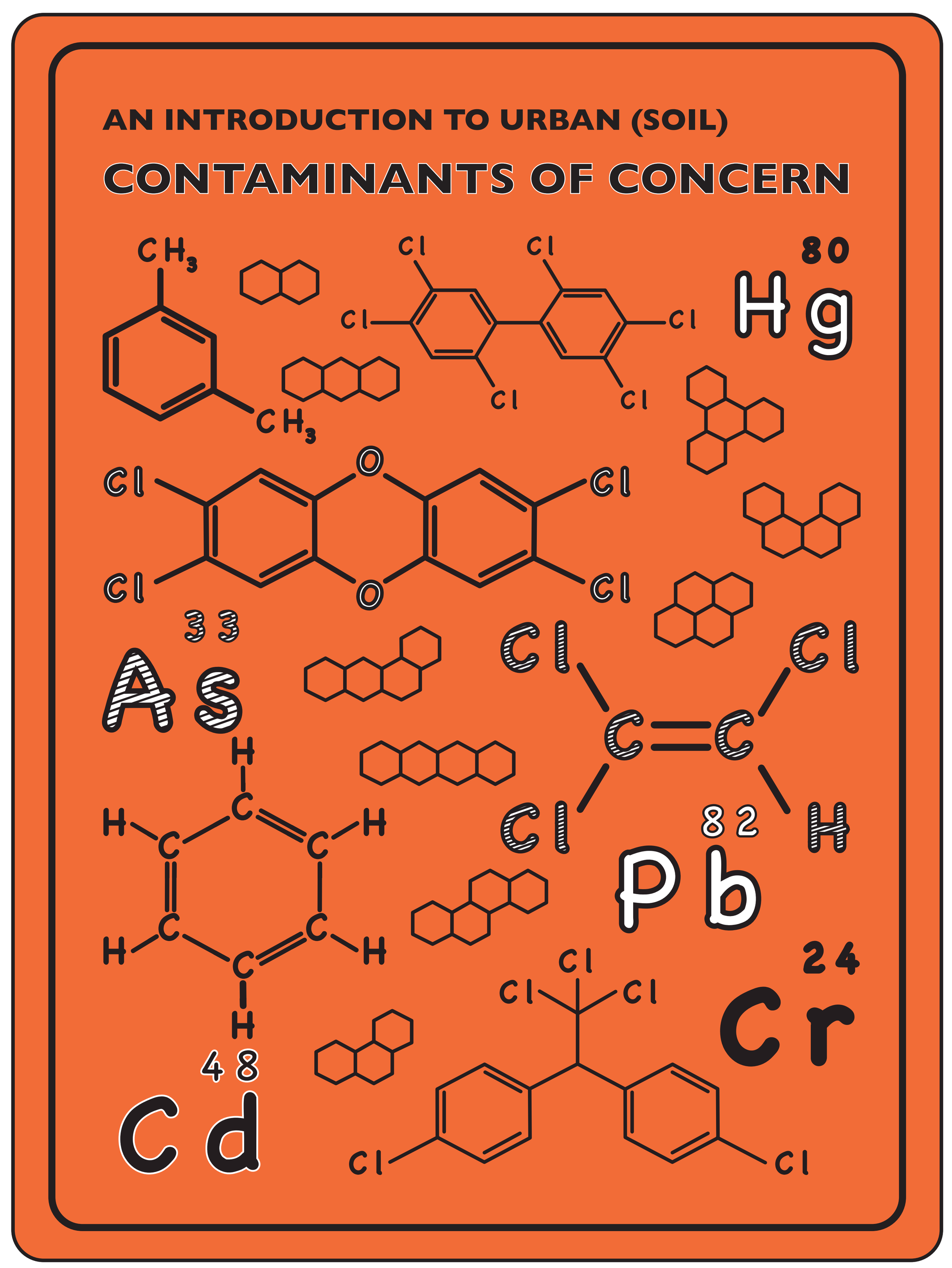
Some Contaminants of Concern:

- Arsenic
- Cadmium
- Chromium
- Lead
- Mercury
- Benzene
- Dichlorodiphenyltrichloroethane (DDT)
- Dioxins
- Polychlorinated biphenyls (PCBs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Trichloroethylene (TCE)
- Xylenes

*See the inside the poster for more information

Learn more about urban soils:
Cornell Waste Management Institute, *Sources and Impacts of Contaminants in Soils*
www.cwmi.css.cornell.edu/sourcesandimpacts.pdf

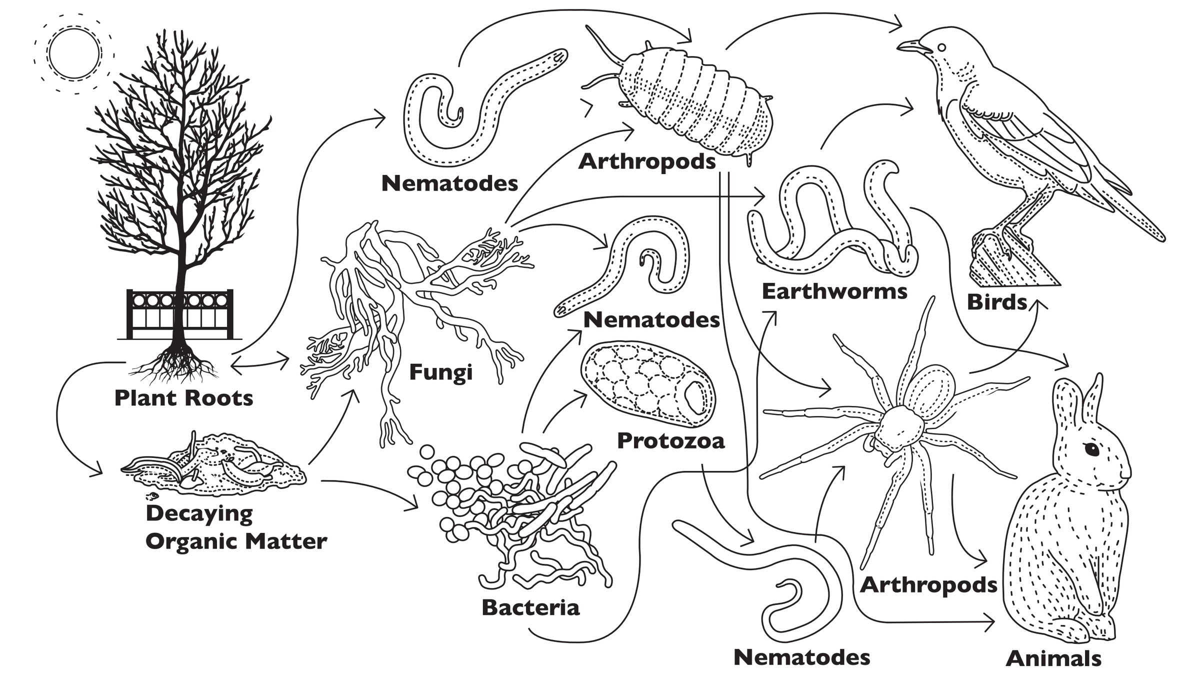
U.S. EPA, *Evaluation of Urban Soils: Suitability for Green or Urban Agriculture Infrastructure*
www.nacto.org/docs/usdg/evaluation_of_urban_soils_epa.pdf

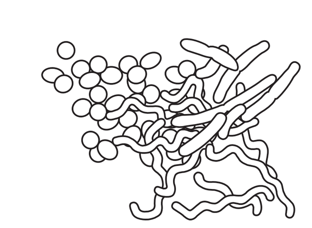


Soil Biology / The Soil Food Web

The soil food web is the community of organisms living all or part of their lives in the soil. Billions of organisms and thousands of different species can be found in a handful of healthy soil. The presence of these organisms is what sets soil apart from the nonliving rocks, minerals, and dust around us. It is the activities of these creatures that enable soil to perform its vital functions, and each organism provides its own essential role in soil ecosystems.

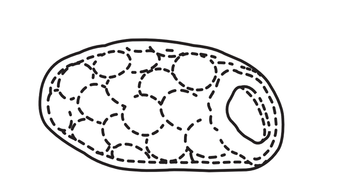
An incredible diversity of organisms make up the soil food web. They range in size from the tiniest one-celled bacteria, algae, fungi, archaea and protozoa, to the more complex nematodes and micro-arthropods, to the visible earthworms, insects, small vertebrates, and plants. Soil organisms decompose organic compounds, including manure, plant residue, and pesticides, preventing them from entering water and becoming pollutants. They sequester nitrogen and other nutrients that might otherwise enter groundwater, and they fix nitrogen from the atmosphere, making it available to plants. Many organisms enhance soil aggregation and porosity, thus increasing infiltration and reducing runoff. Soil organisms prey on crop pests and are food for above-ground animals.[2]



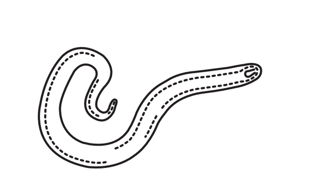


Bacteria
-Feed other members of the food web
-Decompose organic matter
-Help keep nutrients in the rooting zone and out of the surface and groundwater
-Improve soil structure, improving the flow of water and reducing erosion
-Compete with disease-causing organisms
-Filter and degrade pollutants as water flows through the soil

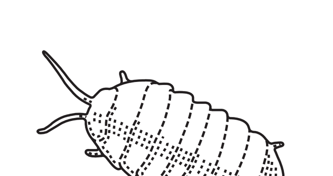
Fungi
-Decompose complex carbon compounds
-Improve accumulation of organic matter
-Retain nutrients in fungal biomass, reducing leaching of nutrients out of the
root zone
-Physically bind soil particles in aggregates
-Are an important food source for other organisms in the food web
-Improve plant growth when mycorrhizal fungi become associated with the roots of some plants
-Compete with plant pathogens
-Decompose certain types of pollutants



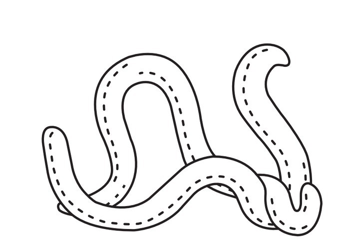
Protozoa
-Release nutrients stored in microbial biomass for plant use
-Increase decomposition rates and soil aggregation by simulating bacterial activity
-Prevent some pathogens from infecting plants
-Provide prey for larger soil organisms, such as nematodes



Nematodes
-Regulate the populations of other soil organisms
-Mineralize nutrients into plant-available forms
-Provide a food source for other soil organisms that influence soil structure
-Consume disease-causing organisms



Arthropods
-Improve soil structure through burrowing and the creation of fecal pellets
-Control disease-causing organisms
-Stimulate microbial activity
-Enhance decomposition through shredding of large plant litter and mixing of the soil
-Regulate healthy soil food web populations



Earthworms
-Shred and increase the surface area of organic matter, thus stimulating microbial decomposition and nutrient release
-Improve soil stability, porosity, and moisture-holding capacity by burrowing and aggregating soil
-Turn soil over, prevent disease and enhance decomposition by bringing deeper soil to the surface and burying organic matter
-Improve water infiltration by forming deep channels and improving soil aggregation
-Improve root growth by creating channels lined with nutrients

[source: NRCS, Soil Biology Primer[2]]

Restoring Urban Soils: How Can Bioremediation Help?

Our actions are not only a cause of urban soil degradation, but are also capable of helping to restore urban soil quality, particularly within the context of environmental movements and greening cities. We have tremendous opportunities to promote the sustainability of our urban areas by focusing on the health of our soils.

A restoration technique called **bioremediation** has been gaining interest in recent years. Bioremediation is the use of natural processes involving microorganisms, plants, and fungi, or their enzymes to clean and restore polluted sites. Remediation, whether by biological means, chemical means or a combination of both, is of particular interest because it both addresses problems of pollution and paves the way for a more ecologically sustainable future. It presents humans with an opportunity to interact with nature in a way that is *proactive* and promotes ecological health in sites which are most in need of attention.

There are numerous methods for bioremediation, and each one has strengths and limitations. Soil remediation techniques can be either *in situ* or *ex situ*. *Ex situ* methods involve removing soil from the site or excavating soil for treatment while in situ methods involve direct treatment, keeping soil in place and essentially enhancing natural remediation processes.

In situ treatments have many benefits, including minimal costs and disruption to the site, and minimal human and environmental exposure to contaminated soil. The suitability of each bioremediation technology is determined by several factors, which may include site conditions, indigenous populations of microorganisms, and the types, quantities and potential toxicities of specific pollutants in the soil. Here, we will offer brief summaries of various bioremediation techniques which can be performed *in situ*.[3]

Bioremediation Methods

Compost & Compost Tea

Compost is living soil organisms and decomposing organic matter recycled into a rich a soil amendment. When plant matter falls to the ground or organisms die, they slowly decay materials into humus under the activity of the many soil organisms present. This process takes the minerals and nutrients locked in the formerly living tissue and makes them available for new forms of life. While this process, facilitated by the soil food web, occurs naturally in soil, making compost is how humans create and enhance this cycle. Compost can be made at home with substances like leaves, grass clippings, wood shavings and paper, among others. Compost tea is essentially liquid fertilizer that is rich in beneficial microbes. The tea helps build soil structure by supplying vital nutrients, microorganisms and organic matter to soil. It can also increase soil porosity and water retention, encourage biodiversity, and prevent plant diseases.

The application of compost and compost tea to soil can help remediate sites polluted with certain types of contaminants through **bioaugmentation** of soil to increase its capacity to **biodegrade** contaminants. Compost may help remediate contaminated soils by increasing microbial communities to immobilize, dilute, degrade, and remove toxins that might be present in urban soils. Compost can also help by moderating pH, binding soil particles together, and eliminating the need for synthetic fertilizers, pesticides, and herbicides. Although compost can break down some organic contaminants, the remediation process can take decades to be effective depending on the level, type, and/or source of contamination, and may not be able to rid soil completely of toxins. However, an additional benefit to reduce public exposure to toxins exists when gardeners, farmers, and landscapers use compost to manage nutrients, weeds and pests, instead of using synthetic chemicals.

Learn more about compost: NYC Compost Project: *Master Composter Course Manual*
www1.nyc.gov/assets/dsny/docs/nyc-master-composter-manual-mcm.pdf

Mycoremediation

Mycoremediation is the use of fungi such as mushrooms and mycelia to treat polluted soil. Fungi break down, or encourage biodegradation of certain chemical contaminants and discourage the spread of bacterial contaminants. This helps to rid the soil of potentially harmful organisms or compounds which may be transferred to edible plants or may otherwise be an exposure risk to humans and animals.

Mycorrhizal fungi form symbiotic relationships with the roots of plants. Plant root structures and fungi can often live in mutually beneficial relationships. In such cases, plants bring food to fungi, while fungi allows nutrients and water to flow more easily to plants. Mycorrhizal fungi produce chelates, compounds that break down the tight chemical bonds of inorganic chemicals that are usually unavailable to plants. The chelates bond with these inorganic nutrients - particularly nitrogen, phosphorus, and copper, but also potassium, calcium, magnesium, zinc, and iron - and then deliver them to the plant in return for carbon made available through plant roots. Microorganisms, particularly bacteria, associate with mycorrhizal fungi and stimulate the growth of fungi, and thus the growth of the host plant. In addition to all these benefits, mycorrhizal fungi also produce vitamins, hormones, cytokinins, and increased protection against host plant pathogens.[4]

Some mushrooms are **hyperaccumulators** of heavy metals, meaning that they pull heavy metals from the soil and concentrate them within their own tissues at a very high rate. The potential for heavy metal mycoremediation is currently being studied, but is **not recommended** for use in your garden if heavy metals are present. The metals accumulated by mushrooms may stay in soils and accidentally consuming these mushrooms can cause potential health problems.

Learn more about Mycoremediation: *Mycelium Running: How Mushrooms Can Help Save the World*, by Paul Stamets
www.fungi.com/products/mycelium-running

Phytoremediation

Some plants may potentially remove, sequester, or break down certain chemical and biological contaminants in soil through a process known as phytoremediation or phytotechnology. There are many methods of phytoremediation, which include **biodegradation**, **biostabilization**, **phytovolatilization**, and **phytoextraction**. Phytoextraction is one method that has been popularized for use with metals, but this technology is **not recommended** for use with lead. Lead does not readily enter plant roots when the soil's pH level is neutral or near neutral (pH of 6.5 - 7.5), as is usually the case with urban garden soils. Though some metals are very slowly absorbed by plants, they do not break down into less toxic components. Plants with accumulated contaminants require proper disposal, and interaction with or accidental consumption of these plants could put people at risk. Phytostabilization of metal contaminated soils is recommended as one way to limit exposure.

Note: Although some plants are capable of breaking down select biological and chemical contaminants, it is important to understand that not all plants are capable of this. In addition, not all chemical and biological contaminants can be broken down through phytoremediation, and even successful phytoremediation can take decades to create significant change.

Learn more about phytoremediation: U.S. EPA, *Phytotechnologies For Site Cleanup*
www.clu-in.org/download/remed/phytotechnologies-factsheet.pdf

Bioremediation terms to know

Bioaugmentation: Adding cultured microorganisms to assist in the breakdown of contaminants.

Bioavailability: The amount of an element or compound that is accessible to an organism for uptake or absorption across its cellular membrane.

Biodegradation: Breakdown of materials by bacteria, fungi, or other biological means.

Biostabilization/Biosequestration: The precipitation or immobilization of inorganic contaminants in the soil, on the root surface, or within the root tissues.

Hyperaccumulation: Extremely high concentrations of trace metals absorbed into the roots and tissues of plants and fungi.

Phytoextraction: The removal of inorganic contaminants from the surface-subsurface soil through plant uptake. This includes heavy metals, metalloids, radionuclides, and salts. During this process plant roots uptake metal contaminants.

Phytovolatilization: The process where plants uptake contaminants which are water soluble and release them into the atmosphere as they transpire the water.

Learn more about bioremediation: U.S. EPA Contaminated Site Clean-Up Information
www.clu-in.org/techfocus/default.focus/sec/Bioremediation/cat/Overview/

AN INTRODUCTION TO URBAN (SOIL) CONTAMINANTS OF CONCERN

Arsenic

33
As

What is it?

Arsenic is an element. Small amounts are found in rock-forming minerals and clays. Higher levels are found in lead, copper, and sulfide ores mined for metals, as well as black shales and coal.

Where do we find it?

Arsenic is used for preserving wood, making "pressure-treated" lumber, industrial purposes, and pesticides. Arsenic can enter air, water, and can spread via wind-blown dust. Many common arsenic compounds can dissolve in water, and most of the arsenic in water will ultimately end up in soil or sediment.

How does it affect us?

Short term exposure to arsenic may lead to nausea and vomiting, a decrease in red and white blood cells, heart arrhythmia, damage to blood vessels and a sensation of "pins and needles". Long term exposure may lead to cancer of the skin, lungs, bladder, kidney, liver and/or prostate.

Cadmium

48
Cd

What is it?

Cadmium is an element commonly found in black shales, rock phosphate deposits, and zinc ores. It is present in extremely low levels in soils around the world.

Where do we find it?

Cadmium is released into the atmosphere by burning fossil fuels, coal, and municipal solid waste. Cadmium is concencentrated in the environment by the production of phosphate fertilizers, iron, zinc, steel, cement and nonferrous metals. Cadmium is commonly found in batteries, pigments, plastics and metal coatings.

How does it affect us?

Inhaling cadmium can cause lung damage and ingesting cadmium containing foods can cause stomach irritations leading to vomiting and/or diarrhea. Long term cadmium exposure can lead to cadmium build up in the kidneys and possibly kidney disease in addition to lung damage and fragile bones.

What Can We Do?

Are you at risk of exposure to contaminated soils?

A few considerations:
- Where are you may potentially be exposed contaminated soils?
- Do you know what types and concentration of contaminants in soil you may be exposed to?
- What is your frequency and duration of exposure?
- What is your general health and age?

Note: Children are the most at-risk populations due to their developing systems and likelihood for hand-to-mouth exposure.

In the city, be aware of potentially contaminated soil especially around:

- Vacant lots
- Current and former industrial sites
- Near buildings with chipping lead paint
- Areas of heavy street traffic
- Underneath bridges, highways, train and subway overpasses

Learn more about soil safety at The Johns Hopkins Center for a Livable Future
https://www.jhsph.edu/research/centers-and-institutes/-johns-hopkins-center-for-a-livable-future/_pdf/projects/urban-soil-safety/CLF Soil Safety Guide.pdf

Human Exposure Pathways:

- Inhalation: breathing soil particles
- Ingestion: eating soil particles
- Dermal contact: touching soil

General Best Practices:

- Wash hands
- Take off shoes when indoors
- Leave sports and garden equipment outside of home
- Keep an eye on children

Gardening Best Practices:

- Use clean soil and compost (contaminant free)
- Grow edible crops in raised beds
- Avoid using treated or painted wood in your garden
- Maintain soil nutrients and pH
- Wash and/or peel produce
- Cover soil and garden paths with mulch or cover plants
- Block wind so as not to disperse potentially contaminated particles
- Wear gloves

Note: If making compost, avoid using materials like yard waste that may have come into contact with contaminated surfaces (e.g. sidewalks, streets, exterior house paint)

Planning a vegetable garden?

You should have your soil and compost tested for contaminants, such as heavy metals, as well as pH and nutrient content.

Affordable soil testing is available at the Urban Soils Lab at Brooklyn College
http://testmysoil.brooklyn.edu

Learn more about urban gardening safety practices on Cornell's Healthy Soils, Healthy Communities
www.cwmi.css.cornell.edu/healthysoils.htm

The Agency for Toxic Substances and Disease Registry (ATSDR), is a federal public health agency of the U.S. Department of Health and Human Services to protects communities from harmful health effects related to exposure to natural and man-made hazardous substances.

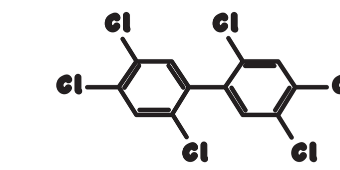
>> ATSDR: www.atsdr.cdc.gov

>> ATSDR's Substance Priority List: www.atsdr.cdc.gov/spl/index.html

>> ToxFAQs™: www.atsdr.cdc.gov/toxfaqs/index.asp

PCBs

Polychlorinated biphenyls



What is it?

Polychlorinated biphenyls (PCBs) are one of many persistent organic pollutants (POPs) not found in nature. PCBs have no smell or taste. They exist either as oily liquids, colorless or light-yellow solids, or as vapor in air.

Where do we find it?

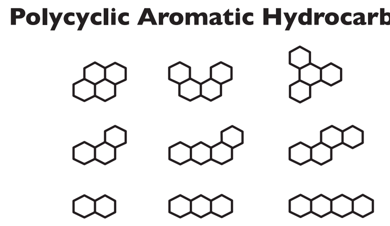
PCBs are used in coolants and lubricants in transformers, capacitors, and other electrical equipment. In 1977, PCBs ceased to be manufactured in the U.S. due to evidence that they accumulate in the environment and cause harmful health effects. Some products made before then, including old fluorescent lighting fixtures, electrical devices, rubber, plastic, paints and hydraulic equipment may contain PCBs. PCBs stick to organic particles, sediments, and soils.

How does it affect us?

Low levels of PCBs exposure may cause anemia, liver, thyroid and stomach problems. High levels of PCB exposure may lead to acne-like skin conditions and rashes. In large amounts, PCBs can cause liver damage, immune system changes, and fatalities in animals.

PAHs

Polycyclic Aromatic Hydrocarbons



What is it?

Polycyclic Aromatic Hydrocarbons (PAHs) represent a group of over 100 different chemicals which form during the incomplete burning of natural or human-made subtances.

Where do we find it?

PAHs are byproducts of the burning of oil, coal, gas, garbage, tobacco and meat. Manufactured PAHs are used as additives in petroleum based products like roofing tar and occur in crude oil, coal tar and creosote. Some are used in medicines, plastics, dyes and pesticides. PAHs can be found in the air, water, and soil. They attach to dust particles in the air or as solids in soil or sediment.

How does it affect us?

Long term exposure to PAHs can result in cancer. The Department of Health and Human Services has designated some PAHs as "reasonably expected to be carcinogens."

Chromium

24
Cr

What is it?

Chromium is an element found in rocks, animals, plants, and soil. High levels occur in serpentine rocks, which can be parent materials of soils. Chromium can exist as a liquid, solid, or gas.

Where do we find it?

Chromium is used for making steel, leather tanning, brick making, wood preserving, chrome plating, in dyes and pigments, aerospace and automobile refinishing, cement, car brake lining, and catalytic converters. It is also found in tobacco smoke and certain dietary supplements.

How does it affect us?

Hexavalent chromium causes skin irritation, nosebleeds and sneezing, itching, liver damage and cancer. Trivalent chromium (Chromium(III)) is relatively safe.

Mercury

80
Hg

What is it?

Mercury is an element found in air, water, and soil. The most common mercury compound is made by microscopic organisms in water and soil.

Where do we find it?

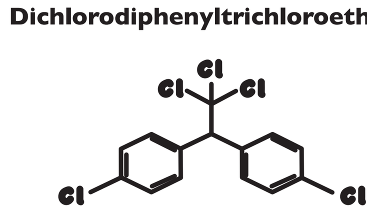
Metallic mercury is used in commercial products such as thermometers, batteries, fluorescent light bulbs, electronics, medical products and dental fillings. Mercury salts are used in skin lightening creams and antiseptic creams. Smelting and processing metals and coal also emit mercury into the environment.

How does it affect us?

Small children and unborn babies are most vulnerable to the health effects of mercury. Methylmercury, a mercury compound, is a neurotoxin that can damage the adult nervous system and can interfere with neurological development in both young and unborn children. Eating contaminated fish or other food in which mercury has accumulated and drinking or touching contaminated water or soil can pose mercury-related health risks as well.

DDT

Dichlorodiphenyltrichloroethane



What is it?

Dichlorodiphenyltrichloroethane (DDT) is a synthetic insecticide that was developed in the 1940's to control insects in agriculture that carry diseases such as malaria. DDT is one of many persistent organic pollutants (POPs).

Where do we find it?

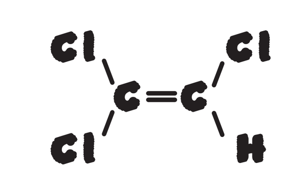
Though used elsewhere, DDT has been banned in the U.S. since 1972. DDT was used to control insects on agricultural crops, in livestock, residential, and institutional settings. DDT breaks down slowly, and may remain in soil for up to hundreds of years.

How does it affect us?

DDT can disrupt the normal functioning of the nervous system when ingested. Inhalation of DDT can cause tremors, seizures, dizziness, vomiting, sweating and headaches. The symptoms generally stop when exposure to the chemical ceases. DDT is considered a "probable carcinogen" by the EPA.

TCE

Trichloroethylene



What is it?

Trichloroethylene (TCE) is a manufactured chemical not found in nature. TCE is one of many volatile organic compounds (VOCs) and is a colorless, nonflammable chemical with a sweet odor.

Where do we find it?

TCE is used as a metal cleaner and degreaser, and as a building block in the creation of other chemicals, notably the refrigerant HFC-134a. TCE breaks down very slowly in soil and water and is removed mostly through evaporation to air.

How does it affect us?

Moderate exposure to TCE can cause headaches, dizziness and sleepiness. High levels of TCE exposure can cause result in changes in the rhythm of the heartbeat, liver and kidney damage, coma and even death. EPA and the International Agency for Research on Cancer (IARC) classify trichloroethylene as a human carcinogen.

Lead

82
Pb

What is it?

Lead is an element commonly found in black shale rock and lead sulfide ore. Human activity has concentrated lead in our environment.

Where do we find it?

Lead is prevalent in our daily lives and can be found in construction applications such as in paint, caulk, pipe solder, etc., X-ray protection, ammunition, batteries, PVC plastic, ceramic glazes and more. In the past, lead was widely used in pesticides, common house paint, gasoline, and other construction purposes. Lead persists in soil and water and is not easily extracted.

How does it affect us?

Lead targets the nervous system and can affect almost every organ in the body. Long term lead exposure can cause a decrease in performance in neurological function, increase in blood pressure, and anemia. High levels of lead exposure can cause damage to the kidneys and nervous system and ultimately may result in death in both adults and children.

Benzene

What is it?

Benzene is formed by natural processes like volcanic emissions and forest fires, and industrial processes are the main source of benzene in the environment. Benzene is a highly flammable colorless liquid that has a distinctly sweet odor.

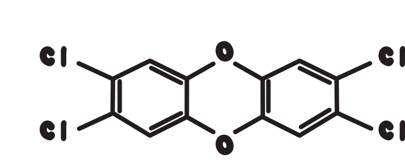
Where do we find it?

Benzene is found in crude oil, gasoline and cigarette smoke and used in the creation of pesticides, drugs, detergents, lubricants, dyes and certain types of rubber. Benzene is also used to make other chemicals which are used to create plastics, resins and synthetic fibers. Benzene can break down in the air within a few days, however, it breaks down slowly in water and soil.

How does it affect us?

Eating or drinking foods with high concentrations of benzene can result in nausea, vomiting, dizziness, sleepiness, convulsions, rapid heart rate, leukemia, and may result in death. Breathing high levels of benzene can be fatal. Long term exposure to benzene can result in changes to the blood and bone marrow, anemia, prevent blood coagulation, weaken the immune system, and interfere with reproductive function in women. The EPA has determined benzene is a carcinogen.

Dioxins



What is it?

Dioxins are unintentional byproducts of combustion of both natural and human-made materials. Dioxins are a group of chemically-related compounds that are persistent organic pollutants (POPs).

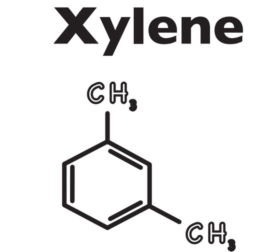
Where do we find it?

Dioxins are found in the environment after being formed by forest fires, burning of medical and municipal waste, PVC plastic melting, and metal smelting may release dioxins. Dioxins can remain in soil for decades, breaking down extremely slowly.

How does it affect us?

Dioxins are known carcinogens and can cause reproductive and developmental problems, can damage the immune system, and can interrupt normal hormone functioning.

Xylene



What is it?

Xylene is one of many volatile organic compounds (VOCs) which occurs naturally in petroleum and coal tar. It can also be chemically isolated from petroleum.

Where do we find it?

Xylene is used as a solvent, in printing, rubber, and leather production. It is also used as a paint thinner, cleaning agent, and in paints and varnishes. It is found in small amounts in airplane fuel and gasoline. In surface soil and water, Xylene evaporates quickly into the air.

How does it affect us?

No health issues have been associated with daily exposure to xylene at low levels. However, high levels of xylene exposure can result in headaches, dizziness imbalance, confusion, and lack of muscle coordination. Xylene exposure can cause skin, eye, nose, and throat irritation, respiratory problems, delayed reaction time, memory difficulties, upset stomach, alter liver and kidney functions. Very high levels of xylene exposure can cause unconsciousness and death.