

Concept Clearance

Branch: HSRB

Council Period: 202001

Concept Title: NIEHS Superfund Research Program R01 Individual Research Grant Program Continuation

Introduction

The NIEHS Superfund Research Program (SRP) (<http://www.niehs.nih.gov/research/supported/srp/>) was established in 1986 under the Superfund Amendment Reauthorization Act (SARA) Section 311(a), which authorizes NIEHS to implement a university-based program of basic research for the development of: 1) advanced techniques for the detection, assessment, and evaluation of the effect of hazardous substances on human health; 2) methods to assess the risks to human health presented by hazardous substances; 3) methods and technologies to detect hazardous substances in the environment; and 4) basic biological, chemical, and physical methods to reduce the amount and/or toxicity of hazardous substances. These broad biomedical and environmental science/engineering mandates are addressed through the Multi-Project P42 Grants, interdisciplinary Centers that develop solutions for the safe management of hazardous substances with the goal of improving public health. In 2006, SRP initiated the Individual Research Project Program to address specific issues that complement the multi-project research Centers (P42) and meet high-priority research needs of the national Superfund Program. The first eight SRP R01 awards were made in 2006 and specialized in novel methods for site characterization, remediation and bioavailability. Since then, there have been five focused Funding Opportunity Announcements (FOAs) with an emphasis on application-oriented mechanistic research, development and incorporation of new technologies, and sustainable approaches to remediation. The subsequent FOAs were for sediment remediation ([RFA ES 06-006](#)), bioremediation mechanisms ([RFA ES 07-007](#)), bioavailability assays ([RFA ES 11-005](#)), and mechanisms of biogeochemical interactions ([RFA ES 13-010](#)). Grants funded under these FOAs have produced high impact basic research that has yielded, for example: publications revealing fundamental mechanisms of resilience among wild populations impacted by hazardous substances; patents that use biomimetic approaches to extract uranium from water; new commercial products tailored to sequester mercury and PCBs from sediments; led to new detection product lines for small businesses; and contributed to optimizing conditions – such as the geological and chemical conditions – to enhance natural bioremediation processes (i.e. those processes mediated by bacteria, algae, fungi, plants, etc.).

SRP continues its commitment to maintaining a strong portfolio in sustainable remediation technologies (Henry and Suk 2017), and the R01 portfolio has been an important mechanism to boost the presence of remediation research within the SRP portfolio. A recent programmatic analysis showed the favorable return on investment for remediation technology research supported by the SRP, including examples of cost-saving sustainable technologies like bioremediation (Suk et al. 2018). Nonetheless, research challenges remain in advancing the fundamental knowledge of bioremediation processes. SRP recently hosted a 6-part webinar series featuring the state of the science in bioremediation which 1) highlighted the findings of the recent grantees from the biogeochemical interactions RFA and 2) explored new directions in bioremediation (NIEHS 2019a, NIEHS 2019b). Taken together, the series identified fundamental findings that limit (and stimulate) the ability of natural systems to degrade, destroy, or detoxify hazardous substances; as well as new approaches to optimize conditions to improve bioremediation outcomes. One area that is not well-represented in the SRP portfolio, but shows great promise, is the incorporation of advanced materials science in bioremediation efforts. For example, innovative *in situ* stimuli-responsive materials that are designed to react, sense, and respond to external condition in a predetermined manner may have potential to enhance bioavailability, deliver nutrients, or release signal molecules to enhance bioremediation. These materials science and engineering approaches hold promise to overcome some of the limitations of bioremediation such as the speed of the process, the formation of unintended byproducts, or the inability to remediate co-contaminants simultaneously.

Research Goals and Scope

SRP proposes to build on the prior FOA "Biogeochemical Interactions: Affecting Bioavailability for in situ Remediation of Hazardous Substances" by continuing the concept of exploring biogeochemical interactions, that is, to identify the geologic and chemical conditions to optimize bioremediation. The proposed Funding Opportunity Announcement (FOA) would continue research that will advance mechanistic understanding and effectiveness of bioremediation, with the addition of incorporating of advanced, novel materials science approaches. Applicants would assemble teams to elucidate mechanisms impacting bioremediation success and stimulate innovative transdisciplinary approaches incorporating materials science to optimize bioremediation. For example, nanotechnology or engineered microenvironmental systems can optimize the process of bioremediation by facilitating/adding consortia of living systems to degrade complex mixtures (bioaugmentation), and/or devising materials to create conditions optimal for bioremediation (biostimulation) in the presence of contaminants. Like the prior solicitation, applicants will be encouraged to develop approaches that may be applied *in situ* (on site) for the bioremediation of soil, groundwater, surface water, sediments, and/or complex geological aquifers, fractured bedrock, etc. Applicants will be encouraged to address recalcitrant emerging contaminants and mixtures (i.e. a heterogeneous group of contaminants) as these may require carefully engineered systems to maximize the efficacy of bioremediation (ie EPA, 2019).

As noted in their respective strategic plans, the NIEHS and SRP are committed to advancing the practice of data sharing, reuse, and its translation to knowledge to accelerate new breakthroughs. Like the prior solicitations, SRP also plans to continue the theme of sustainability and research translation within this next FOA iteration. Accordingly, applicants will be asked to address sustainability and resiliency of their bioremediation process(es) including the economic sustainability (*i.e.* costs) of their proposed approach. SRP has also encouraged applicants to engage end-users during the early stages of application development and throughout the duration of the grant, as this greatly increases the positive impact of SRP research and its utility to stakeholders. This iteration will continue the practice of engaging stakeholders and will take an additional step forward by having applicants include a data sharing plan to identify suitable data-sharing platforms to make data FAIR (findable, accessible, interoperable, and reusable).

This initiative would fit under the NIEHS strategic plan goal of both "Advancing Environmental Health Sciences through Basic Biological Research" through advancing fundamental knowledge of bioremediation; but also "Evidence-Based Prevention and Intervention" whereby the remediation advances prevent exposures to hazardous substances in the environment. In addition, the transdisciplinary framework of this proposed FOA fits under "Promotion of Collaborative Science" by stimulating bioremediation expertise to work together with materials science experts to find solutions. Lastly, the proposed management strategy for this program supports "Creating Knowledge From Data," "Outreach, Communications, and Engagement" of end-users, and "Emerging Environmental Health Issues."

It is believed that this transdisciplinary research approach of incorporating materials science with bioremediation could offer new breakthroughs to advance sustainable solutions for hazardous substances in the environment. Furthermore, this type of research, though promising, is not represented among the current SRP portfolio, creating an excellent opportunity to fill a gap through the R01 FOA.

Mechanism and Justification

This funding announcement will utilize the R01 grant mechanism, which is the individual research grant mechanism. SRP proposes to allocate up to \$2,500,000 annually for the support of up to 10 programs with a proposed Direct Cost limitation of \$200K per year for up to 5 years.

References:

EPA, 2019, Emerging Contaminants and Federal Facility Contaminants of Concern, <https://www.epa.gov/fedfac/emerging-contaminants-and-federal-facility-contaminants-concern>.

Henry H, Suk W. 2017. Sustainable exposure prevention through innovative detection and remediation technologies from the NIEHS Superfund Research Program. *Rev Environ Health* 32(1-2):35-44, PMID: 28212109, doi:10.1515/reveh-2016-0037.

NIEHS, 2019a, "Biogeochemical Interactions Affecting Bioavailability for in situ Remediation," Progress in Research Webinar Series: https://www.niehs.nih.gov/research/supported/centers/srp/events/inprogresswebinar/biogeochemical_interactions_2019/index.cfm.

NIEHS, 2019b "Bioremediation – Expanding the Toolbox," Risk e-Learning Webinar Series: <https://www.niehs.nih.gov/research/supported/centers/srp/events/riskelearning/bioremediation/index.cfm>.

Suk WA, Heacock ML, Trottier BA, Amolegbe SM, Avakian MD, Henry HF, Carlin DJ, Reed LG. 2018. Assessing the Economic and Societal Benefits of SRP-Funded Research. *Environ Health Perspect* 126(6):065002, PMID: 29916809, doi:10.1289/EHP3534.