NATIONAL INSTITUTE OF ENVIRONMENTAL HEALTH SCIENCES (NIEHS)

The mission of the National Institute of Environmental Health Sciences www.niehs.nih.gov is to discover how the environment affects people in order to promote healthier lives, with a vision of providing global leadership for innovative research that improves public health by preventing disease and disability. NIEHS achieves its mission and vision through a multidisciplinary biomedical research program, prevention and intervention efforts, and a communication strategy that encompasses training, education, technology transfer and community outreach. www.niehs.nih.gov/sbir
Join our listserv for program announcements https://list.nih.gov/cgi-bin/wa.exe?SUBED1=sbir-niehs&A=1.

Exposure Assessment Tools

The NIEHS Exposure Biology and Exposome Program (http://www.niehs.nih.gov/research/supported/exposure/bio/) studies the totality of the exposures that a person experiences from conception to death along with the associated biological responses. Validated tools are needed that measure, analyze, and predict a wide range of internal and external exposures and health outcomes across diverse geographic populations. These tools should be designed fit for purpose in collaboration with the purchasers and end-user populations (*e.g.,* community outreach programs, citizen scientists, disaster response personnel, epidemiologists, or clinical researchers). Examples include:

- Sensors
  - Technologies to assess personal exposure in population studies using networks of fixed site and wearable monitors
  - Personal, wearable, real-time detection measurements across multiple stressors and scales (*e.g.*, time, space, route of exposures, distribution), with emphasis on high sensitivity and specificity and/or low cost devices. High priority analytes include ultrafine particulates and PAHs

- Biomonitoring technology
  - Personal monitoring technologies that can detect multiple toxicants in biospecimens using non- or minimally invasive approaches
  - Devices that can continuously monitor and report exposures in real-time

- Computational and informatics-based tools and methods
  - Computational and statistical approaches to integrate exposure data from different sources to provide quantitative exposure estimates, including publicly available databases, and monitoring devices (sensors, biomonitors, remote sensing)
  - Novel tools and methodologies to collect, analyze, and visualize exposure data from large populations, especially temporally and spatially resolved exposure data (such as crowdsourcing and exposure mapping)
  - Informatics tools and strategies to organize, store and retrieve complex, heterogonous exposure and health data (such as exposure databases)
  - Tools and technologies that address data security and privacy issues related to exposure and health information

New strategies for detecting analytes not currently measured in CDC NHANES, including replacement chemicals (*e.g.,* alternatives to current flame retardants or chemicals used in plastics manufacture) or emerging chemicals

- Technologies that can assess multiple exposures in archived biological samples
- New approaches to integrate smart device technologies into exposure assessment
- Untargeted discovery or annotation of environmental analytes in metabolomics studies

Nano Environmental Health and Safety

http://www.niehs.nih.gov/research/supported/exposure/nanohealth/index.cfm The NIEHS Nano Environmental Health and Safety (Nano EHS) program is interested in the detection of engineered nanomaterials in the environment, in products, and in biological samples; and technologies that can predict toxicity potential. High priority engineered nanomaterials of interest are those with a potential for human exposure.

Examples include:

- Sensors that can detect metal, carbonaceous engineered nanomaterials in air, water, and consumer products, and provide a contextual assessment on the toxicological potential
- Biomonitoring technologies that can detect engineered nanomaterials for personal monitoring of biospecimens using non- or minimally invasive approaches
- High-throughput *vitro* assays to evaluate biological responses to engineered nanomaterials, beyond cytotoxicity

Toxicity Screening, Testing, and Modeling

The National Toxicology Program http://ntp.niehs.nih.gov/ at NIEHS is interested in technologies to improve predictivity in toxicology testing to support the goals and initiatives of Tox21 http://ntp.niehs.nih.gov/results/tox21/index.html. Phase III of Tox21 is focused on expanding biological endpoints and human relevance with increased focus through the following efforts:

Improved or expanded testing methods for toxicity screening
These should include the development of physiologically relevant, cell-based systems or phylogenetically lower order animal models. *In vitro* approaches should reflect *in vivo* effects in animals and humans, and may be used to reduce or replace *in vivo* animal use. High priority areas are the development of metabolically competent *in vitro* screening systems that are predictive of xenobiotic metabolism in humans, and the incorporation of genetic variation in *in vitro* or animal models to understand susceptibilities. Examples include:

- Data rich *in vitro* approaches that incorporate mid- to high-throughput omics or high-content imaging
- *In vitro* toxicology screening models to predict idiosyncratic effects of toxicants and drug compounds in humans
- Enhanced lower organism models (*e.g.,* zebrafish or *C. elegans*) for mid-throughput toxicant screening
- Stem cell assays (both embryonic and iPS cells) for effects of toxicants on cell differentiation, with multiple functional endpoints
- Screening systems that incorporate genetic diversity into toxicology testing (*e.g.,* panels of human iPS cells or rodent models for genetic diversity)
- Improved human organotypic models that more accurately predict *in vivo* function. Tissue models include, but are not limited to liver, kidney, gastro-intestinal, lung or brain tissue. Organotypic models using cells from rat and mouse models are also needed to reduce animal use in toxicity screening
- *In vitro* assays to model inflammatory responses to xenobiotics
- Short-term tests, assays, or systems that reduce or replace animal studies, or increase predictivity of *in vivo* animal models of acute toxicity (oral or inhalation), reproductive or developmental toxicity (*e.g.,* from endocrine-disrupting xenobiotics), carcinogenicity, or ocular toxicity
- Improved identification and characterization methods for untargeted, high-throughput metabolomics analysis of xenobiotics

Computational approaches for predictive toxicology

- New computational systems and tools for integrating toxicity data that analyze and visualize data across different screening systems, as well as *in vivo* data
- Improved experimental and computational tools for *in vitro* to *in vivo* extrapolation of xenobiotic exposures across a range of assay types
- Technologies for pre-market identification of problem xenobiotics through *in vitro* and computational tools (*e.g.,* development of an integrated testing strategy for green chemistry)
- Computational tools for modeling detoxification and metabolic activation

Other technologies for enhanced toxicology testing

- High-throughput, low cost approach to measure global gene expression in cells or tissues
- Improved methods for fixing and preserving tissues that maintain cellular structure for histopathology while minimizing degradation of nucleic acids (RNA, miRNA, DNA, methylated DNA) so that archival tissue blocks can be better used for molecular analysis.
- Alternatives or improvements to formalin fixation, paraffin embedding (FFPE) of tissues are sought for improved molecular or genome-wide analysis for better use of tissue archives.
- *In vivo*, real-time, and tissue-specific detection of oxygen radicals in experimental animals

Biomarkers

NIEHS supports the development and validation of biomarkers, assays, or detection systems that can distinguish reversible from irreversible changes in target organs of toxicity as a result of individual responses to environmental stressors (*e.g.,* air pollution components, pesticides, toxic metals, endocrine-disrupting compounds, and other industrial chemicals).
Biological pathways of interest include:

- Oxidative stress (*e.g.,* measurement of excess ROS in specific cell types)
- Inflammation
- DNA damage response (*e.g.,* functional assays of DNA repair phenotypes)
- Immune function
- Mitochondrial function
- Epigenetic regulation

High priority human biomarkers include, but are not limited to:

- Inflammation biomarkers
- Plasma- or serum-based markers using altered RNA or protein expression or altered metabolite profiles to determine response to environmental exposures
- Markers developed in exhaled breath, buccal cells, or other easily accessible, non-invasive biological samples that characterize alterations in key pathways associated with environmental stressors
- Urinary biomarkers for exogenous compounds and their metabolites or other cellular markers
- miRNA or exosome biomarkers for exposure assessment to environmental toxicants (*e.g*., drug-induced liver injury)
- Epigenetic markers in surrogate tissues reflecting modifications in target tissues

Superfund Research Program

http://www.niehs.nih.gov/research/supported/dert/programs/srp/ The NIEHS Superfund Research Program (SRP) is interested in applying new engineering, bioengineering, and biotechnology approaches to develop novel strategies to characterize, monitor, and remediate hazardous substances at contaminated sites.

Topics of interest include, but are not limited to:

Monitoring, Detection, and Site Characterization

- Real-time, on-site monitoring: soil, surface water, groundwater, subsurface, sediments, air (such as volatile releases from sites), etc.
- Nanotechnology-based sensors and probes, biosensors, and miniaturized analytical probes
- Non-targeted or multi-analyte field sampling tools or kits
- Products that allow for rapid sample clean-up/preparation for analysis of environmental samples
- Devices to detect chemical mixtures in environmental media
- Self-contained miniaturized toxicity-screening kits for detecting contamination hotspots
- Passive sampling devices: soil, surface water, groundwater, subsurface, sediments, air (relevant to Superfund), etc.
- Assays or devices to determine the extent to which a contaminant is bioavailable
- High throughput assays or toxicity screening products for use in ecological risk assessments

Examples of specific environmental monitoring, detection, and site characterization needs:

- Devices to detect and measure dense non-aqueous phase liquids (DNAPLs) in the subsurface
- Site characterization techniques and strategies for complex geology (fractured, karst and heterogeneous layered deposits)
- Technologies for rapid extraction or processing of soil for incremental sampling methodologies (ISM)
- Technologies for automated fiber counting for asbestos samples

Remediation

- Novel technologies for in situ remediation of contaminated sediments, soils, and groundwater
- Technologies to remediate chemical mixtures in environmental media
- Portable adsorption systems for removing chlorinated VOCs from indoor air to achieve risk-based indoor air standards
- Nano-enabled structures, electrochemical methods, photocatalytic processes, thermal treatments, or filtration-based methods of remediation
- Bioremediation and phytoremediation technologies including development and culturing/propagation of plants, bacterial strains, or fungal species optimized for bioremediation
- New strategies for delivery of reagents for groundwater remediation: in situ chemical oxidation ISCO), zero valent iron (ZVI), and hydraulic fracturing (note: this excludes gas exploration)
- New strategies for delivery of reagents for recovery/extraction of contaminants in groundwater

Information Technology to Support Monitoring and Remediation

- Computational, geographical information system-based, or modeling products for predicting fate and transport of contaminants, rates of remediation, or for identifying contamination sources
- Miniaturized data analysis tools

SRP encourages applicants to develop green / sustainable detection technologies and remediation approaches that improve energy efficiency and reduce waste generation. Proposals must demonstrate that the proposed detection and remediation technologies are relevant to Superfund. For more information about the types of hazardous substances found at Superfund sites: http://www.niehs.nih.gov/research/supported/dert/programs/srp/hwaerp/index.cfm

Education/Outreach

http://www.niehs.nih.gov/research/supported/dert/programs/peph/ As part of its Partnerships for Environmental Public Health (PEPH) Program, NIEHS is interested in developing tools that build capacity, improve environmental health literacy, and support citizen science endeavors. These approaches or resources should be fit for purpose to meet the needs of the following audiences: community members, health care and public health professionals, educators, and students of all ages. Approaches may include:

- Mobile applications that contextualize environmental health information about exposures of concern in food, air, water, or consumer products
- Devices for collecting and reporting information on exposures in environmental samples for educational purposes in schools or communities
- Systems that can utilize public and voluntary population data from sensors, activity trackers, GIS enabled devices, social communications, and surveillance cameras; for example, to assist disaster response and communication
- STEM education resources related to environmental health in school settings or community education programs
- Continuing medical education classes related to environmental health
- Documentaries, short films, and television shows on environmental health science topics with accompanying discussion guides, lessons, or activities to facilitate broader use of the programming

Worker Training Program

http://www.niehs.nih.gov/careers/hazmat/about_wetp/
The NIEHS Worker Training Program (WTP) is interested in Advanced Training Technology (ATT) products for the health and safety training of hazardous materials (HAZMAT) workers, skilled support personnel, and emergency responders in biosafety response and cleanup, community and citizen preparation and resiliency, and for ATT tools to assist in research into the acute and long-term health effects of environmental disasters. ATT as defined by WTP includes, but is not limited to, online training, virtual reality, serious gaming, and tools that complement all aspects of training from development to evaluation including advance technologies that enhance, supplement, improve, and provide health and safety training for hazardous materials workers. WTP accepts solicitations via requests for applications (RFA). Please contact Kathy Ahlmark ahlmark@niehs.nih.gov for information on the next solicitation date, which differs from the standard receipt dates of this NIH omnibus.

NIEHS DOES NOT Fund

- Technologies for the detection and remediation of pathogens in the environment - contact EPA or DoD for information on SBIR funding opportunities for this topic

Other Topics within the Mission of the Institute

For additional information on research topics, contact:
Dr. Daniel T. Shaughnessy
National Institute of Environmental Health Sciences
Division of Extramural Research and Training

POB 12233 (K3-12)
Research Triangle Park, NC 27709
(919) 541-2506, Fax: (919) 541-4606
Email: shaughn1@niehs.nih.gov

For information on the Hazardous Substances Detection and Remediation Program, contact:

Dr. Heather Henry
National Institute of Environmental Health Sciences
Division of Extramural Research and Training
POB 12233 (K3-12)
Research Triangle Park, NC 27709
(919) 541-5330, Fax: 919) 316-4606
Email: henryh@niehs.nih.gov

For administrative and business management questions contact:

Ms. Pam Clark
National Institute of Environmental Health Sciences
Division of Extramural Research and Training
Grants Management Branch
POB 121233 (K3-11)
Research Triangle Park, NC 27709
(919) 541-7629, Fax: (919) 541-2860
Email: evans3@niehs.nih.gov

For express mail:
530 Davis Drive (K3-12)
Morrisville, NC 27560