Superfund Research Program

The Superfund Research Program (SRP) supports practical research that creates benefits, such as lower environmental cleanup costs and reduced risk of exposure to hazardous substances, to improve human health. SRP funds colleges, universities, and small businesses, including the University of Arizona Superfund Research Center (UA SRC), to advance this work across the nation.

Research Highlights

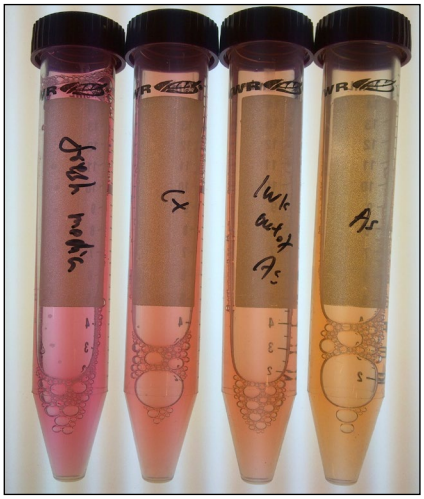
Using plants to stop the spread of mine waste

Specific types of plants and soil conditions are being investigated for their ability to stabilize areas contaminated with mine tailings. (Photo courtesy of UA SRC)

Work by UA SRC suggests that certain native plants significantly reduce dust from mine tailing sites.[1] Mine tailings, materials left over after removing the valuable portion of ore, cover thousands of acres in the western United States. This finely crushed waste is often acidic, contains harmful metals like arsenic, and lacks vegetation. Raina Maier, Ph.D., and her colleagues are developing a strategy for long-term management of mine waste by growing native plants of the desert southwest on these sites. Working with U.S. Environmental Protection Agency Region 9 and the site owner, the researchers started a field trial at the Iron King Mine and Humboldt Smelter Superfund site in Arizona in 2010, and are currently in phase 3 of the trial. The positive results have led to partnerships with four mining companies, who are now working with Maier's group to apply the method at their active and inactive mining sites.

A new understanding of arsenic toxicity

A research team led by Walt Klimecki, D.V.M., Ph.D., and Bernard Futscher, Ph.D., found that chronic, low-dose arsenic exposure causes human cells to change their metabolism, specifically how they metabolize sugar for energy, through a process normally reserved for conditions of oxygen starvation.[2] The study suggests that arsenic tricks the cells by triggering their sensors for low oxygen conditions, even when the cells have an abundance of oxygen. This may have important consequences for arsenic-associated disease because a similar shift in sugar metabolism has been observed in diseases such as diabetes and cancer. Arsenic is thought to contribute to a diverse range of diseases, including cancer, heart disease, and diabetes.[3] This new information about metabolism changes helps researchers understand how arsenic causes health problems, and may ultimately help prevent and treat them.



Exposure to arsenic causes changes in cellular metabolism, visualized in the laboratory as color changes in the medium. (Photo courtesy of UA SRC)

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UA SRC is studying the human and environmental risks associated with hardrock mining of metal in arid environments and developing innovative cleanup technologies to limit these risks. The arid climate of the southwestern U.S. and U.S.-Mexico border brings unique challenges when it comes to contaminants in the environment.

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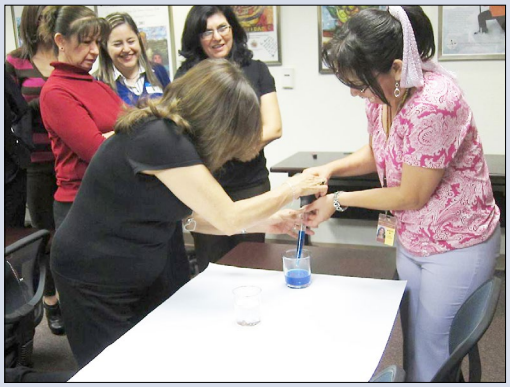
Community engagement along the border

The 2,000-mile border between the U.S. and Mexico is a unique arid region, and people residing along the border are at risk for exposure to a variety of environmental contaminants. As one of their outreach projects, UA SRC worked with Hispanic community health advocates, promotoras de salud, on environmental issues relevant to the border of Arizona and Sonora, Mexico. Together, UA SRC Community Engagement Coordinator Denise Moreno Ramírez, UA SRC researchers, and promotoras developed training materials in English and Spanish on topics including arsenic and risk assessment. The modules have been used in the U.S. and Mexico, and are publicly available.[4] Currently, UA SRC is drawing on this model to develop educational materials for tribal community colleges, focusing on mining and its environmental and social impacts on tribal lands.



Promotoras from the Regional Center for Border Health Inc. and Sunset Community Health Center participate in a hands-on activity that helps them visualize dispersion of a contaminant. UA SRC has partnered with promotoras, who provide environmental health information in primarily Spanish-speaking neighborhoods. (Photo courtesy of UA SRC)

Research overview

- Identifying how plants, such as buffalo grass, can help reduce human exposure to mining waste at active and inactive mining sites. (Raina Maier, Ph.D., rmaier@ag.arizona.edu)
- Examining energy metabolism during arsenic-induced tumor cell formation in lung cancer. (Walter Klimecki, D.V.M., Ph.D., klimecki@pharmacy.arizona.edu)
- Identifying contaminants in dust from mining operations and predicting its movement in the environment. (Eric Betterton, Ph.D., betterton@atmo.arizona.edu)
- Determining if inhalation of arsenic-containing dust during critical stages of development leads to changes in lung function as an adult. (R. Clark Lantz, Ph.D., lantz@email.arizona.edu)
- Understanding what factors determine the amount of toxic metals in mining waste that can be absorbed by living organisms. (Jon Chorover, Ph.D., chorover@cals.arizona.edu)
- Identifying contaminants in acid rock drainage and groundwater at hardrock mining sites, and developing cleanup strategies. (Mark Brusseau, Ph.D., brusseau@ag.arizona.edu)
- Examining how arsenic induces changes in epigenetic gene regulation during human cancer formation. (Bernard Futscher, Ph.D., bfutscher@azcc.arizona.edu)

Sharing results

- UA SRC is strengthening the ability of stakeholders in the U.S., Mexico, and tribal nations to address hazardous waste problems by providing culturally-relevant training, education, and teaching tools. (Sarah Wilkinson, Ph.D., wilkinso@pharmacy.arizona.edu; Karletta Chief, Ph.D., kchief@email.arizona.edu)
- UA SRC is partnering with international stakeholders to form the Latin American Hub for Environmentally Sustainable Mining. (Jim Field, Ph.D., jimfield@email.arizona.edu)
- UA SRC, in partnership with the UA Lowell Institute for Mineral Resources, is building a network of mining expertise that will serve as a global resource to solve environmental health problems related to hardrock mining. (Raina Maier, Ph.D., rmaier@ag.arizona.edu)

Other contributions to advance science

- The UA SRC research support facility provides vital access to expertise, research resources, and state-of-the-art instrumentation for its research projects. (Jon Chorover, Ph.D., chorover@cals.arizona.edu)
- The UA SRC integrated, multidisciplinary training experience provides early-career scientists access to teams of diverse professionals, and encourages innovation to develop solution-oriented approaches to complex environmental health problems. (Raina Maier, Ph.D., rmaier@ag.arizona.edu)

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For more information on the National Institute of Environmental Health Sciences, visit **www.niehs.nih.gov**.

For more information on the Superfund Research Program, visit **www.niehs.nih.gov/srp**.

For more information on the University of Arizona Superfund Research Center, visit **http://superfund.pharmacy.arizona.edu**.

[1] Solis-Dominguez FA, White SA, Hutter TB, Amistandi MK, Root RA, Chorover J, Maier RM. 2012. Response of key soil parameters during compost-assisted phytostabilization in extremely acidic tailings: effect of plant species. Environ Sci Technol 46(2):1019-1027.

[2] Zhao F, Severson P, Pacheco S, Futscher BW, Klimecki WT. 2013. Arsenic exposure induces the Warburg effect in cultured human cells. Toxicol Appl Pharmacol 271(1):72-77.

[3] Naujokas MF, Anderson B, Ahsan H, Aposhian HV, Graziano JH, Thompson C, Suk WA. 2013. The broad scope of health effects from chronic arsenic exposure: update on a worldwide public health problem. Environ Health Perspect 121(3):295-302.

[4] The University of Arizona Superfund Research Program. 2015. Promotor Modules. Available: http://superfund.pharmacy.arizona.edu/learning-modules/promotor-modules [accessed 1 June 2015].