**Opportunities for Reducing Lead Exposure in Vermont**

*"Environmental health and protection is the art and science of protecting against environmental factors that may adversely impact human health or the ecological balances essential to long-term human health and environmental quality. Such factors include, but are not limited to: air, food and water contaminants; radiation; toxic chemicals; disease vectors; safety hazards; and habitat alterations."*
–Report of the Committee on the Future of Environmental Health (1992)

Lead poisoning is an insidious yet widespread phenomenon. The Centers for Disease Control and Prevention (CDC) estimates that over 4 million U.S. households have children that are exposed to high levels of lead. Pathways of exposure include contaminated air, water, soil, food and consumer products. Trace concentrations of lead (Pb) naturally occur in all environmental media and all living things, however a number of human activities result in toxic levels of Pb in the environment. Some of these activities include the combustion of leaded gasoline, the use of lead-based paints, mining, smelting, improper disposal of old vehicle batteries and electronic devices, and some forms of hunting, target shooting and angling.[1]

High levels of Pb in humans lead to a suite of issues ranging from impaired mental capacity to dysfunctions in the mental, cardiovascular, reproductive and nervous systems, to even mortality.[2] High levels of Pb in invertebrates, fish and wildlife lead to impaired reproduction, growth and ultimately survival.[3]

In the United States, childhood blood levels have dropped since the early 1990s with the introduction of CDC's screening guidelines, however pockets of high blood lead levels persist across the United States and in Vermont.[4] In 2012 federal funds from the CDC were cut nationwide for lead poisoning prevention, despite the synchronous timing of their report that declared, "No blood level of lead is safe."

In this course we will investigate the key pathways lead enters humans, how lead exposure varies across different populations in Vermont, and what opportunities we have in Vermont for reducing exposure. Lead is a pollutant regulated by over a dozen federal laws administered by EPA.[5] We will be analyzing the robustness of federal and state regulations concerning lead, and how policy is then transformed into practice. We will be working closely with the Vermont Department of Health's Healthy Homes Lead Poisoning Prevention Program (HHLPPP) and taking an interdisciplinary approach to understanding both pathways of lead exposure as well as new potential avenues for prevention. As a corollary, we will research what materials and activities exist concerning Pb exposure, testing, and post-testing protocol in Vermont, and explore ways to improve both the information as well as outreach efforts of the HHLPPP.

We will explore three interrelated projects concerning lead exposure and prevention. This community-connected research provides a unique opportunity to integrate and apply our understanding across

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[1] Scheuhammer, A.M., W. Beyer. C. Schmitt. 2010. Lead. In Jorgensen, E. (Ed.) *Ecotoxicology*. Academic Press.
[2] Bellinger, D. C. (2011). The protean toxicities of lead: new chapters in a familiar story. International journal of environmental research and public health, 8(7), 2593-2628.
[3] Eisler, R. (1988). *Lead hazards to fish, wildlife, and invertebrates: a synoptic review* (No. PB-88-193081/XAB; BIOLOGICAL-85 (1.14)). Patuxent Wildlife Research Center, Laurel, MD (USA).
[4] Childhood Lead Poisoning Prevention Annual Report 2013: http://www.leg.state.vt.us/reports/2014ExternalReports/299340.pdf
[5] Some of these laws include the TSCA, Residential Lead-Based Paint Hazard Reduction Act of 1992 (Title X), CAA, CWA, SDWA, RCRA, and CERCLA, amongst others.

disciplinary divides. Through your project work you will analyze the problem of elevated lead levels in people and the environment through multiple disciplinary lenses, across spatial and time scales, and across axes of difference (gender, race, class, etc.).

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**Projects**

1. Cultures of Exposure: collaborating with the Association for Africans Living in Vermont (AALV) to tailor information and outreach to the needs of the refugee population in Vermont

***Partners**: VT Department of Health (Burlington), Association of Africans Living in Vermont, Refugee Resettlement Program (Burlington), Middlebury International Student and Scholar Services (ISSS)*
***Main Zone of Intervention:** Burlington, VT*

The Department of Health's HHLPPP is working to expand and improve outreach as it moves ever closer to its goal of universal testing of 1-2 year old children in Vermont. Currently most of their outreach material and efforts are primarily conducted in English and therefore miss a very important and expanding multicultural and multilingual demographic in Vermont. Since 1980, the Vermont Refugee Resettlement Program has been helping refugees and immigrants settle in Vermont. Between 2008 and 2011, Vermont welcomed 1398 refugees. The countries of origin for these arrivals were Bhutan (60%), Burma (16%), Somalia (9%), Iraq (8%), and smaller numbers from Burundi, Republic of the Congo, Sudan, and others.[6]

This project focuses on supporting the HHLPPP's mission of expanded outreach and collaboration with Vermonters through engagement with the refugee and non-English speaking communities in the wider Burlington area.

Research questions include:

- What are the best ways to engage a wider Vermont audience about lead exposure and prevention measures?
- What are the best methods to collaborate with and communicate information to a wide variety of cultural backgrounds and languages?
- How do Vermont's initiatives compare to what other states have done?
- Are there unique lead exposure pathways for refugees living Vermont?
- What are the ways one can decrease lead exposure while working within cultural norms and values?
- What information and kinds of material should be developed to serve these populations?

2. Soil Spectrums: Identifying the spectrum of lead levels in soil in order to inform best practices for gardeners

***Partners**: VT Department of Health, Vermont Community Garden Network, Burlington Parks and Recreation, New Farms for New Americans (Association for Africans Living in Vermont)*
***Main Zone of Intervention**: Burlington (residential and community gardens and parks), Middlebury (residential gardens and community parks)*

Lead in soil may reach toxic levels close to busy streets, near old buildings with peeling leaded paint, in areas where lead arsenate insecticide was used commercially, and a variety of other ways. Although

[6] http://www.ethniccommunities.org/spotlight/association-for-africans-living-in-vermont-aalv/

lead in paint, insecticide, and gasoline have been banned for decades (if not longer), lead can persist in the environment for a long time. One of the most serious sources of exposure to soil lead is through ingesting contaminated soil or breathing contaminated dust.

The Vermont Department of Health is interested in determining whether gardeners from a range of settings may be exposed to lead through these pathways. The Burlington Parks and Recreation Department tested the community gardens they manage in 2011 and found very low lead soil levels (under 5 mg/kg) in most of their community garden sites. It remains unclear however, whether this low level is typical of all garden soils in the Burlington area, including backyard gardens that might be located close to building awnings which are pathways for leaded paint flakes to enter the garden environment, or gardens located in other areas with different historical land uses that may have increased overall lead levels in soil.

Research questions include:

- What is the spectrum of lead levels in soils in the Burlington area?
- What are the main pathways Pb contaminates soil in this area?
- How do baseline levels (sites selected based on historical land-use) compare to City Park, community garden, and home garden levels?
- What should gardeners consider for the siting of backyard or community gardens?
- Are there protocols that should be developed for the siting of backyard or community gardens?
- Are there protocols that should be developed for the washing and consumption of produce from backyard and community gardens?
- What do Burlington and Middlebury "urban" farmers already know concerning lead in the garden context?
- What forums exist, or how can one create a forum where gardeners share best practices? What outreach materials should be developed?
- What information and kinds of material will best serve the range of diverse populations engaging in gardening in Vermont?

3. Toxicity of Black Gold: Measuring lead levels in compost and considering the potential impact of Vermont's new Universal Recycling Law.

***Partners**: VT Department of Health, VT Department of Environmental Conservation's Solid Waste Management Program (Montpelier), Middlebury College Recycling and Waste Management*

**Main Zone of Intervention**: Burlington and Middlebury

Compost, also nicknamed black gold, is a key component to all productive gardens. With the introduction of Vermont's Universal Recycling Law[7] which requires the diversion of all food scraps, leaf and yard debris and clean wood debris from the landfill and instead into compost[8], understanding the current and projected levels of lead in compost is critical. While food waste tends to contain only very low levels of lead, leaf and yard debris has the potential to be a key pathway of introducing lead into compost. Leaf and yard debris can easily mix with peeling or chipped lead paint that falls from exterior siding during storms, or contaminated soils near streets where the remnants of lead gasoline often remain. Several larger cities, including most recently Boston, had to shut down its municipal leaf/yard debris collection due to toxic lead levels (over 200 ppm) in their municipal compost.

[7] http://www.anr.state.vt.us/dec/wastediv/solid/act148.htm
[8] http://www.anr.state.vt.us/dec/wastediv/compost/main2.htm

Vermont currently has 16 certified composting facilities that accept a blend of organic feedstocks.[9] The finished compost from these facilities is regularly tested and samples to date have not shown elevated lead levels. However, smaller composting facilities (<3000 cubic yards) that compost solely leaf and year debris likely exist in Vermont, but are not required to register with the state and are therefore not tested. Backyard composting of yard and lawn debris is another source of untested compost.

This project will collect data and/or directly test compost and other soil amendments used in the wider Burlington and Middlebury areas. This project will also identify key avenues through which lead currently enters the Vermont compost stream, project future contamination rates, and develop protocols to minimize the amount of lead entering Vermont's compost as the state's composting capacity expands. Identifying lead levels in Vermont compost will also be an important point of regional comparison, allowing us to draw on best practices from other states. Unfortunately, most municipal composting facilities with lead soil levels exceeding EPA limits simply shut down operations. Currently, there is no one dominant approach to address lead contamination in compost, although scientists working with composting facilities are experimenting with different remediation techniques such as altering pH levels of compost and developing rules concerning feedstocks.

This project has a collaborative component with the garden-focused project, by considering how soil amendments (including compost) influence garden lead soil levels.
Research questions include:

- What are gardeners main sources for compost?
- What are the lead levels in these different compost sources?
- If we are able to ascertain that compost solely from leaf and yard debris shows more elevated lead levels as compared to the blended compost, are there protocols that should be developed regarding small-scale and backyard composting?
- What opportunities exist to help decrease lead levels in future compost assuming that the leaf and yard debris component of compost feedstocks will increase as the Universal Recycling Law is implemented?
- Considering current waste compositions, how will the percentage of leaf and yard debris vary across composting facilities?
- What information and kinds of material should be developed to serve:
    - Composting facilities?
    - Household composters?
    - General population?

[9] http://www.anr.state.vt.us/dec/wastediv/solid/documents/Certified_Compost_Facilities_000.pdf