Superfund Research Program: 35TH Anniversary Annual Meeting

Wednesday, December 14, 2022

Poster Session I

1: Longitudinal assessment of lead (Pb) exposure among mother-child dyads in an environmental justice community impacted by multiple legacy sources

Yau Adamu, University of Iowa

Background: Although average blood lead levels (BLLs) in the US general population have been declining, trends in urban communities with historical uses of Pb and persistent socioeconomic, ethno-racial, and geographical disparities are limited. Methods: Archived clotted erythrocytes samples (n=408) from 2008 to 2019 collected from a cohort of 109 mother-child dyads from the Airborne Exposure to Semi-volatile Organic Pollutants (AESOP) study were assayed for BLLs and compared to the BLLs from a matched U.S. National Health and Nutrition Examination Survey (NHANES) population. Results: More than half (62.9%) of the participants were of Hispanic origin, 28.4% non-Hispanic Black. The mean BLLs of the AESOP participants increased (+41.5%) over the study period, contrary to a decreasing trend (-73.3%) in the NHANES participants ($p=0.003$). Similar increasing trends in mean BLLs were observed among mothers and children ($p<0.05$). The BLLs of participants from the West Calumet Housing complex, which is considered a contaminated site and undergoing remediation by the U.S. Environmental Protection Agency, were not significantly different from the surrounding neighborhoods ($p>0.05$). Our results reveal factors playing distinct roles in explaining the BLLs in mothers and children. Conclusion: The contrasting patterns in BLLs between our study and the nationally representative populations reflect persistent institutionalized inequities in environmental exposure. Our findings call for an intensified advocacy for environmental justice. Impact Statement: The availability of comparable information on Pb exposure levels and trends among disproportionately affected communities is highly relevant for the exposure evaluation and implementation of mitigation strategies toward better public health and justice.

2: Quantification of perfluoroalkyl substance in human serum from patients evaluated for non-alcoholic fatty liver disease

Juliana Agudelo Areiza, University of Rhode Island

Non-alcoholic fatty liver disease (NAFLD) is characterized by the accumulation of lipids in the liver, lipotoxicity, and insulin resistance. Some perfluoroalkyl substance (PFAS) are known to be highly persistent and bioaccumulative in vivo (i.e., detected in human liver). Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), have been associated with elevated serum liver injury markers in humans, but few studies have addressed risk of NAFLD. Therefore, we aimed to compare the serum concentrations of PFOA, PFOS, and emerging PFAS among NAFLD cases (N=23 for children, 17 for adults) and non-NAFLD controls (N=15 for children, 11 for adults). Blood samples were collected at the time of being evaluated for NAFLD between 2014 - 2020 at Children's Mercy Hospital or the University of Kansas Medical Center. Preliminary findings illustrated that for PFOA, perfluorohexanesulfonic acid (PFHxS), and PFOS, the odds ratios (95%) for detection comparing cases to controls were 0.05 (0.002, 1.27), 0.40 (0.03, 4.84), and 0.39 (0.006, 23.59), respectively, adjusted for age, sex, BMI, and race. The averaged adjusted log transformed PFOA concentrations in pediatric cases were 0.208 (95% CI: -1.08, 0.66) lower than controls. Differences in log transformed concentration comparing adult cases to controls adjusted for age and sex were: -0.4 (95% CI: -1.10,0.30) for PFOA, 0.05 (95%CI: -0.89, 0.98) for PFHxS, and -0.97 (95% CI: -1.68, -0.25). The findings suggest that children with NAFLD had lower serum PFAS concentrations than children without non-NAFLD. However, a larger sample size is required to confirm these findings, with sample collection and analysis ongoing.

3: Kinetics of Per- and Polyfluoroalkyl Substances (PFAS) Adsorption to Granular Activated Carbon (GAC)

Maria Isabel Alexander Rodriguez, NC State University

Per- and polyfluoroalkyl substances (PFAS) are anthropogenic recalcitrant contaminants that have been extensively used for industrial and military purposes since the early 1950s. Their removal from water is complex due to their unique properties. PFASs can lower surface tension, are thermal and chemically stable, and are highly soluble in water. Adsorption to granular activated carbon (GAC) is a widely employed technique for their removal from contaminated water. Nevertheless, PFAS adsorption and desorption kinetics are not well understood, and this knowledge gap prevents the effective prediction of GAC performance from bench-scale experiments or mathematical models. The aim of this research is to quantify PFAS adsorption/desorption kinetics in single- and multi-solute systems by conducting short-bed adsorber (SBA) tests. Results from SBA tests will be interpreted with mass transfer models to determine how the intraparticle diffusion coefficient varies with GAC particle size, GAC properties, and PFAS properties. Single-solute SBA tests will be conducted with five types of GAC crushed to 110, 320, and 710 µm and five adsorbates (PFBS, PFHxS, PFOS, PFOA, and polystyrene sulfonate (PSS), a surrogate for naturally occurring organic matter). It is expected that by applying the shell adsorption framework model, adsorption kinetics for a given solute can be described by a single diffusion coefficient, regardless of GAC particle size. The results of this project are expected to help lower PFAS treatment costs and enable the optimization of GAC treatment systems to provide safer and cleaner drinking water.

4: Climate-induced variation in toxic metal(loid)s concentration and speciation in weathered mine tailings

Ma'in Alghzawi, The University of Arizona

Sulfide ore-derived mine tailings pose risk to human and ecosystem health because of elevated toxic metal(loids) (e.g., As, Pb, Zn) concentrations. Investigating the distribution patterns of toxic metal(loids) in tailings profiles and developing a global understanding of the processes that lead to variation in these patterns is vital for risk assessment. Moreover, when supported by speciation analysis of toxic elements, these patterns provide a critical assessment of the products and propagation of the redox reaction front. We postulated that the rate of tailings weathering, and the types of reaction products are controlled by annual precipitation, weathering time, and primary-mineral composition. To test this hypothesis, we collected tailings samples from different climates and quantified elemental enrichment and depletion patterns, in addition to characterizing molecular speciation. Thirteen sulfide ore tailings (many Superfund) sites, representing a wide range in climatic forcing, were sampled in the western U.S. Samples were collected across the weathering profile (0-200 cm), freeze-dried, and subjected to (HF-HNO3) digestion prior to ICP-MS analysis. Results showed As was enriched between 20 and 150 cm in the weathering profile and depleted above 20 cm and below 150 cm at arid sites. In humid climates, As was depleted above 50 cm, and enriched between 50 and 150 cm. This suggests that oxidative weathering is mobilizing As by introducing O2 and H2O whereby As is translocated and retained through adsorption/co-precipitation reactions at depth. Molecular speciation of As, Fe, and S (using X-ray spectroscopic analysis) provided insight into the distribution patterns induced by weathering.

5: Understanding Geospatial Controls on Arsenic Contamination in North Carolina Groundwater

Taylor Alvarado, NC State University

Abstract. Arsenic (As) is a common contaminant in groundwater drinking resources that is associated with negative health impacts from chronic exposure. Approximately 3 million people in North Carolina rely on private wells for their primary source of domestic water and it is estimated that 24% are exposed

to levels above the Environmental Protection Agencies standard. Recent work using the NCWELL database, containing 117,946 groundwater measurements of private wells taken by the State Health Department across North Carolina (Eaves et al.), has clearly identified counties with high incidences of wells with dissolved arsenic that exceeds the drinking water standard. However, the spatial distribution of elevated As within those countries is highly variable resulting in varied exposure and risk. Because most As in groundwater is naturally occurring with geogenic origins, we anticipate a strong spatial dependence on underlying geology. This research is utilizing the new NCWELL database to identify and characterize the geologic formations underpinning areas with the greatest risk for As exposure. The work highlights the relevance of tectonic and erosional development processes as drivers of As in regional groundwater sources. Results have significant implications for enhanced As prediction in North Carolina and public health.

6: Graphene oxide (GO)-based two-dimensional sorbents for the removal of PFASs from drinking water

Nafisa Amin, NC State University

Per- and polyfluoroalkyl substances (PFASs) are contaminants of emerging concern because of their toxicological properties, persistence and mobility in the environment, and their ubiquity in drinking water. Most water treatment technologies are relying on conventional adsorbents such as granular activated carbon (GAC) and polymeric ion exchange resins to remove PFASs from drinking water. These treatment technologies are costly for the removal of short chain PFASs and recently identified perfluoroalkyl ether carboxylic acids (PFECAs), and they are adversely impacted by background water matrix constituents. The objective of this study is to design graphene oxide (GO)-based two-dimensional sorbent materials modified with different linkers and b-cyclodextrins (bCD) with the goal of developing PFAS-selective sorbents that can strongly bind short-chain PFASs and PFECAs.

Ten GO-based materials have been synthesized using different linkers and bCD. In this study, the adsorption capacity of plain GO was compared with modified GO. Linkers used included (poly)DADMAC of varying molecular weights (161; <100,000; 100000-20000 g/mol), azide, and amines. We evaluated these synthesized sorbents with PFOA and GenX in buffered (pH = 7.4), ultrapure water (UPW) and Florida groundwater with high levels of dissolved organic matter. Plain GO and GO modified with bCD exhibited negligible adsorption capacities for PFOA and GenX whereas polyDADMAC-containing sorbents showed promise. Positive charges in repeating units of polyDADMAC likely contributed to adsorption of anionic PFAS. In an effort to further enhance the adsorption capacity of GO-based sorbents, we are exploring modifications with tertiary amines and polyDADMAC of higher molecular weights (200,000-350,000 and 400,000-500,000) as linkers.

7: PCBs in Schools—Case Study Investigations of PCB Discoveries in Five US School Districts

Jessica Andino, University of Iowa

Polychlorinated biphenyls (PCBs) have been a persistent organic pollutant for decades, and the period of mass producing Aroclors (1930-1977) overlapped with the rapid construction period of public schools in the U.S. (1950-1980). The EPA does not require schools to test for PCBs; however, some schools choose to test for various reasons. Testing may create a call to action from school districts to mitigate PCB exposures. These incidents may be of interest to the public and gain the attention of media and the broader community. In fall 2021, news outlets online were searched for terms PCBs and schools. From this search, five major cases were chosen for inclusion. Articles associated with the cases were downloaded from major news media outlets, followed by document gathering from local news outlets, school districts' websites, school board meeting documents, and related social media accounts. Thematic analysis occurred to develop timelines of events and identify key stakeholders. Our analysis showed building ages are often not systematically recorded and be difficult to find. Record keeping

strategies vary among school districts, and lack of uniformity may limit transparency to the public. Involved groups may need to push for testing since testing as a preventative measure is not required. Various misconceptions were identified in media reports, and litigation is common when it comes to requiring testing and remediation. Many school districts lack knowledge and resources to remediate PCB contamination. This project developed case studies of real-world PCB contamination discoveries to guide future best practices for communities and school districts.

8: Building an Environmental Health Mapping Tool for Arizona Communities Through Data Integration and Community Science

Alma Anides Morales, University of Arizona

Many Arizona communities are impacted by the exposures, health impacts, and risks associated with resource extraction and environmental contamination. The University of Arizona Superfund Research Center plays an important role in studying these issues and the Research Translation Core has generated citizen/community science (CS) datasets (i.e., Gardenroots) that provide local environmental monitoring information in under-resourced and/or environmental justice communities. A lack of integration of CS data with other existing datasets (i.e., government) is a missed opportunity to create a holistic perspective on the existing resiliencies and vulnerabilities that create environmental health disparities. In response, using a transdisciplinary research framework and methodology, CS data was integrated with existing government environmental and social attribute data to develop a database and application ontology (Superfund Research Project Data Interface Ontology, SRPDIO) (Ramirez-Andreotta et al., 2021). This research builds off these efforts and proposes to develop an online environmental health mapping tool by the name of HOWL (Health Opportunity Wellness Landscape) in which CS datasets will be ethically integrated with local, state, and federal datasets and be easily accessible. Additionally, these will be incorporated and standardized to create vulnerability and resiliency indices further informed by a state-wide bilingual Community Needs and Assets online survey that asked Arizona residents to determine which factors and the degree to which these contribute to the vulnerability and resiliency experienced in their communities. Our objective is for HOWL to serve as a hypothesis-generation tool for community members, policymakers, and researchers to visualize and address environmental health injustices in Arizona.

9: Treatment of Per and Poly-fluoroalkyl Substances (PFAS) using Redox Active rGO-nZVI Nanohybrid: Influence of Oxidant Concentration and Water Chemistry

Jonathan Antle, University at Buffalo

The removal of per- and polyfluoroalkyl substances (PFAS) from environmental samples has become a major goal for scientists and engineers in the last decade due to their toxicity and widespread occurrence in the environment. Previous works have shown that a carbon-metallic nanohybrid material composed of reduced graphene oxide and nanoscale zero-valent-iron (i.e., rGO-nZVI) can achieve partial defluorination and chain-shortening for the two regulated PFASs, i.e., perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS). In this study, we evaluated how and to what extent different water quality parameters such as concentration of PFAS, pH, ionic strength, and the presence of natural organic matter (NOM) as well as the H2O2 concentration influence the removal and degradation of PFOS and PFOA from an aqueous system. Results showed that the removal efficiency decreased with the increase in initial PFAS concentration and with the decrease in H2O2 concentration. The nanohybrid material also showed higher efficiency removal at lower pH (pH = 3) after 20 min treatment. High salt concentrations slightly reduced the removal of both the PFOS and PFOA. Furthermore, the presence of NOM slowed down the PFOS removal kinetics; however, for PFOA, not only it slowed down the removal kinetics but also reduced the overall removal efficiency. Overall, the synthesized nanohybrid material exhibited acceptable ability to remove PFAS in different conditions.

10: New RO membrane post-modification shows promise toward optimization for neutral solute removal from water

Mikayla Armstrong, University of North Carolina-Chapel Hill

Background: Performance enhancements over the last decade to existing polyamide-based reverse osmosis (RO) membranes have resulted in water permeance near the thermodynamic limit and exceptional inorganic salt rejection (>99%); however, secondary solute rejection, such as small neutral solutes, still needs improvement. Taking inspiration from recent work on solvent activation, alternative interfacial polymerization, and molecular plugging post-modification techniques, this study explored a new post-modification technique that combined solvent activation with alternative polymerization. We hypothesized that such a technique would change the free volume size distribution of the polyamide layer, resulting in improved water permeance and water-solute selectivity.
Methods: We evaluated the filtration performance, transport properties, physico-chemical properties, and property-performance relationships of unmodified, modified, and solvent control membranes.
Results: Results show that our post-modification technique changed the physico-chemical properties of the membranes, including free volume size distribution, and resulted in changes to membrane performance. In particular, the modified high-flux RO membrane had higher water permeance and water-As(III) selectivity than its corresponding unmodified and solvent control membranes, which correlated with mean free volume size.
Impact statement: Our new post-modification technique shows promise for optimization toward enhancing neutral solute removal from impacted waters. An example of a potential application of this technology is for residential well-water contaminated with As(III).

11: Increased cardiovascular and respiratory disease-related hospitalizations and mortality in an area surrounding a hazardous waste incinerator

Liana Baconguis, Louisiana State University

Clean Harbors, LLC operates a thermal treatment plant near the city of Colfax, LA in Central Louisiana. Its regular open burning of explosives causes consistent community disturbances. We hypothesized that airborne pollutants produced from this facility increased the disease burden of individuals residing in Colfax compared to surrounding areas. We gathered hospitalization and mortality rates from the years 2000-2017 from the Louisiana Vital Records Registry, Tumor Registry, and Department of Health. We found greater incidence rates of cardiovascular and respiratory diseases in Colfax compared to the rest of Grant Parish or Louisiana. The incidence rate of hospitalization for hypertension was 932.931 per 10,000, 1.153 (95% CI: 1.13 to 1.18) times that of surrounding regions, and for asthma it was 99.0163 per 10,000, 1.165 (95% CI: 1.14 to 1.19) times that of surrounding regions. Significantly higher mortality rates were also found in Colfax for hypertension (2.060 times that of surrounding regions, 95% CI: 1.71 to 2.48) and ischemia (1.828 times that of surrounding regions, 95% CI: 1.59 to 2.10). Most hospitalized patients lived under 10km from the burn site and most lived northwest to it, consistent with prevailing wind directions over the study period. Despite the small sample size and limited demographic information present in the dataset, we describe a clear trend of increased hospitalization and mortality in Colfax compared to surrounding areas; these are consistent with previous literature on the effects of long-term pollution exposure. This suggests the need for a detailed epidemiological study and exposure analysis within the community.

12: Sorption behavior of chromate and vanadate on two distinct saprolites from the North Carolina Piedmont region

Fatai Olabanji Balogun, University Of Oregon

Chromium (Cr) and vanadium (V) contamination of groundwater in the Piedmont area of North Carolina

(NC) is an environmental health issue. The contaminants are naturally derived but spatially heterogeneous, with the release and retention of Cr and V dependent on their redox conditions and mineralogy of saprolite and aquifer materials. Hydrogeochemical processes superimposed on differences in physico-chemical properties amongst near-surface geologic materials make it difficult to predict the fate of Cr and V. The objectives of this study are to 1) determine mineral phases that host Cr and V in subsurface materials, 2) quantify contaminant binding properties for mineralogically distinct samples, and 3) correlate the resulting data with groundwater Cr and V concentrations from across the Piedmont. To address these objectives, batch isotherm experiments using chromate and vanadate, and chemical extractions were conducted on two different saprolites to determine the maximum adsorption capacity (Qmax) and binding coefficients (Kf and Kl) of contaminants to each saprolite. Preliminary results show that the binding capacities for Cr and V depend on the proportions of amorphous Fe-oxides in the saprolites. Saprolite with a higher amorphous Fe (~0.1 wt% Fe) retained Cr (Qmax = 36.4 mg/kg) than saprolite with lower amorphous Fe (~0.05 wt% Fe; Qmax = 31.2 m/kg). Vanadium isotherm experiments revealed that saprolite with higher crystalline Fe content adsorbed V stronger (Qmax = 345 mg/kg). Overall, expected results will give insights on contaminant transport capacities under different geologic regimes and help parameterize mechanistic models for predicting the fate of Cr and V.

13: The Impact of Polychlorinated Biphenyl Emissions on Concentrations Measured Indoors: Evaluation of Surfaces

Moala K. Bannavti, University of Iowa

Currently, federal laws on indoor PCBs only regulate bulk PCB concentration within a room's building materials. Yet, airborne exposure to PCBs has increasingly become a concern. To reconcile federal regulation of material bulk PCB concentrations with state airborne PCB regulations there is a need to characterize PCB emissions and congener distributions. Here we report a study of PCB emissions from flooring and walls. We measured 206 PCB congeners' room air concentrations via polyurethane foam passive air samplers. We measured emissions of the same set of PCBs from wood panel walls, from tile flooring, and from tile flooring overlaid with carpet using polyurethane foam emissions samplers. Room air concentrations ranged from 21.79 to 133.90 ng m-3. Emissions of the sum of 206 PCB congeners ranged from 4.61 x 103 from wood panel to 2.98 x 104 ng m-2day-1 from vinyl tile. Emissions were reduced by more than 60% after hexane wiping. We found a correlation between the congener profiles for the emission and ambient room air concentration measurements ($\cos \theta > 91\%$). The bulk concentration of the materials ranged from 204.91 to 1.20 x 104 ng g-1. If the rooms had a no PCBs in the air initially, no deposition, and no flow of air inside the room, it would take 0.02 days (0.5 hrs) for emissions to reach observed air concentrations. This work highlights the importance of emission measurements in addition to room air measurements to curate unique, informed, and targeted airborne PCB remediation plans for any room or building.

14: Navajo WaterGIS: Harmonization and visualization of water quality at unregulated sources

Daniel Beene, University of New Mexico

Background: Groundwater contaminated with metals and other pollutants hazardous to human health is part of the intractable legacy of uranium mining across the Colorado Plateau. This is especially so in the Navajo Nation, where it is estimated that between 7% and 30% of homes lack plumbing to deliver household drinking water. While this challenge is actively confronted by the Navajo Nation Water Access Coordination Group (WACG), residents still rely on hauling water from unregulated sources for consumption, livestock watering, or other domestic uses. Unregulated water sources are not necessarily contaminated but they are also not routinely monitored or treated for multiple contaminants.
Methods: We developed an interactive web-based mapping application to facilitate engagement with water quality data compiled and harmonized from more than 20 sources. The app assists a diverse

audience of end-users, policymakers, and researchers quickly visualize water quality information. More than 64,000 laboratory records for 1,116 wells are represented in the public-facing product.
Results: Embedded Google Analytics show that interaction with the app is consistent but still low among Navajo residents. Possible reasons are the lack of access to desktop computers, limited broadband internet, and a paucity of awareness. To address this, we are developing a mobile app with offline capability, more intuitive water use recommendations, training materials, and focused outreach strategies for end users.
Impact Statement: These activities reflect the FAIR principles of data management and enable a greater degree of participation in a community with pressing and culturally specific environmental justice challenges.

15: Aroclor 1016, Aroclor 1254, and Cabinet Mixtures impair adipose stem cell growth and viability
Riley Behan-Bush, University of Iowa
Human exposure to polychlorinated biphenyls (PCBs) has been linked to an increased risk of heart disease, stroke, and cancer, as well as the development of metabolic syndromes such as obesity, hyperlipidemia, and type II diabetes. PCBs are known to accumulate in adipose tissue, the lipid-rich organ responsible for regulating metabolism and insulin sensitivity. Proper expansion and turnover of adipose tissue are fundamental to the prevention of metabolic syndromes. However, the ways in which PCBs affect the cells responsible for expansion, the adipose mesenchymal stem cells (MSCs), are not well understood. Herein, we investigated how exposure to Aroclor 1016 and Aroclor 1254, as well as a newly characterized non-Aroclor mixture that resembles the PCB profile found in cabinets, Cabinet Mixture, affects human adipose MSC growth and viability in vitro. We found that exposure to all three mixtures resulted in toxicity. At high concentrations, >20 μM, PCBs are cytotoxic to MSCs. At low, sublethal concentrations, MSCs remain viable but display decreased proliferation and numerous morphological changes. Thus, PCBs negatively impact the adipose stem cell niche necessary for tissue expansion and turnover which could contribute to adipose dysfunction and metabolic syndromes.

16: Trichloroethylene Metabolite Impacts RNA Expression of Immune Processes in a Macrophage Cell Model: Implications for Pregnancy Outcomes
Annella Benjamin, University of Michigan
Trichloroethylene is a Superfund contaminant associated with adverse pregnancy outcomes. We previously showed that S-(1,2-dichlorovinyl)-L-cysteine (DCVC), a trichloroethylene metabolite, downregulates transcriptional immune pathways in a macrophage cell model (THP-1). Because macrophages function in immune regulation and tissue remodeling during pregnancy, DCVC could adversely affect pregnancy outcomes. In this study we sought to 1) identify potential transcription factors that regulated macrophage responses to DCVC and 2) identify DCVC impacts on genes and pathways directly relevant to critical macrophage functions (e.g. phagocytosis). Briefly, THP-1 cells were differentiated into macrophages, treated for 24 hours with 5 μM of DCVC followed by immune stimulation with lipopolysaccharide (LPS). RNA was collected from four conditions: control, DCVC (5 μM), LPS (100 ng/mL), and DCVC (5 μM) + LPS(100 ng/mL). Transcriptomic profiling was conducted using RNA sequencing. EnrichR was used for transcription factor enrichment analysis. Genes impacted by DCVC after immune activation with LPS were enriched for binding sites of the transcription factors EGR1, TRERF1, CEBPD, and VDR ($p<0.05$). Gene set enrichment analysis revealed that DCVC altered expression of genes in pathways corresponding to the steps of phagocytosis. Individual phagocytosis genes downregulated by DCVC included: TNF ($p<0.05$, fold change = -3.49), TLR7 ($p<0.05$, fold change = -4.42), SYT7 ($p<0.05$, fold change = -4.77), and SELE ($p<0.05$, fold change = -4.02). Our results suggest that DCVC impacts genes associated with transcriptional regulation of immune processes, potentially increasing maternal susceptibility to intrauterine infection and disrupting immune homeostasis during pregnancy.

17: Assessing Bone Marrow Specific Molecular Changes Linked to Alzheimer's Disease

Rebecca Beres, University of North Carolina-Chapel Hill

Alzheimer's disease (AD) is a progressive form of dementia linked to a variety of genetic and environmental factors. Recently, reduced bone mineral density was linked with AD, but in-depth molecular profiling has yet to be performed. Thus, in this study bone marrow from wild type (WT) mice was compared to transgenic 5XFAD heterozygous (HET) mice which overexpress the human amyloid precursor protein. To assess AD molecular changes in bone marrow, tibia and femur bone marrow were obtained from the WT and 5XFAD HET mice. Lipids were then extracted from the marrow and subsequently analyzed with a liquid chromatography, ion mobility spectrometry, and mass spectrometry (LC-IMS-MS) platform. An in-house lipid library was utilized for identifications and statistically significant lipids were evaluated using covariate and t-tests. To address phenotypic differences between WT and HET mice, the 375 lipids identified from the tibia marrow and 376 identified from the femur marrow were statistically compared. A 2-fold decrease in 4 unsaturated triglycerides and 3 fatty acids was observed in both the 5XFAD HET tibia and femur samples, while a 2-fold decrease in 3 phosphatidylethanolamines was observed in the 5XFAD HET femur. Femur and tibia bone marrow lipids from 5XFAD HET and WT mice were analyzed using LC-IMS-MS to determine lipidomic differences in AD. While almost all identified lipids were observed in both the tibia and femur marrow, less than 20 statistically significant lipids were found in the AD versus WT comparisons including 4 unsaturated triglycerides and 3 fatty acids for further investigation.

18: Developing novel ento-phyto-screening methods: Detecting carcinogenic environmental chemical contaminants using insect-induced plant galls

Sarah Black, Wayne State University

Plants can successfully detect and track the movement of subsurface chemical contaminants through a process known as 'phytoscreening.' However, due to their transient nature in the environment, volatile organic compounds (VOCs) may be difficult to reliably detect in plants, particularly at low concentrations. We propose that insect induced plant galls–three-dimensional tumor-like outgrowths induced by specific insect species and serve as sinks for extraordinarily high concentrations of nutrients–will accumulate chemical contaminants in higher concentrations than other aboveground plant tissues typically used in phytoscreening applications. To test this hypothesis, we compared the concentration of the chemical contaminant 1,4-dioxane, a semi-VOC and known human carcinogen that exists in a 32-km2 plume below Ann Arbor, Michigan, in three plant tissue types of grapevine (Vitus riparia): leaves, shoots and galls. Sampling of multiple replicates in each of the three tissue types at 18 sites across the plume revealed that dioxane was not detectable in shoots or leaves (with one exception), yet dioxane was detected in 27% of the galls. Interestingly, galls detected dioxane at two sites, one outside and one within the known plume, where the contaminant was absent from co-localized monitoring wells. The concentrations of dioxane within galls did not correlate with the concentration from co-localized wells, suggesting that other factors may influence the uptake of dioxane. Overall, our results imply that insect-induced plant galls, with further development, may serve as a reliable, low-cost tool for ento-phyto-screening belowground chemical contaminants, particularly at low concentrations.

19: Evaluating firefighter PAH dermal exposure and turnout gear efficacy with silicone passive sampling

Emily Bonner, Oregon State University

Firefighters face elevated rates of various cancers compared to the general population. One etiological concern is exposure to combustion byproducts, including polycyclic aromatic hydrocarbons (PAHs) during fires. Gaps in typical US fire service personal protective equipment (PPE) allow dermal chemical exposure to occur. In this study, co-located pairs of mannequins (n=8pairs) were dressed in a standard PPE ensemble, or an intervention ensemble with a one-piece liner hypothesized to reduce gaps and provide increased protection against dermal PAH exposure. Mannequins were loaded in a fireground exposure simulator (FES), using a couch as fuel, to emulate a residential fire. PAHs were sampled using silicone passive samplers underneath mannequins' PPE at the neck, chest, and wrist, plus in the air. To our knowledge, this is the shortest exposure of silicone passive samplers on the fireground (10-minutes; six minutes of combustion). Gas chromatography, tandem mass spectrometry was used to quantify 63 parent and alkylated PAHs in samples. 51 PAHs were detected, far exceeding the 16 priority PAHs typically quantified; nine of the detected PAHs have not previously been reported in fireground studies. Paired t-tests indicate that samples underneath the one-piece liner PPE had reduced sum PAH concentrations at the neck and chest. Additionally, 98% of mean worker protection factors for individual PAHs at the neck were greater for the one-piece liner PPE. The FES, coupled with silicone passive sampling allowed for an effective comparison of PPE protection against dermal PAH exposure and demonstrated the potential of a one-piece liner to reduce exposure.

20: A Model for Youth Community Science in Environmental Justice

Azariah Boyd, Harvard TH Chan School of Public Health

Background: Systematically marginalized communities are exposed to environmental metals disproportionately, yet have limited resources, partnerships, and scientific knowledge on adverse health effects. Community science for youth has served as a catalyst in education, prevention, pathways into STEM careers, health promotion, and trust building.

Methods: The IMPACT (Interested in Metals, Parental and Child Health) Community Science Program developed two curriculums geared towards high school aged youth and elementary to middle school aged youth. In collaboration with Bethel Math and Science Scholars Program and the Boston Nature Center (BNC)'s Environmental Leadership Teen Program, we demonstrated techniques used by environmental health scientists to measure metals in soil samples, research design using scientific methods, discussed remediation strategies of metals, exposed youth to careers in research, explored topics in environmental justice by youth activists, and described the health effects of metals exposures.
Results: We found that youth at BNC disagreed or strongly disagreed to knowing how metals are measured in the soil before camp, however, after camp, they agreed or strongly agreed. In addition, youth at the Bethel Math and Science Scholars Program had a better understanding of what environmental health is after completing the IMPACT program.
Impact Statement: This model aims to enhance environmental health literacy among youth regarding environmental metal exposures in soil.
Our program functions out of the MEMCARE (Metals and Metals Mixtures, Cognitive Aging, Remediation and Exposure Sources) Superfund Research Center based at the Harvard T.H. Chan School of Public Health within the Community Engagement Core.

21: Computational Approach for iron hydroxide sorbent design for predicting oxo-anion breakthrough for Arsenate and Vanadate

Emily Briese, Arizona State University

Oxo-anions present in drinking water sources, which are harmful to human health, can be removed via adsorption. When structurally similar oxo-anions (i.e., as Arsenic (As(V)) and Vanadate (V(V))) are present in water, they compete for binding sites and mass transfer processes during adsorption. Understanding these competing processes is crucial for designing selective adsorbents in mixtures. By conducting Surface Complexation with Pore Surface Diffusion Modeling, the aim is to gain theoretical data that could inform future designs to maximize oxo-anion removal for two commercially available sorbents, E33 (Iron Bayoxide) and GFH (Granular Ferric Hydroxide). Using unmodified and theoretically modified sorbents, this work aims to model breakthrough curves (BTC) and surface complexation models (SCM) of the adsorption of As(V) in the presence of V(V) in a realistic water matrix, at pH=8.3. It was observed that for the sorption of single-solute As(V) onto E33, when increasing the Surface Site Density (SSD) of adsorbent sites by a magnitude of 1.5, reaching 50% of the breakthrough curve (BTC50%) was delayed 42%, and when Surface Area (SA) was increased by a magnitude of 1.5, reaching BTC50% was delayed 79% of the baseline. After introducing V(V) into the simulation, increasing SSD delayed BTC by 60%, and increasing SA delayed BTC50% by 71% of the baseline, indicating these are both desirable properties to exploit when designing novel adsorbents. This work provides a computational methodology that can provide insight on important adsorbent design properties to treat a variety of water chemistries for mixtures of oxo-anions.

22: Toxic and essential metal mixtures associated with gestational age in the Extremely Low Gestational Age Newborn (ELGAN) cohort

Eric Brown, University of North Carolina-Chapel Hill

Prenatal exposure to individual toxic metals has been associated with adverse neonatal outcomes, specifically reduced gestational age. Few studies have investigated whether such outcomes are associated with metal mixtures. This study evaluated the associations between umbilical metal concentrations and gestational age. Data were collected from 294 children from the Extremely Low Gestational Age Newborns (ELGAN) cohort. Umbilical cords were collected and analyzed for 11 metals: Arsenic (As), Manganese (Mn), Cadmium (Cd), Lead (Pb), Mercury (Hg), Copper (Cu), Antimony (Sb), Strontium (Sr), Selenium (See), Barium (Ba), and Zinc (Zn). Metal co-exposures were modeled within

three groups: total measured metals, toxic metals, and essential metals. These groups were also analyzed within a mixture's context utilizing quantile g-based computation. Covariates included in the analysis were maternal education, insurance status, maternal age, maternal BMI, and maternal smoking status. In co-adjustment analysis, cord levels of Sr and Se were associated with a reduction of 2.257 and 6.94 days in gestational age respectively. In the metal mixtures analysis, the total metal mixture was significantly associated with a reduction in gestational age. Four metals within the group (Pb, Sb, Cu, and As) were associated with increased gestational age (mean difference: 1.85 days), while the remaining six metals were associated with a 4.61 gestational day reduction. These finding support the concept that exposure to metals in a mixture's context are associated with decreased gestational age, highlighting the need for increased exposure monitoring programs for pregnant women.

23: Atmospheric Measurements of Volatile Methyl Siloxanes in New York City
Christopher Brunet, University of Iowa
Background: Volatile methyl siloxanes (VMS) are a class of chemical compounds ubiquitous in personal care products which are readily released into the air when consumers use them. Due to these large emissions as well as the fact that VMS have long atmospheric lifetimes and no natural sources, VMS have been suggested as chemical markers of urban airmasses. In addition, concerns have been raised over the intensive use VMS in consumer products due to the resulting high concentrations in populated areas, the potential human health impacts of VMS, and the ability for these compounds to form secondary organic aerosols.
Methods: We conducted a one-month field campaign in New York City. High resolution measurements of multiple VMS congeners were collected using a low volume air sampling system and analyzed via GCMS to determine the outdoor air concentrations of these compounds.
Results: Measured concentrations of VMS will be compared and contrasted with previous measurements from other large, highly populated cities In addition, we will shared our initial findings on temporal changes in VMS concentrations and our hypothesis about how meteorological conditions and the timing of emissions explain these changes.
Impact Statement: This work will improve our understanding of the factors which govern atmospheric concentrations of VMS compounds. Understanding these factors will allow the broader scientific community to better model the behavior of these compounds in urban settings to assess their potential health impacts and their viability as atmospheric tracers of urban emissions.

24: Arsenic Uptake by Fungi Isolates from the Jackpile Mine on the Laguna Pueblo, NM
Taylor Busch, University of New Mexico
The Laguna Pueblo, NM depends on surface and groundwater sources that are susceptible to mobilized arsenic (As) and uranium (U) from natural deposits and mining legacy. The Rio Paguate flows through the Paguate Village of Laguna Pueblo and just south of the nearby Jackpile Mine. The Jackpile Mine was one of the largest open pit U mines in the world operating between 1953 to 1982, and remediation efforts to cover the mine with topsoil and overburden have been insufficient in the arid climate. The measured As and U concentrations in Rio Paguate exceed the EPA MCL of 10 µg/L As and 30 µg/L U. Fungal taxa have been isolated from plant roots on Laguna Pueblo. The objective of this project is to determine the uptake of As by a diverse set of endophytic fungi isolated from blue grama grass (Boutelloua gracilis) on the Jackpile Mine at the Laguna Pueblo and evaluate their potential use for bioremediation. The experiments of this study include: 1) growing fungi isolates in liquid culture, 2) conducting a chemical control experiment to ensure no removal of As from solution by the nutrient solution, and 3) exposing fungi to As in nutrient solution. The initial phase of this investigation integrates biological culturing methods with spectrophotometry, inductively couple plasma (ICP-OES and ICP-MS), and electron microscopy. The results of this research will evaluate bioremediation catalyzed by fungi for

the development of risk reduction methods for As and metals mixtures exposure relevant to tribal communities impacted by mining legacy.

25: Assessing Future Flood Risk Reduction through Combining Digital Twin Models with Landscape Performance and Urban Analytics

Zhenhang Cai, Texas A&M University

Galveston Island, TX has a long history of being vulnerable to the hurricanes due to its flat topography and coastal adjacency. Due to the impacts of Hurricane Ike, a coastal spine paralleling the island known as "the Ike Dike" has been proposed to increase inland protection1. Before completing the Ike Dike within Galveston Bay, the City of Galveston must elevate the existing coastal roadway nearly 17ft above sea level2 while using the Galveston Seawall to also help protect the southeastern inland from storm surge. In this project, we evaluate the performance of Galveston's existing Seawall in responding to four sea level rise scenarios (slow, medium, fast and extreme) by 2200 through the use of 3D urban analytics modeling and digital twin development(Kostelnick et al., 2013). Through this, we also examine how storm surge and flooding affect Galveston regarding socioeconomic differences. Lastly, we combine digital wind modeling with landscape performance and urban analytics models to examine the effectiveness of the proposed Ike Dike in protecting the Galveston Island through 10-year, 100-year, and 500-year storm surges as well as another Hurricane Ike scenario.

26: 2,3,7,8-Tetrachlorodibenzo-p-dioxin inhibits hepatic acetyl-CoA metabolism despite AMPK activation

Giovan Cholico, Michigan State University

The aryl hydrocarbon receptor (AhR) is a ligand-activated transcription factor most prominently known for mediating the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and related compounds. TCDD is a persistent environmental contaminant that disrupts metabolic activities and can promote non-alcoholic fatty liver disease (NAFLD), a spectrum of disorders ranging from simple steatosis to non-alcoholic steatohepatitis (NASH) with fibrosis. Acetyl-CoA is a central metabolite in multiple metabolic pathways dysregulated by TCDD. In the present study, mice were orally gavaged with sesame oil vehicle or 0.01 - 30 μg/kg body weight TCDD every 4 days for 28 days to test the hypothesis that TCDD disrupts hepatic acetyl-CoA availability and utilization, consistent with the progression of NAFLD-like pathologies. Targeted metabolomic analysis revealed a dose-dependent decrease in hepatic acetyl-CoA levels. TCDD induced Pdk4, a kinase that inactivates the pyruvate dehydrogenase (PDH) complex, thereby reducing pyruvate metabolism to acetyl-CoA. Capillary electrophoresis confirmed an increase in phosphorylated PDH, and a decrease in ATP citrate synthase, the enzyme responsible for cytosolic acetyl-CoA synthesis from citrate. Consistent with depletion of acetyl-CoA levels, a surrogate for overall energy status, AMPK phosphorylation was induced in a dose-dependent manner. Collectively, the integration of metabolomics and transcriptomics data indicate TCDD repressed pathways responsible for acetyl-CoA and β-hydroxybutyrate production inducing a nutrient starvation-like phenotype in the liver despite normal food intake levels. Results from this study demonstrate the widespread impact TCDD has on promoting the progression of NAFLD-like phenotypes. GNC and RRF were supported by T32ES007255. This project is funded by R01ES029541 and the SRP P42ES004911.

27: Modeling PAH mixture interactions in a human in vitro 3D respiratory culture system

Victoria Colvin, Oregon State University

One of the most significant challenges in environmental human health assessment is to evaluate hazards from exposure to environmental chemical mixtures. Polycyclic aromatic hydrocarbons (PAHs) are a class of ubiquitous contaminants typically found as mixtures in gaseous and particulate phases in ambient air pollution associated with petrochemicals from Superfund sites and burning of fossil fuels. However,

little is understood about how PAHs in mixtures interact to contribute to toxicity in lung cells. To investigate mixture interactions from environmentally relevant PAHs, a synthetic mixture was created from seven PAHs identified in passive air samplers at a legacy creosote site during wildfires. Primary human bronchial epithelial cells differentiated at the air liquid interface were treated with PAHs in mixtures at environmentally relevant proportions at total concentrations ranging ~5 to 120 uM. In addition, cells were treated with each PAH individually across concentrations matching those in the mixture. Mixture interactions were investigated by comparing biomarkers of oxidative stress, xenobiotic metabolism and tight-junction integrity utilizing quantitative PCR. Transcript profiles were quantified across dose for calculation of EC50's and evaluated for additivity in the mixture. Concentration addition, generalized concentration addition, and independent action models were used to evaluate and characterize the interactions of PAHs in the synthetic mixtures. Preliminary analysis has found that not all PAHs contribute to an interaction effect in mixtures and that chemical interactions can be endpoint specific. Overall, the results from these studies can contribute to predictive approaches and risk assessments for PAH toxicity associated with complex environmental exposures.

28: Evaluating developmental effects of low-level benzene exposure in zebrafish (danio rerio)
Mackenzie Connell, University of Florida
Urban environments are afflicted by anthropogenic volatile organic compounds (VOCs), such as mixtures of benzene, toluene, ethylene, and xylene (BTEX). Sources of BTEX that drive human exposure include vehicle exhaust, industrial emissions, and oil spillage and leakage. Benzene, the most volatile compound of the BTEX mixture, has been linked to adverse health outcomes. However, few studies have focused on the immediate and long-term effects of low-level benzene exposure during early development. Early development is a susceptible window in which hematological, immune, metabolic, reproductive, endocrine, and detoxification systems are immature. In this study, we used the zebrafish model to conduct controlled VOC exposures and evaluated phenotypic and transcriptomic responses following 0.1 and 1 ppm benzene exposure during the first five days of embryogenesis (n = 740/treatment). We also evaluated the long-term behavioral, reproductive, and transcriptomic responses to this low-level benzene exposure. Key genes including pik3c2b, pltp, and chia.2 were differentially expressed in both 1 and 0.1 ppm exposures at the larval timepoint. However, fewer transcriptomic changes were induced by 0.1 ppm compared with 1 ppm. Transcriptomic responses during embryogenesis have potential long-term consequences at levels equal to or lower than 1 ppm, therefore, these results warranted transcriptomic analysis of the developmentally exposed adult zebrafish. In adults, we have evaluated mortality, fertility, and gene expression changes. Because molecular pathways are highly conserved between zebrafish and mammals, adult zebrafish behavioral, transcriptomic, and reproductive results are important endpoints for providing insight into the long term-effects of VOCs on public and human health.

29: How Do Per- And Polyfluoroalkyl Substances (PFAS) Affect Macrophage Phagocytosis?
Ashley Connors, NC State University
Immune function can be impaired by environmental contaminants. One class of chemicals recently shown to interfere with the innate immune system is per- and polyfluoroalkyl substances (PFAS). We are evaluating how macrophages are affected by a 2-day (in vitro) or 4-day (in vivo) exposure to ten PFASs: perfluorobutanesulfonic acid (PFBS), perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic acid (PFOS), perfluorohexanoic acid (PFHxA), Perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA), Nafion Byproduct 2, perfluoro-2-methoxyacetic acid (PFMOAA), and hexafluoropropylene oxide dimer acid (HFPO-DA or GenX). In single-PFAS cytotoxicity studies with macrophage-like THP-1 cells, exposure to 320 µM PFDA, PFNA, PFOS, and Nafion Byproduct 2 significantly reduced viability. We found no changes in cell viability at or below exposures to 80 µM

PFAS. We are currently investigating how phagocytosis is affected during PFAS exposures: macrophage populations derived from larval zebrafish (Danio rerio) and THP-1 cells will be challenged with fluorescent heat-killed E. coli. Phagocytic index and number will be measured with flow cytometry. For this presentation, we will discuss the in vitro effects of PFAS on phagocytosis. Based on these results and parallel studies in larval zebrafish, we will select 2-3 specific PFASs for studies to elucidate currently unknown molecular mechanisms of PFAS immunotoxicity. Understanding how PFASs affect innate immunity will help us better understand how PFAS exposure can alter an organism's ability to recognize and destroy pathogens in its environment, as well as infected or transformed cells.
This research is supported by NIH grant P42-ES031009.

30: Towards a Comprehensive Model for Predicting Toxic Equivalents (TEQ) Reduction in Response to Biotic and Abiotic Interventions at Polychlorinated Dibenzo-p-Dioxin and Dibenzofurans (PCDD/Fs)-Contaminated Sites

Tafazul Islam Dar, Michigan State University

Remediation-focused predictive tools related to polychlorinated dibenzo-p-dioxin and dibenzofurans (PCDD/Fs) have generally relied on transformation models to evaluate reduction in total contaminant load, toxic equivalents (TEQs), health risks, models for congener specificity and preferred pathways, geospatial 1-D and 2-D models incorporating flow, adsorption, and other field associated parameters. However, comprehensive predictive models integrating many of these aspects are limited. We developed a PCDD/Fs transformation model consisting of 11 microbial guilds including Dehalococcoides, 256 transformation reactions for all 75 congeners of PCDD, and 421 transformation reactions for all the 135 congeners of PCDF. In addition, two sub-models - one reflecting the dynamics of vitamin B12 (one of many cobalamins) and the other representing the adsorption of vitamin B12 and PCDD/Fs to activated carbon and its bioavailability to Dehalococcoids mccartyi strains DCMB5 and CBDB1 were developed and integrated. Vitamin B12 is a cofactor present at the active site of the reductive dehalogenase (RdhA) enzyme of organohalide respiring bacteria (OHRB) and serves as the action centre for microbial respiration of PCDD/Fs. Rates were extracted from previously reported PCDD/Fs studies and, if appropriate, were used to calibrate the model. The integrated model was used to predict the reduction in TEQ if the PCDD/Fs congeners present at the Tittabawassee River/ Saginaw River and Passaic River sites were to be transformed over time. A sensitivity analysis was performed to assess the associated uncertainties in predicting TEQ. Future work will extend the model to include congener and site specificity, geo-spatial visualizations, and cost estimates.

31: Contamination of environmental samples from Birmingham urban area measured using Laser Induced Breakdown Spectroscopy

Deblina Das, University of Alabama-Birmingham

Historical and ongoing air, water, and soil pollution in North Birmingham with mixtures of heavy metals (HM) and other toxic compounds from open quarries, steel mills, coal-fired power plants, and coke furnaces remain a problem. Inhalation of HM (such as Cd, Pb, Mn) carried on dust causes Chronic Obstructive Pulmonary Disease (COPD), ranked as the third leading cause of death in the USA. Laser Induced Breakdown Spectroscopy (LIBS) is a rapid, real-time analytical technique based on the analysis of the spectral emission from laser-induced plasmas. The method enables fast chemical analysis of any matter (solid, liquid, or gas) without sample preparation. Detection limits for LIBS using nanosecond laser pulses are typically in ppm for HM elements. For applications where sub-ppm-ppb HM limit of detection is required, a combination of LIBS with laser-excited atomic fluorescence spectroscopy (LEAFS) enables superior sensitivity (sub-ppt). The current paper report on the development and calibration of the LIBS system using environmental samples, including a) soil samples collected from three urban sites and b) plant materials collected from several sites. An experimental setup was designed by using a

Nd:YAG laser operating at 1064 nm (up to 100 mJ per pulse at 20 Hz rep rate) and an Echelle spectrometer with an ICCD detector. The limit of detection of Pb concentration in environmental samples was measured at <100 ppm level. The increased level of Pb and Mn contamination was measured in the North Birmingham industrial area. We will also discuss the integration of the LIBS with LEAFS.

32: The Politics of Baselining in the Grants Uranium Mining District of Northwestern New Mexico
Thomas De Pree, University of New Mexico Health Sciences Center
Background: During the second half of the twentieth century, the Grants uranium mining district of northwestern New Mexico provided almost half of the total uranium ore accumulated by the United States federal government for the production of nuclear weapons, in addition to becoming a national source for commercial nuclear energy. What was once referred to as "The Uranium Capital of the World" now encompasses hundreds of abandoned uranium mines and seven massive uranium mill tailings piles, which are now associated with airborne and soil contamination as well as groundwater plumes of uranium and other contaminants of concern.
Methods: This presentation is based on an ethnographic study of the diverse forms of expertise involved in monitoring and managing the mine waste and mill tailings. Drawing from over two years of ethnographic research, I describe the relationship between different stakeholders from local communities, government agencies, and transnational mining corporations as they deliberate about the possibility of cleaning up the former mining district.
Results: The possibility of cleaning up the Grants district hinges on the "politics of baselining"—a concept I introduce to account for the relationship between different stakeholders and their competing environmental models and hydro-geological theories; each accounts for a different geological past prior to mining that can be deemed "natural," as the background against which to measure the anthropogenic impacts from mining.
Impact Statement: This presentation will scrutinize the policy of alternative concentration limits (ACLs) that makes possible federal, state, and tribal environmental remediation practices that are contested by impacted communities.

33: Clays Play a Catalytic Role in Pyrolytic Treatment of Crude-Oil Contaminated Soils That Is Enhanced by Ion-Exchanged Transition Metals
Sara Denison, Rice University
Pyrolytic treatment of crude-oil contaminated soils offers great potential for rapid remediation without destroying soil fertility with lower energy requirements than incineration. In our recent research at Rice, we show that clays impregnated with non-toxic transition metals (iron or copper) can be used as an amendment to decrease the required pyrolytic treatment temperature and time. Amending a weathered crude-oil contaminated soil with 10% (by weight) of bentonite modified via ion-exchange with Fe or Cu, achieved 99% removal of residual total petroleum hydrocarbons (TPH) at a pyrolysis temperature of 370°C with 15-min contact time. Pyrolytic treatment of amended soils at the unprecedentedly low pyrolysis temperature of 300°C resulted in 87% TPH removal efficiency with Cu-bentonite and 93% with Fe-bentonite. We postulate that the transition metals catalyzed the pyrolysis reactions at lower onset temperatures. This hypothesis is supported by thermogravimetric analysis coupled with mass spectrometry, which revealed the release of hydrogen, methyl and propyl ion fragments (markers of pyrolytic degradation products of crude oil) at lower temperatures than those observed for unamended soil. Overall, this work shows proof of concept that metal-impregnated clays can enhance rapid pyro-catalytic treatment of crude-oil contaminated soils and encourages further work to understand the detailed reaction mechanisms and inform process design.

34: Biofilm Enrichment and Encapsulation on Black Carbon to Biodegrade Lower Chlorinated PCBs
Qin Dong, University of Iowa
Polychlorinated biphenyls (PCBs) as legacy pollutants cause adverse impacts on ecosystems and human health. They can be released from contaminated sediment to water column and bioaccumulate in the aquatic food chain, and lower chlorinated PCBs (LC-PCBs) are susceptible to volatilization causing direct human exposure. We aim to develop novel biofilm-enriched black carbon (BC) for delivering microbial

biofilms to sediment and prolonging the bioactivity with encapsulation. Our approach is to develop aerobic PCB-degrading biofilms on BC and encapsulate biofilms with high mechanical strength porous matrix to extend bioactivity after bioaugmentation into sediment. The aerobic PCB-degrader Paraburkholderia xenovorans LB400 formed significantly more biofilms ($p<0.05$), as quantified by qPCR analysis of biphenyl dioxygenase functional gene (bphA) abundance and live/dead cells ratio based on biofilm imagery, on corn biochar than other BCs presumably due to its lower sorption capacity and/or surface structure. We also confirmed that LB400 biofilms were viable and active through microscopic visualization and monitoring benzoate degradation. Furthermore, our results suggested that pre-soaking sorptive BCs with benzoate could significantly enhance biofilm formation ($p<0.01$). We predict that encapsulation will protect LB400 biofilms from leaving the BC surface and allow LC-PCBs to freely transfer, extending microbial activity and PCB biodegradation; we are developing and testing encapsulation approaches. This research is an innovative approach that combines chemical encapsulation with biofilms and BC for applications involving LC-PCB remediation in sediment. Overall, our work suggests that biofilm-enriched black carbon will improve LC-PCB removal in sediment and concomitantly lower the risk of human exposure to airborne PCBs.

35: PFOS exposure upregulates CD36 in spleen-derived T cells.
Jerika Durham, University of Kentucky
Perfluorooctane sulfonate (PFOS, an 8-carbon PFAS) is one of the environmental pollutants detected with high frequency and concentration in human and environmental samples. Research suggests that PFOS can induce immunotoxicity in the spleen and alter responses of both the adaptive and innate immune systems. While PFOS are considered immune hazards to humans, the mechanism(s) by which these PFOS induce immunotoxicity remain elusive. Our previous study demonstrated that exposure to PFOS upregulated hepatic CD36 gene expression and induced disturbances in hepatic lipid metabolism in mice. The scavenger receptor CD36 is a central metabolic modulator of T cell metabolism in immune responses. In the present study, the role of a CD36-lipid metabolism axis during PFOS exposure in inducing immunotoxicity was investigated in in vitro and in vivo settings. Splenic T cells separated from C57BL/6 mice were treated with PFOS, and lipidomic analysis will be performed to define CD36-lipid peroxidation pathways perturbed by PFOS exposure. C57/BL6 mice were exposed to PFOS for 7 weeks, and transcription level of CD36 was determined by RT-qPCR. It was found that PFOS exposure upregulated the CD36 gene in mice spleen and CD4+ T cells. The contribution of CD36 to altered lipid metabolism resulting from PFOS exposure is under investigation. (Supported in part by NIEHS/NIH grant P42ES007380 and by UK-CARES grant P30ES026529).

36: The association between urinary polycyclic aromatic hydrocarbons and preterm birth among pregnant women in PROTECT
Jarrod Eaton, University of Michigan
Previous research has shown that ambient polycyclic aromatic hydrocarbons (PAH) concentrations are associated with adverse pregnancy outcomes such as fetal growth restriction. The association between PAH and preterm birth remains poorly understood, and limited studies have used biomarkers to assess PAH exposure.
PAH metabolites were measured in urine samples from 344 participants collected over multiple study visits from pregnant women in the Puerto Rico PROTECT birth cohort. Following delivery, detailed information on pregnancy complications was recorded. Multiple logistic regression was used to determine associations between individual PAH metabolites and preterm birth when adjusting for important covariates.
Urinary concentrations of 1-Hydroxypyrene (1-OH-PYR) were associated with a significantly increased odds of preterm birth (OR = 1.98, CI - 1.37-2.60). Urinary concentrations for all other PAH metabolites

were not statistically significant, although effect estimates followed a positive trend (1-OH-NAP: OR = 1.09, CI = 0.76-1.43 | 1-OH-PHE: OR = 1.57, CI = 0.92-2.22 | 2-3-OH-PHE: OR = 1.62, CI = 0.91-2.33 | 2-OH-FLU: OR = 1.35, CI = 0.74-1.96 | 2-OH-NAP: OR = 1.33, CI = 0.88-1.79 | 4-OH-PHE: OR = 1.42, CI = 0.84-2.02 | 9-OH-PHE: OR = 1.24, CI = 0.82-1.66).
1-OH-PYR was associated with significantly increased odds of preterm birth while the remaining PAH metabolites followed similar positive trends. Future analyses with additional data from the PROTECT birth cohort will aim to assess associations between the overall PAH mixture and preterm birth among a larger sample size, as well as the potential for interactions among PAH.

37: Flow-through Three-dimensional Activated Carbon Cathode with Regeneration Capabilities for Electrochemical Water Remediation

Muhammad Fahad Ehsan, Northeastern University

In-situ electrochemical generation of hydrogen peroxide (H2O2) and its catalytic decomposition to produce reactive oxygen species (ROS) e.g., hydroxyl radicals (•OH), for degradation of persistent organic pollutants is critical for the development of effective water treatment technology. Here, we propose a novel three-dimensional (3D) electrochemical flow-through reactor employing activated carbon (AC) encased in a stainless-steel (SS) mesh as a cathode for degradation of a model recalcitrant contaminant p-nitrophenol (PNP), a highly toxic compound that can accumulate and lead to adverse environmental health outcomes. As a stable 3D electrode, granular AC supported by a SS mesh frame as a cathode is hypothesized to (1) electrogenerate H2O2via a 2-electron oxygen reduction reaction (ORR) on the AC surface, (2) initiate decomposition of this electrogenerated H2O2 to form •OH on catalytic sites of the AC surface (3) remove PNP molecules from the waste stream via adsorption, and (4) co-locate the PNP contaminant on the carbon surface to allow for oxidation by formed •OH. Additionally, this design is utilized to electrochemically regenerate the AC within the cathode that is significantly saturated with PNP to allow for environmentally friendly and economic reuse of this material. Under flow conditions with optimized parameters, the 3D AC electrode is nearly 20% more effective than traditional adsorption in removing PNP. 30 g of AC within the 3D electrode can remove 100% of the PNP compound and 92% of TOC under flow. It is anticipated that this platform holds great promises to eliminate analogous contaminants as well as mixtures.

38: Point-of-Use electrochemical nanobodies-based sensor for sensitive monitoring of pyrethroids in water

Ahmed El-Moghazy, University of California-Davis

3-Phenoxybenzoic acid (3-PBA) is the common metabolite of different pyrethroid insecticides and can be used as an indicator for these pesticides. An ultrasensitive nanobody-based electrochemical immunoassay system was designed by immobilization of 3-PBA-bovine serum albumin conjugate onto citric acid decorated nylon nanofibrous membrane modified screen-printed carbon electrode (SPCE). The 3-PBA detection was via a direct competition between free 3-PBA in the sample and immobilized antigen for binding to 3-PBA nanobody-alkaline phosphatase. The employment of the nylon nanofibrous membranes in the immunosensor assembling exhibited an improvement in electrochemical performance of the electrode by more than 5 times compared with nylon casted membranes. Integrating the nanofiber, nanobody, and electrochemical technologies introduced a highly sensitive and selective immunosensor for 3-PBA detection in a range of 0.8 to 1000 pg mL-1, with a detection limit of 0.64 pg mL-1. Furthermore, the established immunosensor showed good feasibility as a promising alternative to conventional monitoring of pyrethroid insecticides without any pretreatment, with good specificity, reusability, and stability over time.

39: Behavioral effects of chronic PFAS exposure in zebrafish
Matthew R. Farrell, NC State University
Per- and polyfluoroalkyl substances (PFAS) are ubiquitous environmental contaminants used in manufacturing and numerous consumer products. These chemicals are notable for their stability, leading to persistence in the environment and within organisms. PFAS have been connected to a number of health effects in animal models, including impaired neurodevelopment and behavioral alteration. This study aims to determine if chronic PFAS exposure at environmentally relevant concentrations can induce behavioral phenotypes in adult zebrafish. Zebrafish were aqueously exposed to individual and triplicate mixtures of 45-250 ng/L perfluorooctanoic acid (PFOA), 45-250 ng/L perfluorooctane sulfonic acid (PFOS) and 10-125 ng/L perfluorohexane sulfonic acid (PFHxS) for 8 months, beginning 3 hours post-fertilization. Exposure concentrations were selected by averaging water samples collected from the Cape Fear river basin. Adult zebrafish are tested for altered anxiety-like behavior and altered swimming behavior following chronic PFAS exposure. Anxiety-like behavior is assessed using a 5-minute novel tank assay performed with NOLDUS video recording and analysis software. Swimming performance is being evaluated by allowing fish to swim until exhaustion in a Loligo swim tunnel. The results of this study will improve understanding of the behavioral effects of chronic PFAS exposure at environmental levels.

40: Human Health Risk Assessment of Heavy Metals in Residential Soil—Houston, Texas
Leanne Fawkes, Texas A&M University
Human health risk assessment, geospatial analysis, and environmental epidemiology are research methods that are commonly used to characterize contaminant concentrations, distributions of heavy metals and metalloids (HMM), and human health exposures in residential soils. Participatory-based research was used to promote inclusion of all partners studying exposures. Soil samples were collected using a complete canvassing method within the Greater Fifth Ward neighborhood in northeast Houston from July to November 2021. The concentrations of heavy metals (As, Ba, Cd, Cr, Pb, Se, Ag, Hg) in 200 soils from residential sites were measured using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Individual heavy metals as well as cumulative cancer and non-cancer risks were calculated for children and adults using the U.S. EPA Regional Soil Screening Levels and benchmarks for specific land uses, such as crop growing. Geospatial analytics allowed for visualization of individual and cumulative risks, clustering of heavy metal concentrations, and related land use within the study boundary. Results suggested clustering of heavy metal contaminants within one geographic area of the Greater Fifth Ward neighborhood. Soils from most sites had low or typical background levels expected in urban areas. However, soil samples from several locations had significantly high (>1,200 ppm) lead levels that warrant additional investigation. Findings from this study highlight the need to determine baseline concentrations and distribution of heavy metals in underserved environmental justice neighborhoods both for characterizing current risks as well as for establishing reference levels for future comparisons.

41: Long-term monitoring of micropollutants and mixture toxicity effect in drinking water in Puerto Rico
Yinmei Feng, Cornell University
Micropollutants in drinking water have raised both environmental and human health concerns, which has especially been impacted by both historical and active Superfund sites in Puerto Rico (PR). Previous water quality surveys often focused on individual group of chemicals but ignored the complexity of chemical mixtures in drinking water. As part of our NIEHS national PROTECT (Puerto Rico Testsite for Exploring Contamination Threats) study, we collected nearly 100 drinking water samples from July 2017 to August 2019 in the northern region of PR. High-performance liquid chromatography, coupled with

high-resolution mass spectrometry, identified 173 target organic micropollutants. A quantitative toxicogenomics assay using GFP-fused reporters was employed to detect and quantify the mixture toxicity of the drinking water samples. 106 of 173 micropollutants were identified in at least one drinking water sample, belonging to categories of pesticides, industrial materials, pharmaceuticals, personal care products, and hormones. Temporal evaluation prior to and after Hurricane Maria revealed that Diethyl_phthalate, DEET, adenosine, and coumarin changed at nearly all locations. Summation of micropollutant concentration in all categories showed increasing trends after hurricane, with slow decrease over time. Within PROTECT, the premature birth outcome, survey of personal use of various chemicals and social-economic parameters, were collected from participants in PROTECT cohort. A molecular epidemiology study was also performed by the center team. All these data are evaluated in parallel using advanced data analytics to identify potential relationships among molecular toxicity quantifiers, organic micropollutant concentrations, and health outcomes.

42: Sentence Transformer-guided Harmonization of Environmental Health Data
Zlatan Feric, Northeastern University
Background: The initial steps of sorting and comparing language across disparate data sources is a challenging task due to differences in variable definitions and the lack of available tools to identify textual and semantic similarity between variable label pairs. Data harmonization is one such example, where similar entities collected across different studies need to be identified and analyzed.
Methods: We apply several text encoding approaches to convert textual labels and variable choices from REDCap to real-valued vectors. The first method is a classical approach known as term frequency (TF), which will serve as our baseline method. We also use four transformer-based models for encoding: i) Universal Encoder, ii) BERT, iii) S-BERT, and iv) GPT-3. We fine-tune the BERT model on the text in each dictionary in masked language modeling. We use cosine similarity to identify the most relevant pairs. We use recall and precision to evaluate our approach against a human-harmonized dataset.
Results: When considering the top-50 matches, we observe that the highest recall is observed for S-BERT at 88.46%, and this is followed by using the Universal Encoder at 76.92%. The third-highest recall is achieved by TF at 74.04\%. The fourth highest recall is achieved by fine-tuned BERT model (BERT-ft) at 70.19% and the fifth highest recall is achieved by GPT-3 at 68.27%. The untuned BERT model consistently provides the lowest recall at 66.35% across all top recommendation thresholds.
Impact Statement: We believe that NLP and ML methods can automate a significant amount of harmonization tasks.

43: Algorithm-assisted quantification of zebrafish neutrophils for high-throughput identification of immunotoxic compounds
Giuliano Ferrero, NC State University
In vertebrates, neutrophils represent the most abundant cells of the innate immune system and serve as a front-line defense against infectious pathogens. Several drug treatments and pathologies have been associated with alterations in neutrophil counts, entailing adverse effects on the organism. It is therefore paramount to fill in data gaps regarding the effects of environmentally relevant chemicals on neutrophil development. Here, we present a novel method for the high-throughput imaging and quantification of neutrophils in zebrafish, which has emerged as a prominent model to study innate immunity. Three days-old zebrafish larvae expressing the neutrophil-specific lyz:EGFP transgene were distributed into a 96-well plate and imaged simultaneously using the high-resolution Multi-Camera Array Microscope (MCAM). After selecting images based on the orientation of the larvae, neutrophils were quantified manually and via a machine learning-based algorithm for segmentation and cell counting. Transient knockdown of csf3r, a gene required for neutrophil development, was induced via morpholino injection in a subset of lyz:EGFP embryos to test the accuracy of the algorithm in capturing a decrease in

neutrophil counts. Our results show a good correlation between manual and algorithm-based neutrophil counts and suggest that the two approaches are equally accurate in discriminating wild-type embryos from csf3r knockdown siblings. The next step of the project will consist of scaling up this approach to count neutrophils in zebrafish embryos exposed to an array of per- and polyfluoroalkyl substances (PFASs), a class of highly persistent compounds whose effects on the innate immune system remain hitherto poorly characterized.

44: Semi-Automated Optimization of Feature Weights for the Toxicological Prioritization Index (ToxPi)
Jonathon Fleming, NC State University
Background: The Toxicological Prioritization Index (ToxPi) is a framework for aggregating high-dimensional feature data into summary scores that provide rank-ordered prioritization of samples. Generally, features are any collection of descriptors gathered on a set of samples, such as chemical characteristics or census tract-level information. Related features are aggregated into "slices". The relative importance of the slice in the overall ToxPi model must be provided as a user-supplied weighting that impacts resulting sample ranks. To date, no automated guidance for setting slice weights has been provided. Further, typical exploratory applications lack prior hypotheses about the specific rank of samples. We address this problem by introducing agnostic, data-driven guidance for optimization of slice weights based upon relative priority tiers (e.g. high, medium, and low) known only for a subset of samples.
Methods: We propose a two-step method that first uses ordinal regression to predict starting slice weights considering only known data, and secondly fine-tunes the weights by incorporating unknown data via a custom genetic algorithm (GA). Simulated data sets up to 10,000 samples and 15 slices were generated for scenarios specifying known priority tiers for 5% to 20% of samples.
Results: We show that our two-step method produces weights that can accurately bin samples into appropriate priority tiers across scenarios, with an increase in performance over ordinal regression results alone.
Impact Statement: Building integrated models using predicted feature weights often involves partial outcome knowledge. Our method allows for feature weight prediction in situations where prior rank knowledge is small and non-specific.

45: New Approach Methods to Evaluate Human Susceptibility of Emerging Contaminants: A Study of 56 PFAS
Lucie C. Ford, Texas A&M University
Per- and polyfluoroalkyl substances (PFAS) are emerging contaminants of concern because of their wide use and persistence. Some PFAS have known hazardous properties and have been detected in most environmental and human samples. Recently, select PFAS have been designated as hazardous substances under Superfund legislation; still, thousands of these compounds lack hazard data. Structure-activity relationship modeling identified cardiotoxicity as a potential health concern for these substances; however, there are no data to validate these in-silico predictions. Human-induced pluripotent stem cell-derived (iPSC) cardiomyocytes have become a widely used new approach method (NAM) to test for cardiotoxicity hazard and risk, as well as used to address human variability in susceptibility. The primary objective of this study was to characterize potential human cardiotoxic hazard, risk and inter-individual variability in responses to PFAS from different representative subclasses. A total of 56 PFAS were tested in concentration-response using human iPSC-derived cardiomyocytes from 16 donors. Kinetic calcium flux and high-content imaging were used to evaluate biologically relevant phenotypes such as beat frequency, ion channel repolarization and cytotoxicity. Of the PFAS tested, 11 had concentration-response effects, as shown by the effects on beat frequency or membrane repolarization. Inter-individual variability in the effects was observed indicating that this

model system can be used to characterize susceptibility. These results provide scientific underpinnings to identify potentially hazardous PFAS and to support possible chemical structure-based grouping of PFAS. This study demonstrates the feasibility of using population-based NAMs to address human susceptibility and characterize cardiotoxicity risk of emerging contaminants.

46: Assessing metabolism of the most abundant polycyclic aromatic hydrocarbons at the Portland Harbor Superfund Site in vitro in humans

Kari A. Gaither, Pacific Northwest National Lab

Background: Polycyclic aromatic hydrocarbons (PAHs) are common environmental contaminants of concern found at Superfund sites. Exposure primarily occurs through inhalation and ingestion of contaminated food sources. Phase I cytochrome P450s (CYPs) catalyze chemical reactions to enhance solubility. However, bioactivation can also occur, resulting in metabolites with increased toxicity over the parent compound. Understanding the internal dosimetry of PAHs is critical to assessing potential human health concern. As such, we set out to measure in vitro rates of metabolism of the most abundant PAHs found at the Portland Harbor Superfund Site using human hepatic microsomes.
Methods: We incubated pooled human hepatic microsomes with the target PAH (pyrene, fluoranthene, retene, benzo(a)anthracene, chrysene, phenanthrene, and fluorene) and measured the rate of metabolism via disappearance of the parent compound using reverse phase HPLC. Results: Rates of intrinsic clearance ranged from 0.035 ml/min/mg for retene to 0.6 ml/min/mg for phenanthrene, a 17-fold difference. The median rate of intrinsic clearance was 0.17 ml/min/mg. Our findings reveal a high level of variability in the metabolism of seven PAHs found in abundance at the Portland Harbor Superfund Site. Impact: Research is also ongoing to determine the potential for competitive inhibition of metabolism upon exposure to a mixture of these compounds. These results and ongoing work will be used to develop computational models (e.g. physiologically based pharmacokinetic (PBPK) models) of PAH internal dosimetry in humans, which can be used for risk assessment of PAHs found at Superfund Sites.

47: Meteorological data source comparison – a case study in geospatial modeling of potential environmental exposure to abandoned mine sites on Navajo Nation

Chris Girlamo, University of New Mexico

Background: Meteorological data is a crucial input for environmental exposure models. While modeling exposure potential using geospatial technology is a common practice, existing studies infrequently evaluate the impact of input meteorological data on the level of uncertainty on output results. The objective of this study is to determine the effect of various meteorological data sources on the potential exposure susceptibility predictions.
Methods: Three sources of wind data are compared: The North American Regional Reanalysis (NARR) database, meteorological aerodrome reports (METARs) from regional airports, and data from local meteorological (MET) weather stations. These data sources are used as inputs into a machine learning (ML) driven GIS multicriteria decision analysis (GIS-MCDA) geospatial model to predict potential exposure to abandoned uranium mine sites on the Navajo Nation. The results of these models are then validated utilizing a geographically weighted regression (GWR) with sediment samples from the National Uranium Resource Evaluation (NURE) database.
Results: Results indicate significant variations in results derived from different wind data sources. After validation, the METARs data combined with the local MET weather station data showed the highest accuracy, with an average R2 of 0.74. We conclude that local direct measurement-based data (METARs and MET data) produce a more accurate prediction than the other sources evaluated in the study.
Impact Statement: This study informs future data collection methods, leading to more accurate

predictions and better-informed policy decisions surrounding environmental exposure susceptibility and risk assessment.

48: An RShiny application for isotherm models
Joonho Gong, NC State University
Background: The Langmuir and Freundlich models are popular adsorption isotherms that mathematically formulate the amount of adsorbate on the surface of adsorbent as a function of its concentration at given temperature. They are used in many research areas such as chemistry, toxicology, and environmental science.
Methods and Results: To fit these non-linear models, several different methods have been proposed and commercial software programs are available. We have developed an RShiny application to provide maximum likelihood fitted isotherm curves, and confidence band envelopes. In addition to standard output provided in an easy-to use format, novel software output includes model comparisons performed using information criteria, goodness of fit output, and resampling based approaches including the wild bootstrap.
Impact Statement: The tool provides researchers with the capability to easily fit isotherm model for inference and ease of communication in findings.

49: The Impacts of Polycyclic Aromatic Hydrocarbons on Mitochondria-Microbiome Interactions During Development
Emily Green, Duke University
The microbiome influences a broad spectrum of physiological functions. However, knowledge is limited regarding the influence of the microbiome on individual responses to chemical stressors, especially during early development, and how the microbiome may facilitate resistance to chemical toxicity. Atlantic killifish (Fundulus heteroclitus) in polluted regions of the Elizabeth River have adapted to tolerate polycyclic aromatic hydrocarbon (PAH) toxicity, at the cost of mitochondrial dysfunction, and also possess gut microbial communities distinct from non-adapted populations. However, the influence of the microbiome in driving adapted resistance has not been investigated. This study aims to uncover effects of the microbiome on mitochondrial processes during organismal development and the impact of PAH exposure on this interaction. To reveal forces driving the mitochondria-microbiome interaction, germ free, conventionally raised, and recolonized zebrafish embryos, with and without PAH exposure, will be analyzed during early development for mitochondrial DNA (mtDNA) copy number, phagocytic ROS production, mitochondrial ROS (mtROS) generation, and mitochondrial damage. Gene expression analysis in downstream pathways will suggest outcomes of this mitochondria-microbiome interaction. Future studies will analyze how PAH-adapted killifish respond to changes in microbial composition and subsequent PAH exposure. Our results illustrate without a microbiome, mtDNA copy numbers remain higher throughout development while phagocytic ROS production decreases, becoming more apparent when exposed to PAHs. These results suggest the microbiome is necessary for proper mitochondrial development, function, and protection from subsequent stressors. Ongoing studies will expand our understanding of initiating factors and physiological outcomes of the mitochondria-microbiome interaction and its role in driving population adaptations.

50: Environmental pollutant, Polychlorinated biphenyl 126, alters energy metabolism in a rodent ALD model
Tyler Gripshover, University of Louisville
Alcohol-associated Liver Disease (ALD) prevalence is rising which is associated with increased hospitalizations, preventable deaths, and economic cost. ALD is characterized by hepatic steatosis, impaired energy metabolism, and hepatocyte injury. Pathologically, exposure to environmental

toxicants have also shown to induce similar outcomes but characterized as “Toxicant-associated Steatohepatitis”. Environmental toxicant, Polychlorinated Biphenyl (PCB) 126, has shown to enhance non-alcoholic fatty liver disease. However, limited knowledge exists on how other lifestyle related diseases may be enhanced in conjunction with toxicant exposure. We hypothesize that PCB126 will enhance steatosis, metabolism disruption, and hepatocyte injury. Male C57BL/6J mice were exposed to 0.2mg/kg PCB126 or corn oil vehicle by oral gavage. Mice were then fed a 5% or 0% ethanol diet for ten days followed by 5g/kg ethanol binge. Two-way ANOVA with Tukey’s multiple comparisons was used for statistical analyses. All measures of ethanol-induced steatosis and dyslipidemia (increased liver weight, hepatic triglycerides, and lipid droplet formation) were enhanced in the EtOH+PCB126 group. Expressional analyses of lipid metabolism related genes indicated increased lipid import and decreased oxidation. Hepatic glycogen content was decreased while mRNA analyses indicate impaired gluconeogenesis. Infiltrating hepatic granulocytes and apoptotic cells were quantified and were elevated by ethanol feeding. Plasma albumin and its hepatic expression were similarly decreased by 50%, indicating hepatocellular dysfunction.
Liver functionality was compromised in this model where PCB126 altered energy metabolism to enhance ALD severity. This study is relevant to millions of individuals who consume excessive alcohol while inevitably exposed to environmental toxicants, and this interaction is largely understudied.

51: A Community-engaged Study of Toxic Particulate Matter Near an Open-burn/Open-detonation Hazardous Waste Thermal Treatment Facility
Chuqi Guo, NC State University
Colfax, LA, hosts the only commercial open-burn/open-detonation hazardous waste thermal treatment facility in the country. It treats military waste, fireworks, propellants, and soils excavated from Superfund sites. Colfax has a median household income of approximately $26,000, and 58% of Colfax residents are Black or African American. We describe a community-engaged study of particulate matter (PM) concentration and composition. Based on community member interviews and review of public comments submitted to the Louisiana Department of Environmental Quality, sampling sites and targets for chemical analysis were identified. PM smaller than 2.5 μm (PM2.5) samples are collected by two high-volume air samplers. At ten sites varying in distance from the facility, two types of passive samplers collect fine and total PM, and PM at several size cuts is measured by low-cost sensors. The first three months of our sampling campaign occurred from March to June, 2022 and showed that bias-corrected only 35.6% of low-cost PM2.5 sensor readings fell into the “good” category of EPA’s Air Quality Index (AQI) for 24-hour PM2.5, while 0.1% of the readings were considered “unhealthy”, “very unhealthy”, or “hazardous”. Soot-type EPFRs have been detected from the high-volume air samples 1.2 miles and 9 miles away from the facility. Aluminum, barium, chromium, copper, iron, magnesium, manganese, and zinc were detected in fine particles, and cobalt has also been detected in coarse particles. Through this study, we hope to provide the community with information about their exposures and promote community empowerment and engagement to reduce their exposure risks.

52: From the Bottom Up: Deciphering bioaccumulation and biomagnification of PFAS in Plankton
Asta Habtemichael, University of Rhode Island
PFAS are man-made chemicals extremely resistant to environmental degradation and ubiquitous in humans as well as in the environment. Various contamination sources (e.g. application of aqueous film-forming foam (AFFF), industrial and municipal wastewaters) ultimately contaminate adjacent soils and drinking water supplies. Human exposure to PFAS in the US is largely driven by uptake from drinking water, especially near contaminated sites. With the rising treatment of drinking water to meet EPA recent advisory limits, PFAS exposure via food and consumer products has gained attention. Due to bioaccumulation and biomagnification, fish consumption is of particular concern, thus a better

understanding of the mechanisms leading to trophic enrichment are urgently needed. In this work a thorough investigation of the phytoplankton-to-zooplankton transfer of PFAS is proposed to interrogate the bioaccumulation, biotransformation and biomagnification of precursors and terminal PFAS in (i) phytoplankton, (ii) zooplankton, and (iii) along a plankton-based food web. In a series of laboratory-based culture studies the uptake of (a) terminal acids (PFAA), (b) precursor compounds and (c) AFFF-mixtures in phytoplankton and zooplankton monocultures, as well as zooplankton feeding on PFAS-contaminated phytoplankton. By measuring both target compounds and EOF, we will constrain the uptake or production of non-target PFAS in plankton species. Lastly, we will determine precursor and terminal PFAS in Narragansett Bay, including water, phytoplankton, zooplankton and pelagic fish and derive bioaccumulation, biomagnification and trophic magnification factors.

53: Development of a Gas Sensor Array for Detecting Toxic VOCs Using Metalated Gold Monolayer Protected Clusters

Sujoy Halder, University of Louisville

Gas sensor arrays are a promising means of detecting volatile organic compounds (VOCs) in environmental air. Among different airborne VOCs, benzene, toluene, ethylbenzene, xylene (BTEX), and trichloroethylene (TCE) are the most abundant and toxic VOCs. These VOCs induce cardiovascular metabolic syndrome and lung cancer, etc. Detection of these VOCs by current gas sensors is very challenging because of sensitivity, selectivity and air-matrix interference issues. Thiol-functionalized gold nanoparticle-based chemiresistors provide an advantage over other gas sensors, such as lower fabrication cost, room-temperature operation, and higher sensitivity. The present work demonstrates the development of alkali metal ion-carboxylate functionalized gold monolayer protected clusters (Au MPCs) as a sensing material for highly sensitive and selective detection of BTEX and TCE. A gas sensor array has been fabricated using micro-electromechanical system (MEMS) technology. The sensor array features four circularly shaped sensing areas that can perform simultaneously testing four different sensing materials. Lithium, sodium, potassium, and cesium carboxylate-linked Au MPCs were synthesized and tested for sensing vapors of BTEX, TCE including some non-aromatic and chlorinated VOCs. The results demonstrate that the responses of Au MPCs are rapid, reversible, and linear for all tested analytes. Cation-linked Au MPCs improve sensitivity and selectivity toward sensing BTEX due to cation–π interactions and the relative strength of the sensitivity follows the order of K+ > Na+ > Li+. Furthermore, Cs+-functionalized Au MPCs respond highly to chlorinated compounds, which helps to detect TCE. These metalated Au MPCs sensors show much promise for developing a sensor array for real-time measurements of toxic VOCs.

54: Broad-scope extraction and analysis of persistent and mobile organic contaminants in wastewater: From short-chain PFAS and very polar PPCPs to relatively non-polar CECs

Lahiruni M. Halwatura, University at Buffalo

The ever changing and growing numbers of environmental chemical contaminants have attracted the attention of the scientific communities due to the risks posed on the biotic and abiotic systems. One-shot extraction of a broader range of chemicals is a challenge due to the great deal of diversity in chemical nature of these micropollutants limiting their identification in the environment. Trace residue analysis of organic contaminants from complex matrices such as untreated sewage, via liquid chromatography-mass spectrometry (LC-MS) methods can be limited due to matrix interferences. Herein, we developed a tandem solid-phase extraction (SPE) methodology combining both hydrophilic-lipophilic balance and mixed-mode cation exchange sorbents to analyze 60 model compounds in untreated sewage matrices. Model compounds contained log Kow values ranging from -1.9 to 5.5 and were analyzed in positive electrospray ionization (+ESI) LC-MS. The method recoveries were of satisfactory with 51 and 40 compounds showing ≥60% recoveries in matrix free water and in raw

sewage, respectively. The method reproducibility for targeted compounds were ≤12%. The applicability of the optimized SPE method was evaluated for the extraction of a mixture of per- and polyfluoroalkyl substances (PFAS) by analyzing the extracts under -ESI LC-MS. The spiked samples were able to recover sulfonamide-, sulfonic-, carboxylic-, and fluorotelomer sulfonic- PFAS with chain lengths of 8, 4-9, 4-12, and 6-10, respectively. A 24-hour composite wastewater sample was collected, extracted, and analyzed by LC-MS for method application. The suspect screening results revealed the presence of 40 compounds, with their log Kow values ranging from -1.6(Acyclovir) to 4.9(Amitriptyline).

55: Optimization of poly(vinyl)-alcohol-alginate beads to immobilize bacteria for in situ cometabolic bioremediation

Conor Harris, Oregon State University

Groundwater contamination from chlorinated aliphatic hydrocarbons such as cis-1,2-dichloroethene exists throughout the United States. Cometabolic bioremediation with bacteria immobilized in hydrogels can reduce costs of remediation when compared to common remediation techniques such as pump and treat. Rhodococcus rhodochrous ATCC 21198 can degrade cis-1,2-dichloroethene through the process of aerobic cometabolism. Our lab has optimized an immobilization method to immobilize Rhodococcus rhodochrous ATCC 21198 and slow-release compound, tetrabutoxysilane, with poly-vinyl alcohol–alginate beads crosslinked via boric acid and calcium chloride.

We optimized bead performance in batch reactors with a mineral salt media solution and 250 ppb injection of cis-1,2-dichloroethene at days 1 and 30. Cis-1,2-dichloroethene and oxygen were measured using gas chromatography with rates determined using zero-order kinetic models. Compression tests were performed on single beads taken from batch reactors to calculate the compressive modulus, E. Overall, the compressive moduli decreased and the rates of cis-DCE transformation increased after 30 days due to cell growth in hydrogel beads. Rates of oxygen utilization also decreased, indicating a high initial rate of hydrolysis of TBOS. We successfully fit predictive models of compressive modulus and oxygen uptake as functions of crosslinking time and polymer concentrations and found that all three input variables had significant interactions with each other as well as significant effects on the output variables. The response surface models were used to identify the bead formulation that maximized stiffness and minimized oxygen rates.

The impact of this work includes developing materials to enhance bioremediation and restoring contaminated groundwater aquifers.

56: Formation of Environmentally Persistent Free Radicals in Flavoring Compounds of Electronic Cigarette

Farhana Hasan, Louisiana State University

Use of electronic cigarettes (E-cigarettes), devices that deliver a nicotine-containing vapor has gained popularity over past few years. Perceived as healthier alternative to conventional cigarette but there is limited scientific data available on long term health effects of their use. The present study aims at the determination and quantification of environmentally persistent free radicals (EPFRs) in flavoring compounds of E-cigarettes and impact of temperature on their formation. EPFRs are stable and persist for a long time both in the environment and biological systems. The hazards of EPFRs are to produce reactive oxygen species (ROS) which induce oxidative stress. Electron paramagnetic resonance (EPR) spectroscopy was employed to measure EPFRs in E-cigarettes and in their flavoring compounds. Two flavoring compounds, menthol present in menthol-flavored e-cigarette and vanillin present in vanilla-flavored e-cigarettes have been chosen for this study. EPR study showed that vanillin and menthol generate stable long-lived oxygen centered semiquinone type radicals with g value of 2.0034-2.0035. The results have shown that the formation of EPFRs was affected by temperature. Radical intensities

enhanced with increasing temperature, which revealed that the heater's temperature in E-cigarette plays an important role in EPFR formation.

57: Electrochemical Sensors Based on Redox Polymer/Nanoparticles for Heavy Metals Detection
Farideh Hosseini Narouei, Columbia University
Background: Among the heavy metals present in the water as contaminants, Arsenic (As) is considered to be the most toxic in the natural environment. It not only harms humans but also is highly toxic to the soil, plants, and aquatic systems because of its mobility. Therefore, it is important to detect the arsenic presence before it becomes a permanent part of the environment. Electrochemical methods are one of the most cost-effective methods, which has the ability to be designed as portable methods for redox active species monitoring such as Arsenic, Lead and mercury. In our present study, we are fabricating a portable electrochemical sensor using polyaniline copolymers and gold nanoparticles on Screen-printed electrodes. The Square wave anodic stripping voltammetry method is used to detect the As (III) and As (V) with the optimized modified electrode. The future work involved the field study application of the sensor and testing its efficacy and reproduction using screen-printed electrodes in natural waters. Impact: Quality of drinking water, is directly associated with human health and heavy metal ions are one of the main sources of water pollution. Developing portable methods increases our control towards human health and prevent exposure.

58: Chronic arsenic exposure perturbs gut microbiota and bile acid homeostasis in mice
Yun-Chung Hsiao, University of North Carolina-Chapel Hill
Chronic arsenic exposure perturbs mammalian metabolome. Gut microbiota regulates the host metabolic homeostasis, and previous studies have demonstrated that arsenic exposure can cause gut microbiota dysbiosis. However, it still unclear whether arsenic-induced gut microbiota dysbiosis plays a role in the arsenic-perturbed metabolic imbalance in the host body. Bile acids are the functional compounds synthesized in host bodies but regulated by gut microbiota. In this study, we exposed 1 ppm arsenic to C57BL/6 mice from drinking water for 3 months and investigated whether arsenic exposure affects the bile acid homeostasis in mouse sera and livers and whether it is related to the changes in gut bacteria. We found that arsenic exposure caused the decline of major unconjugated primary bile acids in sera. The ratios of unconjugated bile acids and taurine-conjugated bile acids were also decreased. However, the hepatic level of several primary bile acids, including TβMCA, βMCA, TCA, was significantly increased in arsenic-treated mice. Secondary bile acids were consistently decreased both in sera and livers by arsenic treatment. Moreover, the relative abundance of Bacteroidetes and Firmicutes was differentially changed by arsenic exposure, which was associated with the bile acid level in sera. In summary, this study demonstrates that arsenic exposure perturbs the bile acid homeostasis and arsenic-induced gut microbiota dysbiosis could play a role in this process, which suggests the important role of gut microbiota in arsenic-associated toxicity.

59: Data-driven strategies for airborne polychlorinated biphenyl remediation decision making in schools
Jason Hua, University of Iowa
Background: Airborne polychlorinated biphenyls (PCBs) in school air are emitted from building materials and modern paints and surface treatments, posing significant risk of exposure to occupants. This is especially concerning in schools where children are at risk of greater health effects due to inhalation exposure. Removal of these building materials is an expensive and time-consuming process, leading to closure of schools. We hypothesize that there are modern, non-Aroclor sources of PCBs in addition to legacy sources. Further, we hypothesize that congener specific analyses is more revealing than Aroclor analyses. We also hypothesize that there are common sources and profiles between schools.

Methods: We used polyurethan foam passive air samplers (PUF-PAS) in Vermont schools to measure the prevalence of PCBs in school air. We also measured PCB emissions from surfaces with polyurethan foam passive emission samplers (PUF-PES). Surfaces sampled include carpet, dry wall, cove base, brick walls, cinderblock walls, and floor tile.
Results: Preliminary emissions results show PCBs are present at detectable levels in most surfaces. Further analyses will be conducted to determine the contribution of each surface's emission to airborne concentrations.
Impact Statement: The data generated from this study will be used to determine the prevalence of airborne PCBs in Vermont schools. We will also develop models to predict airborne PCBs as a function of school characteristics. By analyzing PCB profiles throughout a school, we can identify specific sources and develop targeted materials remediation strategies that will help schools save time and money.

60: Fluorescent spectroscopy and statistical modeling for monitoring of PAH biotransformation and formation of PAH metabolites

Juliana Huizenga, Oregon State University

Polycyclic aromatic hydrocarbons (PAHs) are a class of environmental contaminants released into the environment from both natural and anthropogenic sources that are associated with carcinogenic, mutagenic, and teratogenic health effects. Many remediation strategies for the treatment of PAH contaminated material, including bioremediation, can lead to the formation of toxic transformation products. Analytical techniques for PAHs and PAH transformation products often require extensive sample preparation including solvent extraction and concentration, chromatographic separation, and mass spectrometry to identify and quantify compounds of interest. Excitation-emission matrix (EEM) fluorescent spectroscopy paired with parallel factor analysis (PARAFAC) is an approach to analyzing environmental or laboratory samples that eliminates the need for extensive sample preparation and separation techniques before analysis. The objectives of this research were to compare an established targeted GC/MS method to two-dimensional (2D) fluorescent spectroscopy and EEM-PARAFAC methods to monitor phenanthrene aerobic cometabolic transformation by a bacterial pure culture, Mycobacterium Strain ELW1, derive kinetic constants for phenanthrene transformation, and identify and quantify phenanthrene transformation products. Both phenanthrene and its primary transformation product were identified and quantified with the EEM-PARAFAC method. The value of the EEM-PARAFAC method was demonstrated in its sensitivity and accuracy of quantification compared to the 2D fluorescent spectroscopy method, as well as its ease and rapidity compared to traditional GC/MS methods. To the authors' knowledge, this is the first study to use an EEM-PARAFAC method to monitor, identify, and quantify both PAH biotransformation and PAH metabolite formation by a bacterial pure culture.

61: Cumulative Environmental Health Impacts in East Baton Rouge Parish, Louisiana

Jennifer Irving, Louisiana State University

Background: Communities that experience environmental justice (EJ) issues also often experience health disparities. Cumulative impact assessments and EJ screening tools integrate information about environmental exposures, social vulnerability, and characteristics of the built environment to provide a more complete picture of environmental health. Louisiana is home to several high-profile EJ communities, documented disparities in health outcomes and health care access, and unequal access to environmental amenities but does not yet have an EJ screening tool that considers cumulative impacts.
Methods: I used the methodology established for CalEnviroScreen and publicly available data from EPA's EJSCREEN and CDC Places to calculate cumulative environmental health impact (CEHI) scores at the census tract for East Baton Rouge (EBR) Parish, Louisiana. While EJ screening tools are not intended to be used as predictive models for specific health outcomes, a good tool for mapping environmental

health disparities should correlate with health outcomes known to be associated with environmental hazards. Therefore, to evaluate the CEHI scores, I used simple linear regression to assess the relationship between CEHI scores and estimated life expectancy.
Results: I found that CEHI scores were significantly and negatively ($R2 = 0.58$, $p<0.001$) associated with life expectancy at the census tract level. Additionally, areas with high CEHI scores clustered in an area of EBR with a high concentration of industrial facilities and a Superfund Site.
Impact: Maps showing cumulative environmental health impacts are powerful visualization tools that can help stakeholders understand environmental health risks and identify where further studies and policy interventions are needed.

62: Probabilistic Concentration Addition of Complex Mixture Exposures in a Population-Based Human In Vitro Model

Suji Jang, Texas A&M University

Although humans are continuously exposed to complex chemical mixtures in the environment, it has been extremely challenging to investigate the resulting cumulative risks and impacts. Recent studies proposed the use of in vitro new approach methods for hazard and dose-response evaluation of mixtures. Based on our finding that concentration addition (CA), the usual default approach to calculate cumulative risk, is mostly accurate, we further investigate how cell-based data can enable quantifying inter-individual variability in CA. We used a human cell-based population-wide in vitro model and applied CA at either the individual or population level for predicting points of departure (PODs) for individuals, for median and sensitive 1st percentile members of the population, and for their ratio as toxicodynamic variability factors (TDVFs). We found that the accuracy of CA, quantified by Loewe Additivity Index (LAI), varies more between different mixtures than between different individuals, and that predictions of the population median are generally more accurate than predictions for the "sensitive" individual or the TDVF. Moreover, LAI values were generally < 1, indicating that the mixtures were more potent than predicted by CA. We conclude that the new approach methods data from a number of human cell-based population-wide in vitro assays can be used for cumulative risk assessment; however, dose or concentration additivity approaches may underestimate potency by an order of magnitude or more. Therefore, whole mixture testing in vitro or more stringent benchmarks of cumulative risk indices are needed to quantify PODs and variability in order to ensure public health protection.

63: Later-life bioenergetic consequences of PAH exposure and increased temperature in Atlantic killifish from the Elizabeth River

Lindsay Jasperse, Duke University

Understanding tradeoffs of rapid adaption to environmental chemicals following chronic exposure is critical for ecological risk assessment. Atlantic killifish that reside in the Elizabeth River (ER), an estuary with significant PAH contamination from decades of creosote pollution, provide a model to study these energetic costs. These fish exhibit a PAH-adapted phenotype that has been associated with organismal-level bioenergetic shifts, including decreased aerobic scope and reduced thermal tolerance. We seek to understand the bioenergetic fitness of offspring from these sites and the later-life mitochondrial effects of early life PAH exposure. Here, embryos collected from adults wild-caught from a reference site (KC) and four ER sites were exposed to 0 or 1% Atlantic Wood sediment extract during early development and then raised to the juvenile stage at 28 or 32°C. Juvenile killifish metabolic rates were tested using a respirometer and heart and brain-specific mitochondrial function were measured using an Extracellular Flux Analyzer. Juveniles from all ER sites had significantly lower metabolic rates than KC, and juveniles from two ER sites had altered heart bioenergetics, indicating that metabolic costs of PAH adaptation persist in lab-reared offspring and through several life stages. Interestingly, juvenile ER fish were

sensitive to early-life PAH exposure only at temperatures above 28°C, which is of particular concern as aquatic habitats are increasingly impacted by global climate change. Juvenile bioenergetic data from subpopulations with a gradient of PAH pollution serve as indicators of fitness and provide important risk assessment data for Atlantic killifish, an integral species in the ER ecosystem.

64: Mechanisms of PFAS adsorption to activated carbon at adsorption equilibrium
Sarangi Joseph, NC State University
Per- and polyfluoroalkyl substances (PFAS) are synthetic chemicals that widely occur in drinking water sources. Granular activated carbon (GAC) adsorption is widely considered to remediate contaminated water, but the fundamental mechanisms of PFAS adsorption are not well understood. An important goal of this research is to determine the distribution of PFAS inside of GAC particles when PFAS adsorb from single-solute and multi-solute systems.
Five GACs were characterized to determine how GAC properties affect intraparticle adsorbate distributions. Batch adsorption and desorption isotherm experiments are being conducted with PFAS of different molecular weights (PFBS, PFHxS, PFOS) as well as with polystyrene sulfonate (PSS), a surrogate for naturally occurring organic matter. In addition, batch loading experiments were completed at relatively high PFHxS and PSS concentrations to determine intraparticle adsorbate distributions by scanning transmission electron microscopy and energy dispersive X-ray spectroscopy (STEM-EDS). In single-solute systems, PFBS adsorption and desorption isotherms were statistically similar, suggesting that PFBS adsorption is reversible on each of the evaluated GACs. For a reagglomerated coal-based GAC, PSS penetrated the entire GAC particle, but areas of lower PSS adsorption density were found in portions of the GAC particle, where oxygen and silicone were present. Experiments are ongoing to determine the effects of adsorbate and adsorbent properties on PFAS penetration depth into GACs of different particle sizes. The results generated in this research will improve our understanding of PFAS adsorption/desorption mechanisms with the goals of improving the production of highly effective adsorbents and supporting policy regarding the disposal of spent GAC.

65: Characterizing the Impact of Simvastatin on TCDD-Induced Liver Injury Utilizing Single-Nuclei RNA Sequencing
Amanda Jurgelewicz, Michigan State University
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD), a Superfund chemical of concern, is associated with metabolic syndrome (MetS) in humans and elicits liver injury in mice that resembles non-alcoholic liver disease (NAFLD). These pathologies occur following persistent activation of the aryl hydrocarbon receptor (AHR). One aspect of MetS, dysregulation of cholesterol homeostasis, has also been linked to TCDD exposure and the development of NAFLD. In a previous study, treating mice with TCDD in the presence of simvastatin, a 3-hydroxy-3-methylglutaryl-CoA reductase (HMGCR) competitive inhibitor, increased toxicity in male mice, compared to TCDD alone. In this study, single-nuclei RNA sequencing was performed in liver from male C57BL/6NCrl mice treated in the presence and absence of TCDD and simvastatin to further investigate disrupted pathways associated with this increased toxicity. Our results suggested that TCDD and simvastatin (T+S) co-treatment exacerbated TCDD-induced injury by inducing wasting and enhanced AHR activation. Furthermore, co-treatment elicited changes in the relative proportion of immune cell and hepatocyte populations, important cell (sub)types in the progression of steatosis to steatohepatitis with fibrosis. Comparison of differentially expressed genes suggested T+S co-treatment disrupted pathways related to NAFLD differently than TCDD alone, which may partially explain the observed phenotypic differences between treatment groups. Overall, this study suggests there are interactions between cholesterol metabolism and TCDD-induced injury and that individuals taking statins are at greater risk of toxicant-induced injury.

66: Evaluation of Perfluorooctanesulfonic acid absorption and tissue concentrations in Organic Anion Transporting Polypeptide 2B1-deficient mice

Emily Kaye, University of Rhode Island

Perfluorooctanesulfonic Acid (PFOS) is a perfluoroalkyl substance (PFAS) of ubiquitous exposure, detected in the serum of ~95% of the U.S. adult population and has a half-life of 4.1-8.67 years. PFOS exposure is associated with liver damage, dyslipidemia, and obesity. Intestinal PFOS absorption is highly efficient (99% absorbed), yet little is known about the mechanism(s) that drive gut PFOS absorption. Organic Anion Transporting Polypeptide 2B1 (OATP2B1) transports drugs/xenobiotic uptake and is located on the apical side of enterocytes and sinusoidal membrane of hepatocytes. PFOS is an OATP2B1 substrate in human and rat overexpressed cells, thus, it is hypothesized that OATP2B1 could contribute to PFAS uptake in vivo. In this study, adult male/female OATP2B1 null (OATP2B1-/-, n=7) and wild-type mice (OATP2B1+/+, n=10) were administered a single PFOS dose via oral gavage (1 mg/kg). Plasma was collected over the course of 5 days (female) and 14 days (male) at 30 minutes, 1, 3, 8, 12, 24, 48 hours, 5, 7, and 14 days, respectively. At the respective times of necropsy, tissues were snap-frozen in liquid nitrogen, and samples were later homogenized and processed utilizing QuEChERS extraction for LC/MS analysis. Liver PFOS concentration between OATP2B1+/+(7.75ng/mg liver=female, 7.31ng/mg liver=male) and OATP2B1-/- mice(6.81ng/mg liver=female, 7.90ng/mg liver=male) did not statistically vary, suggesting that OATP2B1 is not critical for PFOS uptake and deposition to liver. Plasma PFOS measurements are ongoing and will be presented. In summary, our work will present the contribution of OATP2B1 for PFOS uptake and distribution in mice after a single oral exposure to PFOS.

67: Development of an arrayed feto-maternal interface (FMi) Organ-on-Chip (OOC) model for rapid environmental toxicants screening

Sungjin Kim, Texas A&M University

Background: Preterm birth (PTB), or birth before 37th week, is a major pregnancy pathology that contributes to high number of neonatal deaths worldwide. How various molecules, from therapeutics to environmental toxins/toxicants, affect PTB is difficult to study due to limitations in both in vitro and in vivo models. Micro physiological systems (MPS), also known as organ-on-chip (OOC), are great alternatives for studying both potential hazards and mechanisms leading to PTB as they recapitulate the physiological environment.

Methods: We developed an arrayed FMi-OOC platform that consists of five independent FMi-OOCs on a single chip, where the design is such that a single cell loading step (one of the most time-consuming procedures in OOC testing) can be used to load cells into all five FMi-OOCs through an interconnected microfluidic channel.

Result: this higher throughput OOC model has a microfluidic delay channel design, which can control the diffusion of fluid so that diffusion occurs between the cell culture chamber within the same OOC structure but not to the neighboring OOC structure even though they are fluidically connected through a microfluidic channel. This design allows the five single FMi-OOCs to be fluidically separated without a much more complex conventional pressure-based valve operation system.

Impact statement: This proposed new organ-on-chip platform enables to predict the response of FMi upon exposure to environmental chemicals, opening the possibility for using OOC models for various chemical screening in simple & rapid experiment fashion.

68: Evaluating liver lipidome dysregulation following exposure to legacy and emerging per- and polyfluoroalkyl substances (PFAS)

Kaylie Kirkwood, NC State University

Per- and polyfluoroalkyl substances (PFAS) are a class of manmade organofluorine chemicals used in various household and industrial applications. Exposure to PFAS has been associated with adverse

health outcomes including liver damage, cancer, and elevated cholesterol, though the specific molecular mechanisms perturbed by PFAS exposure remain poorly understood. There is evidence of PFAS exposure causing lipid dysregulation, thus lipidomic studies that go beyond simple triglyceride and cholesterol tests are needed to investigate these interactions. Here we have utilized a liquid chromatography-ion mobility spectrometry-mass spectrometry (LC-IMS-MS) method to simultaneously evaluate PFAS accumulation and the resulting lipid changes in a single sample analysis. The ability to distinguish molecular classes by their unique IMS collision cross section (CCS) and m/z values has been well-characterized but not yet applied to enable assessment of various molecule types in a single analysis. PFAS and lipids are optimal molecules for this method as they occupy similar mass ranges and polarities but are well distinguished in the IMS drift time dimension. The co-extraction and analysis of lipids and PFAS greatly increased the throughput of these evaluations without sacrificing quantitative capabilities, data quality, or sensitivity. This method was applied to livers collected from mice exposed to either legacy (PFOA) or emerging (GenX or Nafion byproduct 2) PFAS. A high degree of dysregulation was observed among the hundreds of identified lipids, some of which was dependent on the specific PFAS exposure while other changes were conserved among the multiple exposure groups studied.

69: Gestational Exposure to Environmental VOC Predisposes Offspring to Metabolic Syndrome through Alterations in Hypothalamic Development

Lisa Koshko, Wayne State University

The hypothalamus is essential in the regulation of metabolism, notably during critical windows of neurodevelopment. An abnormal hormonal and inflammatory milieu during development can trigger persistent changes in the function of hypothalamic neurocircuits, which leads to long-lasting effects on the body's energy homeostasis and metabolism. Benzene, a volatile organic compound (VOC), is a known carcinogen capable of crossing the blood-brain barrier. We recently demonstrated that gestational exposure to low concentrations of benzene induces a severe metabolic imbalance in offspring associated with hyperglycemia and impairments in energy homeostasis in adulthood. However, the mechanisms behind these outcomes remain unclear. We hypothesize that gestational exposure to low-dose benzene induces early-life hypothalamic stress, contributing to adverse metabolic effects later in life. Here, we exposed pregnant dams to benzene at 50 ppm or filtered air (from G0 to birth). RNA-seq analysis of the whole hypothalamus reveals several differentially expressed genes related to primary cilia function and metabolic regulation in benzene-exposed male but not female offspring. Quantitation of the fiber density in the paraventricular hypothalamus (PVH) revealed significant decreases in orexigenic and anorexigenic projections in benzene-exposed offspring, accompanied by impairments in leptin signaling, indicating aberrant hypothalamic development. Moreover, benzene-exposed offspring demonstrated increased hypothalamic microgliosis and disrupted microglia morphology at postnatal day 21. This effect was specific for the gestation exposure only since additional exposure of the offspring during lactation did not exacerbate this phenotype. Our new data provide the evidence and mechanistic basis that gestational VOC exposure is a potential risk factor for late-life metabolic disorders.

70: Machine Learning Models to Predict PFAS Removal by Granular Activated Carbon

Yoko Koyama, NC State University

Granular activated carbon (GAC) adsorption is frequently considered to control recalcitrant organic micropollutants (MPs) in both drinking water and wastewater. To predict full-scale GAC adsorber performance, bench- and/or pilot- scale experiments are widely conducted, which in turn has generated a wealth of breakthrough data. The overarching aim of this study was to develop machine learning (ML) models from such existing data to predict MP breakthrough from adsorbent, adsorbate, and background water matrix properties. These models provide a simple and fast tool to predict GAC performance. To

develop information for model calibration, MP breakthrough curves were collected from the peer-reviewed literature, research reports, and engineering reports. These data sets were analyzed to determine the bed volumes of water that could be treated until MP breakthrough reached ten percent of the influent MP concentration (BV10). The data set encompassed 43 MPs, 18 GAC products, and 38 water matrices. Approximately 450 data sets were split into training, validation, and test sets. Seventeen candidate features, such as MP properties (Abraham parameters), background water matrix characteristics, and GAC properties, were explored in ML models to predict log-10-transformed BV10 (logBV10). BV10 values obtained from the resulting predictive model were highly correlated with experimentally determined BV10 values (coefficient of determination ~0.89 for logBV10 prediction), and the most effective model predicted BV10 with an absolute mean error of ~ 0.11 log units. Key drivers influencing BV10 prediction included the MP's partitioning coefficient between air and hexadecane (Abraham parameter L); dissolved organic matter concentration in background water matrix; and the adsorbent's point of zero charge (pzc). The ML models can be used to estimate GAC bed life and select effective GACs for the removal of MPs such as per- and polyfluoroalkyl substances (PFASs) in a wide range of water types.

71: Role of Interleukin-22 in Environmentally Persistent Free Radical-Exposure Exacerbated Influenza Infection

Avinash Kumar, Louisiana State University

Background- Inhalation of Particulate matter containing EPFRs is associated with increased morbidity and mortality following respiratory tract infections in infants. Interleukin 22 (IL22) is a cytokine which help in resolving lung injury following Flu infection. However, the role of IL22 in EPFRs exacerbated influenza infection is not known.

Methods- To determine the effects of PM exposure on pulmonary IL22 responses, 3-day old neonatal mice were exposed to aerosolized PM containing EPFRs. At 4-day post-exposure mice were infected with Flu. Lungs and bronchoalveolar lavage fluid were isolated at different time-points and were analyzed for different parameters.

Results- Exposure to PM containing EPFRs resulted in an immediate (0.5-1-day post-exposure) increase in IL22 expression in the lungs of mice; however, this was not maintained and failed to increase with either continued exposure to PM or subsequent Flu infection of PM-exposed mice. This contrasts with increased IL22 expression in mice exposed to vehicle and Flu infected. Activation of the aryl hydrocarbon receptor, which mediates the induction and release of IL22, was also transiently increased with PM exposure. Exposure to PM induced lung microbiota dysbiosis and altered the levels of indole, a microbial metabolite. Treatment with recombinant IL22 or indole-3-carboxaldehyde prevented PM associated lung injury and increased mortality in Flu-infected mice exposed to PMs.

Impact statement- These data suggest that exposure to PM containing EPFRs results in failure to maintain and induce IL22 upon Flu infection. Insufficient levels of IL22 may be responsible for aberrant epithelial repair and immune responses, leading to increased Flu severity.

72: Multifunctional Membrane Platforms for the Separation of Organics Such as PFAS From Aqueous Environments

Francisco Leniz, University of Kentucky

Background: Polyfluoroalkyl substances (PFASs) are urgent organic compounds that must be removed from water. Separation processes using traditional technologies have some benefits and challenges when separating these pollutants from the environment. Benefits are created by design, for example, good adsorption affinity, high exclusion rates, high conversion rates, and low energetic requirements, among others. Challenges arise from the limitation of the applicability of these benefits to a large range of targeted pollutants, as well as from the competition of the active sites with naturally present

competitors, the fouling of organic matter, etc. Ultimately, these challenges can be reflected in a decrease in the processes' removal efficiency.
Methods: This work studies the synthesis of multifunctional membrane platforms consisting of pore-functionalized microporous support thin-film composites. The main objective is to take advantage of the benefits from each separation mechanism, and their respective functionalities, to help overcome challenges with environmental remediation technologies.
Results: Scanning electron microscope and X-ray photoelectron spectroscopy demonstrate the formation of the multifunctional components. The porous support from these membranes adsorbs organics (178 mg PFOA adsorbed/m2 membrane at an equilibrium concentration of 70 mg/L), and the simultaneous exclusion from the NF layer allows separations of PFOA and the smaller size heptafluorobutyric acid from solutions containing 70 μg/L of these compounds at a high water flux of 100 L/m2-h at 7 bar.
Impact statement: We demonstrated the formation of a multifunctional separation platform and we highlighted the potential of this platform for enhanced separation rates, as well as other benefits.

73: Arsenic exposure in drinking water alters intestinal microsomal epoxide hydrolase expression in mice

Hui Li, the University of Arizona

Consumption of arsenic-contaminated water has been associated with increased risks of multiple adverse health outcomes in humans. Our aim is to identify gene expression changes that may be mechanistically linked to arsenic's adverse effects. The current study is focused on the small intestinal epithelial cells, which is the main site of absorption of ingested arsenic and is understudied for exposure-related changes. C57BL/6 mice were treated with sodium arsenite in drinking water at 25 ppm for 28 days. Preliminary global gene expression analysis of the small intestine revealed an induction by the arsenite exposure of the microsomal epoxide hydrolase (mEH or Ephx1), an enzyme with a major role in converting xenobiotic epoxides to less reactive diols. Subsequent studies confirmed mEH induction at both mRNA and protein levels. Interestingly, the arsenite exposure induced the expression of mEH, but not the soluble epoxide hydrolase (sEH), which is known to prefer endogenous epoxides. Within the small intestine, mEH gene expression was induced only in the proximal, but not distal, part. The induction of mEH was accompanied by increases in microsomal enzymatic activity toward a model mEH substrate, cis-stilbene oxide. These data suggest that mEH, but not sEH, may be more relevant to the adverse effects of arsenic exposure. Our finding also points to the need to assess in vivo functional consequences of mEH induction in intestinal epithelial cells on the detoxification and disposition of xenobiotic epoxides in arsenic exposed mice and humans. (Supported by the Superfund Research Program, ES004940-32)

74: Fine particle (PM2.5) component concentrations in American Indian vs. Non-American Indian communities

Maggie Li, Columbia University

Background: Increased exposure to fine particles (PM2.5) contributes to higher risks of numerous adverse health outcomes, with varying component-specific associations estimated. Prior work examining total PM2.5 in primarily American Indian- (AI-) populated areas shows disparate trends over time compared to the rest of the United States (US), with higher concentrations in more recent years. We compared trends in concentrations of six PM2.5 components in American Indian (AI-) vs. non-AI-populated counties over time (2000 – 2017) in the contiguous US.
Methods: Using a multi-criteria approach to classify counties as AI- or non-AI-populated, we ran component-specific linear mixed models to estimate differences in county-wide annual concentrations of sulfate, ammonium, nitrate, organic matter, black carbon, and soil from well-validated prediction

models in AI- vs. non-AI-populated counties, adjusting for population density and household income. We estimated whether component-specific time trends varied in AI- vs. non-AI-populated counties using interaction terms with calendar year.
Results: Our final analysis included 3,109 counties, of which 199 were classified as AI-populated (6.4%). On average, adjusted concentrations of all PM2.5 components in AI-populated counties were lower than in non-AI-populated counties. However, component-specific trends varied over time; notably, sulfate and ammonium levels were significantly lower in AI- vs. non-AI-populated counties in 2000 but higher after 2011 through 2017.
Impact Statement: The disparities observed in PM2.5 component trends between American Indian and non-American Indian populated counties over time underscores the need to strengthen air pollution regulation and prevention program implementation on tribal lands.

75: Association of urinary uranium exposure with cardiac geometry and left ventricular function in the Strong Heart Study

Wil Lieberman-Cribbin, Columbia University

Background: Drinking water contaminated with uranium is common in areas near abandoned mines. Uranium is a non-essential element potentially associated with cardiotoxic health effects. Measures of cardiac geometry and function are useful for capturing risk, early-detection, and progression to clinical cardiovascular disease outcomes. We leveraged urinary uranium measures to investigate their association with measures of cardiac imaging and function.
Methods: Urinary uranium was measured in the baseline exam (2001-2003) of the Strong Heart Family Study (n=1539), a prospective study of cardiovascular disease among American Indian communities in Arizona, Oklahoma, North Dakota and South Dakota. Cardiovascular outcomes were derived from transthoracic echocardiography performed at baseline and follow-up (2006-2009).
Results: Participants' mean (SD) age was 31.4 (10.4) years; 40.6% were male. The median (IQR) concentration of uranium was 0.029 (0.045) μg/g creatinine. Participants in the highest (>0.06 μg/g) compared to the lowest (≤0.01 μg/g) uranium quartile had a higher prevalence of left ventricular (LV) hypertrophy (7.5% vs 4.5%, p=0.05), longer mean left atrium diameter (3.63 vs 3.49 cm, p<0.001), LV diameter at diastole/height (5.36 vs 5.25 cm/m, p=0.002), stroke volume (82.7 vs 79.6 ml, p=0.003), isovolumic relaxation time (74.7 vs 77.7 ms, p<0.0001), and mitral A-velocity (53.1 vs 51.3 cm/s, p=0.008). These associations remained after adjustment of age, sex, smoking status, body mass index and other cardiovascular risk factors.
Impact Statement: Preliminary findings indicate that uranium exposure may be associated with measures of cardiac imaging and left ventricular function. Future analyses should determine the potential long-term clinical cardiovascular effects of uranium exposure.

76: UV Spectroscopy of Chemo selectively Preconcentrated Exhaled Breath as Novel COVID-19 Screening Method

Saurin Sutaria, University of Louisville

The peroxidation of unsaturated lipids is a widely recognized metabolic process that creates complex mixtures of volatile organic compounds including aldehydes. Elevated levels of reactive oxygen species in diseased cells promote random lipid peroxidation, which leads to an increase in a variety of aldehydes. Increased levels of these volatile aldehydes can be exhaled and are potentially biomarkers of disease. A sub class of these aldehydes, a,b-unsaturated aldehydes, have low concentrations in exhaled breath relative to saturated aldehydes, and often cannot be individually quantified. Analysis of exhaled a,b-unsaturated aldehydes as a group may translate into more accurate diagnoses of disease. Thus, we explored UV spectral detection of the unsaturated metabolite fraction within the complex breath carbonyl mixture. We developed a novel breath analysis approach that couples established carbonyl

preconcentration technology with UV-Vis spectroscopy to constitute a noninvasive test for disease. A pilot study comparing healthy and symptomatic COVID-19 positive patient breath was performed to test the hypothesis that the distinct absorbances of unsaturated carbonyls could be used as a diagnostic indicator. Breath samples were derivatized and preconcentrated using silicon microreactor technology known to isolate carbonyl compounds as oxime ether adducts. The sample is eluted from the microreactor and analyzed by UV-Vis spectroscopy. A significant elevation in UV absorbances at a range of wavelengths from COVID-19 positive samples compared to healthy controls was observed. The data suggests that UV absorbance thresholds could be established, absorbances above which is indicative of SARS-CoV-2 infection. Application to other diseases may be possible.

77: Computational studies investigating interactions between chlorophyll-amended clays and benzene

Kendall Lilly, Texas A&M University

High levels of benzene can be present in water, soil and air, imposing a significant risk for human and animal health, as well as plants in the affected areas during disasters. Various remediation methods, such as activated carbons have been proposed, but have shown limited effectiveness. In this work, we designed novel montmorillonite clays amended with chlorophyll molecules, which are safe for human and animal consumption. We showed that the novel designed amended clays, have the capacity to detoxify benzene according to a combination of in vitro, in silico, and well-established ecotoxicological (ecotox) bioassay methods. Particularly in the computational studies, we modeled montmorillonite clays in the absence and presence of chlorophyll molecules, and showed that within the simulations, chlorophylls have a strong capacity to gradually interact with the clay surfaces, gradually forming larger, stable aggregates which strongly facilitate the adsorption of benzene compounds into the integrated amended clay systems. Additionally, we investigated in detail particular modes of interactions between benzene and chlorophyll-amended clay systems, providing insights into the adsorption mechanisms and the effect of different interfaces present in the designed systems. The computational results were in line with experimental assays, which showed among others that the inclusion of the amended systems in the culture medium significantly reduced benzene toxicity to C. elegans and L.minor. We consider that such novel sorbents may be useful during disasters and emergencies to decreases unintentional exposures from contaminated water, soil, and air.

78: Physiologically-based Modeling to Improve Prediction of Gut Absorption for Environmental Chemicals

Hsing-Chieh Lin, Texas A&M University

The presence of thousands of chemicals in commerce and the environment requires efficient approaches to human health risk assessment. The integration of physiologically based kinetic modeling and in vitro to in vivo extrapolation (IVIVE) have been increasingly used to rapidly predict the toxicokinetics of chemicals with limited available toxicity data. Bioavailability is a key factor in chemical toxicokinetics but has been typically assumed to be 100%. A physiological-based gut absorption model, also known as the advanced compartmental absorption and transit (ACAT) model, has been used extensively to estimate the bioavailability of pharmaceutical compounds, but has not been widely applied to environmental chemicals. Therefore, the goal of this study is to construct a probabilistic environmental compartmental absorption and transit (PECAT) model, adapted from the pharmaceutical-based ACAT model, to predict intestinal absorption of environmental chemicals. We calibrated the model parameters to human in vivo and in vitro datasets of drug permeability and fractional absorption by considering two key factors: (1) differences between apparent permeability in Caco-2 cells and in vivo effective permeability in the jejunum and (2) differences in in vivo/ex vivo permeability across different gut segments. Incorporating these factors probabilistically, the PECAT model provides a statistically

rigorous and physiologically based approach for incorporating gut absorption into toxicokinetic modeling and IVIVE of environmental chemicals based on Caco-2 permeability measurements. The substantial chemical-to-chemical variability in calibration data also highlights the need for more accurate in vitro models and data for measuring gut segment-specific in vivo permeability.

79: UV Spectroscopy of Chemo selectively Preconcentrated Exhaled Breath as Novel COVID-19 Screening Method

Saurin Sutaria, University of Louisville

The peroxidation of unsaturated lipids is a widely recognized metabolic process that creates complex mixtures of volatile organic compounds including aldehydes. Elevated levels of reactive oxygen species in diseased cells promote random lipid peroxidation, which leads to an increase in a variety of aldehydes. Increased levels of these volatile aldehydes can be exhaled and are potentially biomarkers of disease. A sub class of these aldehydes, a,b-unsaturated aldehydes, have low concentrations in exhaled breath relative to saturated aldehydes, and often cannot be individually quantified. Analysis of exhaled a,b-unsaturated aldehydes as a group may translate into more accurate diagnoses of disease. Thus, we explored UV spectral detection of the unsaturated metabolite fraction within the complex breath carbonyl mixture. We developed a novel breath analysis approach that couples established carbonyl preconcentration technology with UV-Vis spectroscopy to constitute a noninvasive test for disease. A pilot study comparing healthy and symptomatic COVID-19 positive patient breath was performed to test the hypothesis that the distinct absorbances of unsaturated carbonyls could be used as a diagnostic indicator. Breath samples were derivatized and preconcentrated using silicon microreactor technology known to isolate carbonyl compounds as oxime ether adducts. The sample is eluted from the microreactor and analyzed by UV-Vis spectroscopy. A significant elevation in UV absorbances at a range of wavelengths from COVID-19 positive samples compared to healthy controls was observed. The data suggests that UV absorbance thresholds could be established, absorbances above which is indicative of SARS-CoV-2 infection. Application to other diseases may be possible.

80: The Human Health Analysis Resource (HHEAR): An Analytical Chemistry Resource for your Superfund Project

Heather M. Stapleton, Duke University

The Human Health Environmental Analysis Resource (HHEAR) program seeks to advance understanding of the role of the environment on human health over a lifetime. HHEAR was designed to provide researchers access to high-quality, exposure-assessment services at no cost to the investigator. Starting in 2019, the HHEAR program expanded to include the Duke Environmental Analysis Laboratory (DEAL), and in combination with the Mount Sinai Untargeted Hub, provide NIEHS and Superfund researchers with support for analytical services to help detect and measure organic contaminants (e.g., flame retardants, polyfluoroalkyl substances, phthalates, pesticides) and inorganic chemicals (e.g. major and trace metals/metalloids, as well as speciation and measures of bioaccessibility) from diverse sampling media. DEAL analyzes external environmental samples including air, water, soil, dust, and personal samplers (e.g. silicone wristbands). The Mount Sinai hub provides exposomic analysis of biological matrices, including blood, urine, dry blood spots, and teeth. The Hubs provide advice to applicants and support for sample preparation, extraction and quantitative analysis of organic and inorganic contaminants. Both hubs utilize the newest cutting-edge approaches for suspect-screening and non-targeted analyses of chemicals using high resolution mass spectrometry. We provide high-resolution, accurate-mass, mass spectrometry services for use in developing exposomics approaches and methodologies. HHEAR's high-resolution mass spectrometry capability and technical expertise will be used to help measure the totality of human exposure to chemicals, (i.e., the human exposome,

consisting of thousands of endogenous and exogenous chemicals). This presentation will provide an overview of the analytical services available to Superfund researchers through the HHEAR program.

81: An Overview of the Elements of a Data Management and Sharing Plan
Anna Kremer, Saint Louis University College for Public Health and Social Justice
Background: In October of 2020, the NIH released the Final NIH Policy for Data Management and Sharing. Under the policy, which becomes effective in January of 2023, all NIH researchers will need to prospectively plan for how scientific data will be preserved and shared through the submission of a Data Management and Sharing Plan (DMSP). This will be a required portion of any applications for funding. The NIH also released Supplemental Information to the NIH Policy for Data Management and Sharing: Elements of an NIH Data Management and Sharing Plan in which the recommended elements of DMSPs are outlined. The elements include (1) data type, (2) related tools, software, and/or code, (3) standards, (4) data preservation, access, and associated timelines, (5) access, distribution, or reuse considerations, and (6) oversight of data management and sharing.
Impact Statement: A deep understanding of the elements required for a Data Management and Sharing Plan has many benefits including accelerating the pace of SRP research, enabling validation of research results, and the continuation of efforts to make all NIH-funded research Findable, Accessible, Interoperable, and Reusable (FAIR).

82: The Superfund Research Program: Engaging with Communities and Communicating Risks of PFAS Exposure
Kirsten Reid, Emory University
To address concerns related to PFAS, SRP grantees are tailoring communication strategies and facilitating knowledge exchange between scientists and local communities to improve health and lower health disparities. SRP grantees engage with community members, regulatory partners, and lawmakers by sharing research results and educational resources that can be used to inform ways to reduce exposure to PFAS and improve health. They have hosted town halls, created community resource websites and fact sheets, developed videos, and shared findings via podcasts. SRP researchers have also communicated results of PFAS testing and conducted interviews and focus groups with participants to learn more about their communication preferences to further customize reports. Additionally, SRP-funded research is being used to help inform new methods for dealing with PFAS in the environment as well as recommendations for health protective standards for PFAS. A unique aspect of the SRP is the University-based multi-project center concept, where health scientists and engineers working in transdisciplinary teams contribute their diverse expertise to address the center's research focus. The multidisciplinary SRP Center concept provides a framework for research teams to rapidly respond and apply knowledge and expertise to understand and reduce environmental threats. This poster will provide examples of successful research and health communication strategies by SRP grantees to understand the health effects, mitigate environmental exposures, or reduce the toxicity of PFAS. It will also describe how SRP grantees have engaged with communities and tailored risk communication strategies to educate communities of PFAS risks.

83: Point-of-need Detection of Lead (Pb) in Drinking Water with Cell-free Biosensors
Khalid K. Alam, Stemloop, Inc.
Safe drinking water is essential for public health yet is threatened by anthropogenic activities and aging infrastructure. In the US, contamination of drinking water with lead (Pb) is pervasive due to leaded water infrastructure and domestic plumbing. There is no safe level of lead exposure and chronic exposure results in numerous adverse health and societal outcomes. While exposure can be mitigated by changing drinking water source, flushing, and filtration, improper management can lead to public

health crises, particularly in vulnerable communities. Frequent monitoring of lead in drinking water can identify where problems exist, alert consumers without delay, and inform risk mitigation/remediation strategies. However, reliable testing remains limited to analytical chemistry techniques that are costly, time consuming, and require substantial infrastructure and technical expertise. This complicates the large-scale of testing needed to address the crisis and is a barrier to the routine testing of water by consumers.
Here, we present a technology platform that allows for the reliable, inexpensive, on-site, and on-demand monitoring of lead in drinking water. Our technology is built from innovations in synthetic biology that repurpose biological sensor proteins that detect lead in 'cell-free' reactions that produce detectable signals when lead is present. These biochemical reactions are safe and can be freeze-dried for long term storage and distribution. Adding water to these reactions activates a biochemical reaction that can be measured with simple lateral flow devices. Our first product, µSense™ for Lead, is sensitive at low parts-per-billion, highly specific for lead, easy-to-use by consumers, and inexpensive.

84: Environmental Liver Disease and the Interactions Between Diet, Metals and Sex
Jamie Young, University of Louisville
Chronic liver disease kills over 2 million people annually. Recently, the mostly rapidly growing contributor to liver mortality and morbidity has shifted from alcoholic fatty liver disease to non-alcoholic fatty liver disease (NAFLD). Although obesity is a major risk factor for NAFLD, it cannot account for all cases, indicating other risk factors, such as, sex and environmental exposures, increase susceptibility to NAFLD. Exposures to cadmium and hexavalent chromium [Cr(VI)], both drinking water contaminants of major public health concern, are implicated in the development and progression of liver disease. However, how exposures to these metals contribute to liver disease is not well known. In addition, there is increasing evidence that the adverse health effects associated with exposures to these toxic metals manifest differently in women and men. Therefore, we developed in vivo models to study the effects of exposure to cadmium or Cr(VI) on high fat diet (HFD)-induced NAFLD, considering outcomes in both males and females. We found whole-life exposure to cadmium exacerbates HFD-induced liver injury in male mice only, possibly through an altered metallothionein response. In our Cr(VI) study, we exposed 3-month-old rats to Cr(VI) in drinking water (0, 0.05, or 0.1 ppm) for 90 days. Preliminary data indicate Cr(VI) alters HFD-induced glucose intolerance and liver injury in males, but not females. Results from these studies confirm the multi-hit nature of NAFLD, show metal exposures alter HFD-induced NAFLD, and highlight the importance of sex as a risk factor in disease development.

85: Moving on from Uranium mining legacy within the Pueblo of Laguna
Kyle Swimmer, **New Mexico Institute of Mining and Technology**
Background: The Pueblo of Laguna was once home to the world's largest open-pit uranium mine. In 2013, Jackpile Mine became a Superfund site. The mine's legacy is one of poor reclamation, health concerns and environmental contamination that forever changed the Pueblo's culture and economy. Laguna people are proud of their agricultural way of life. During mining operations nearly all of the Pueblo's work force was employed by the mine, thus a whole generation gave up traditional farming practices. Additionally, the fear of soil and water contamination caused many growers to stop farming, thus losing our farming traditions.
Methods: We assessed the needs of Laguna communities using the "YAKANAL FoodSovereignty Assessment", Community Listening Sessions, and citizen-engaged sampling of soil, plants, vegetables, and water.
Results: A strong desire exists within the community to move away from the uranium mining era. The Agricultural Soil-Plant Study by UNM METALS SRP relieved a lot of tension of not knowing if agricultural soils are contaminated. The community has begun moving forward within the studied areas with some

peace of mind. While many unknowns still exist, efforts to revitalize agriculture within the Pueblo include reestablishing honeybee populations, fruit orchards and agricultural fields.
Impact Statement: While uranium-mining impacts have been pervasive in some areas of the Pueblo of Laguna, citizen-engaged research has enabled community members to move on from the uranium mining legacy. Pueblo members are resuming traditional farming practices in the studied areas to rebuild the Pueblo's traditional economy.

86: Green and Sustainable in situ Remediation of Heavy Metals Contaminated Soils and Aqueous Systems

Nadia Adam, Biomineral Systems LLC

The widespread contamination of soils, surface waters, and ground water with heavy metal(loid)s currently represents one of the most severe environmental problems that can seriously affect environmental quality and human health. This SBIR phase I project has demonstrated the feasibility of in situ remediation of heavy metals Pb(II), Cd(II), Cu(II), Hg(II), Ni(II), Cr(VI), As(V), and Sb(V) contaminated soils and aqueous systems using novel green Fe-P nanoparticles synthesized using a proprietary process. The project is particularly pertinent to contaminated soils, sediments, and groundwater such as for the USS lead superfund site costing in excess of 100 million dollars. The disturbance to the environment and workers exposure to toxic metals is much higher during the excavation, removal, and storage of contaminated soil to landfills w/o solving the contamination problem. Our next generation, green, and cost-effective in situ remediation technology will impact human health by meeting EPA mandated MCL for metalloids contaminated ground water, surface water, and soils including urban soils. Unique advantages of our technology include: 1) a new paradigm effective in remediating all trace metals in contaminated soils and groundwater; 2) an order of magnitude more cost-effective than current state of the art; 3) synthesis is simple using a green process with no risk of bioaccumulation; 4) Fe-P nanoparticles utilize dual surface functionalities enabling permanent binding of cationic and anionic metalloids enabling a one-step solution to mixed metal contamination; and 5) unlike nZVFe, no stabilizers are needed and no risk of corrosion or aggregation.

87: Thinking Zinc: A Study of Zinc Supplements on the Navajo Nation

Erica Dashner-Titus, University of New Mexico Health Sciences Center

Communities living in proximity to abandoned uranium mines have documented exposures to metals in drinking water, soil and dust. The objective of this study is to characterize and compare metal exposures in "Thinking Zinc" participants of the Navajo Nation. Thinking Zinc is an intervention trial to assess the effect of dietary zinc supplementation to mitigate the toxicity of metal exposures. Urinary metal analysis finds Thinking Zinc study participants with elevated levels of uranium approximately 4-fold greater than those detected in the general US population. Of 15 metals tested, 4 had at least 10% of the participants above the National Health and Nutrition Examination Survey (NHANES) 95th percentile. Interestingly, the median values of multiple metals were lower in the Thinking Zinc group compared to the Navajo Birth Cohort Study. Urinary metals differences were observed between the two study locations, Red Water Pond Road and Blue Gap/Tachee. Many metals show substantial fluctuations over time, with greater differences detected in urinary versus serum metals. Median total urinary arsenic concentrations in Thinking Zinc participants are similar to values in NHANES, although there are distinct differences in arsenic forms suggesting changes in metabolic outcomes for arsenic in the Navajo population. These findings highlight that certain metals exposures related to legacy uranium mine waste are elevated compared to NHANES in studies conducted on the Navajo Nation and that specific metals exposures may differ between Navajo communities. The finding of toxic metal fluctuations over time may ultimately inform additional strategies to reduce exposures through behavioral interventions.

88: An Integrated Analysis of Exposure Biomarker and In Vitro Toxicity Screening Data in Puerto Rico
Sammy Jaber, University of Michigan - School of Public Health
Rates of preterm birth have historically remained higher in Puerto Rico than in the mainland United States. Preterm birth is associated with long term health consequences for both pregnant mother and newborn. Although studies have shown that exposure to environmental pollutants can lead to increased risk for preterm birth, the specific chemicals and mechanisms involved remain unknown. We integrated maternal exposure biomarker data collected from the blood and urine of a cohort of pregnant women in Puerto Rico with publicly available in vitro toxicology data from the U.S. Environmental Protections Agency's ToxCast program. We compared concentrations of chemicals that activated molecular targets in ToxCast assays with pollutant biomarker concentrations. We then identified molecular targets from ToxCast assays that are linked to genes known to be involved in preterm birth. Our analysis revealed that 23 of 23 chemicals assessed (benzophenone, ethylparaben, methylparaben, propylparaben, triclocarban, triclosan, MBP, MBzP, MEHP, butylparaben, BPA, BPS, BPF, 2,4-DCP, 2,5-DCP, 1-hydroxynaphthalene, 1-hydroxypyrene, 2-hydroxyfluorene, oxybenzone, 2-naphthalenol, 9-phenanthrol, arsenic, and copper) were found at concentrations that activated one or more molecular targets in ToxCast assays. These included targets relevant to preterm birth: androgen/estrogen regulation (AR1/ESR1), regulation of progesterone (PGR), and lipid metabolism (PPARA/PPARG).
Impact Statement: Our results show that relevant exposure levels to environmental contaminants in pregnant women in Puerto Rico interfere with multiple molecular targets involved in the etiology of preterm birth. These findings provide important information about potential behavioral or remediation intervention targets for reducing pollutant impacts on adverse pregnancy outcomes such in Puerto Rico.

89: Thinking Zinc: An intervention to address environmental metal exposure on the Navajo Nation
Laurie Hudson, University of New Mexico Health Sciences Center
More than 500 abandoned uranium mines (AUMs) are located on the Navajo Nation and previous studies find an increased risk for chronic diseases related to AUM waste exposure. Experimental models demonstrate that metals such as uranium (U) and arsenic (As) disrupt certain zinc finger motifs and affect protein function: supplemental zinc confers protection against the metal effects. Based on this evidence, a community and academic partnership developed an intervention trial called Thinking Zinc. Thinking Zinc tests the hypothesis that dietary zinc supplementation at the recommended daily allowance will modulate biomarkers of oxidative stress, inflammation, and immune dysregulation, and decrease DNA damage in a metal-exposed population. Extensive community engagement and collaboration informed study name, study design and ensured that Thinking Zinc is congruent with Navajo cultural values. The study is a single-arm cohort design with longitudinal collection of biospecimens. To date, median compliance for the zinc supplements (% pills used/participant) is 83.5% (range 0-100%). Nearly 32% of participants have urinary U exceeding the National Health and Nutrition Examination Survey (NHANES) 95th percentile. Zinc did not appreciably affect urinary levels of measured metals with the exception of U. Zinc supplementation modestly decreased serum copper and increased serum selenium with both pre- and post-zinc levels within the reference ranges. Analysis of biomarkers pre- and post-zinc supplementation reveals a decrease in oxidative damage to lipds and DNA. Expression of some cytokines was modified after zinc supplementation. These preliminary findings suggest there may be benefits of zinc in a population exposed to AUM waste.

90: Arsenic Removal from Aqueous Solution by Interaction with Iron- and Manganese-Based Solid Sorbents
Lindsey Chatterton, RTI International
Concern over the occurrence of arsenic (As) in drinking water has a long history. The effects of chronic As exposure have been well documented and have provided the basis for regulating As concentrations

in drinking water. In recent years, adsorption is considered one of the most competitive methods for arsenic remediation from water due to its high efficiency, economy, and simple operation. There are various adsorbents made for arsenic removal including natural and composite materials. However, none of them is found to be completely applicable. Therefore, improved, and tailor-made materials are sought. Substitutes should be easily available, cheap and, above all, be readily regenerated, providing quantitative recovery. RTI's ultra-high reactive surface solid sorbents (e.g., Fe-and Mn-based sorbents), for optimum removal of metals from drinking water at maximum water productivity and reduced cost was developed to remove As through a novel chelating mechanism. Practical As removal by RTI's sorbent was achieved through high As removal efficiency at low sorbent loadings. As demonstrated from our recent data, both Fe-and Mn-based sorbents adsorb selectively As (III) and As(V). The As capacity of the sorbent is directly tied to the Fe oxide content as well as Mn oxide, which is dependent on the sorbent's amine formulation. It was also found that both sorbents showed greater adsorption capability and selectivity for As(V) and As(III) over other contaminants. Furthermore, both Fe- and Mn-based sorbents demonstrate in kinetics testing to have very quick As adsorption from water.

91: Cross-Training Iowa Superfund Research Trainees through an Immersive and Collaborative Graduate Course

James A. Ankrum, University of Iowa

The Iowa Superfund Research Program is the home to over 2-dozen trainees that have a research home in one of the center's 3 biomedical or 2 environmental science and engineering projects. As part of the RETCC efforts to promote cross-training of trainees across disciplines, a graduate course, PCBs in the Environment, was created. The course was co-taught by ISRP Director, Prof. Keri Hornbuckle, and RETCC Lead, Prof. James Ankrum. The course features 1-2 week modules that cover sources of PCBs, analytical methods, metabolism of PCBs, neurotoxicity of PCBs, inhalation studies, bioremediation, modeling, in vitro models, and data science. Each module is designed to give students a brief introduction to the topic and tools and then challenge the students to immerse themselves through a hands-on assignment. These assignments include reading primary literature, analyzing GC-MS data, handling left-censored data, calculating the partitioning of PCBs from air into passive samplers, observing a rat necropsy, and finding and reusing published data sets. In addition, students are given formal training in research skills, including searching the PCB literature, Community Engagement, and Research Translation. Finally, each student gives a 5 minutes presentation on their own research as a resident expert of one of the modules. Overall, the course content cross-trains trainees and gives them a greater appreciation and understanding for areas of PCB research outside of their own focus while the structure of the course promotes networking between students and with the 13 faculty and staff that lead each module.

92: Hydroxylation markedly alters how PCB52 affects gene expression in human preadipocytes

Aloysius J. Klingelhutz, University of Iowa

Background: Polychlorinated biphenyls (PCBs) accumulate in adipose tissue and are linked to metabolic syndrome, a cluster of conditions that include cardiovascular disease, obesity, and diabetes. The congener, PCB52 (2,2',5,5'-tetrachorobiphenyl), is found at high levels in school air. Hydroxylation of PCB52 to 4-OH-PCB52 (4-hydroxy-2,2',5,5'-tetrachorobiphenyl) by the liver or in the environment may alter its toxicity.

Methods and Results: To understand PCB52's role in causing adipose dysfunction, we exposed human preadipocytes to PCB52 or 4-OH-PCB52 across a time course and assessed transcript changes using RNAseq. 4-OH-PCB52 caused considerably more changes in the number of differentially expressed genes as compared to PCB52. Both PCB52 and 4-OH-PCB52 upregulated transcript levels of the sulfotransferase SULT1E1 at early time points, but cytochrome P450 genes were generally not affected. PPARa was the single biological pathway and predicted upstream regulator that was consistently

inhibited by PCB52. In contrast, 4-OH-PCB52 affected a variety of pathways, including those involving cytokine responses, hormone responses, focal adhesion, Hippo, and Wnt signaling. IL17A and parathyroid hormone (PTH) were predicted to be upstream regulators that are inhibited by 4-OH-PCB52. Most of the genes affected by PCB52 and 4-OH-PCB52 were different and, of those that were the same, many were changed in an opposite direction.
Impact Statement: These studies provide mechanistic insight into how PCB52 or its hydroxylyated metabolite may cause disease in humans. Many of the genes and pathways altered by PCB52 and 4-OH-PCB52 would be expected to have significant biological consequences for adipose function, potentially leading to metabolic syndrome.

93: A Vulnerability-Centered Approach to Building Trust
Joseph Hamm, Michigan State University
Background: Reducing the amount and toxicity of hazardous substances is a complicated endeavor that requires information-sharing, coordination, and cooperation among the various stakeholders of the Superfund Research Program. Success is therefore determined, in part, by the level of trust within the relationships that link these actors.
Argument: Reliably and efficiently building trust requires a nuanced understanding of the construct. Although variously defined, trust is most often understood as the trustor's willingness to accept vulnerability to harm from the deliberate actions of the trustee. Thus, when one trusts, they—more or less consciously—accept that the trustee can make decisions that could cause them harm. Building trust, therefore, requires attention to two important elements: the trustor's evaluation of their vulnerability to harm and the reasons why they would be willing to accept it. Classic trust-building approaches have tended to focus on the latter element at the expense of the former. Thus, although EHG agencies increasingly understand how to effectively communicate their trustworthiness, they often fail to fully understand the specific ways in which that trustworthiness intersects with salient community vulnerabilities. We argue that EHG agencies can best engage the public to protect and improve environmental health when they structure their trust building efforts to explicitly address salient community vulnerabilities.
Impact Statement: The current work offers theoretical grounding and practical strategies for helping EHG agencies ensure that they are responsive, not only to their official mandates, but also to the ways in which those mandates are perceived to interact with salient community concerns.

94: Machine Learning Models to Predict PFAS Removal by Granular Activated Carbon
Yoko Koyama, NC State University
Granular activated carbon (GAC) adsorption is frequently considered to control recalcitrant organic micropollutants (MPs) in both drinking water and wastewater. To predict full-scale GAC adsorber performance, bench- and/or pilot- scale experiments are widely conducted, which in turn has generated a wealth of breakthrough data. The overarching aim of this study was to develop machine learning (ML) models from such existing data to predict MP breakthrough from adsorbent, adsorbate, and background water matrix properties. These models provide a simple and fast tool to predict GAC performance. To develop information for model calibration, MP breakthrough curves were collected from the peer-reviewed literature, research reports, and engineering reports. These data sets were analyzed to determine the bed volumes of water that could be treated until MP breakthrough reached ten percent of the influent MP concentration (BV10). The data set encompassed 43 MPs, 18 GAC products, and 38 water matrices. Approximately 450 data sets were split into training, validation, and test sets. Seventeen candidate features, such as MP properties (Abraham parameters), background water matrix characteristics, and GAC properties, were explored in ML models to predict log-10-transformed BV10 (logBV10). BV10 values obtained from the resulting predictive model were highly correlated with

experimentally determined BV10 values (coefficient of determination ~0.89 for logBV10 prediction), and the most effective model predicted BV10 with an absolute mean error of ~ 0.11 log units. Key drivers influencing BV10 prediction included the MP's partitioning coefficient between air and hexadecane (Abraham parameter L); dissolved organic matter concentration in background water matrix; and the adsorbent's point of zero charge (pzc). The ML models can be used to estimate GAC bed life and select effective GACs for the removal of MPs such as per- and polyfluoroalkyl substances (PFASs) in a wide range of water types.

95: Identification and Evaluation of Contaminant Mixtures in Surface Water Using EDA Coupled to LC-HRMS

Manuel Garcia-Jaramillo, Oregon State University

Decades of intensive industrial activities and urban development has resulted in an increase in the occurrence and concentration of pollutants in the Portland Harbor Superfund Site. Given this site and other inputs, communities in the area raised concerns regarding water quality. In response, our lab is performing a spatial and temporal monitoring campaign to assess chemical changes in the Lower Willamette River. Replicate samples from each of the six locations selected are being monthly sampled for a 7-month period. Samples are processed and analyzed with two different analytical conditions to maximize the recovery of different chemical classes, using an ultra-high performance liquid chromatography system coupled with a high-resolution mass spectrometer. Post column separation, the eluate is split into two portions. Two thirds are led to our fraction collector and one third to our mass spectrometer. Fractions are collected in four 384-well replicate plates at 1s intervals. One of the plates is used in a zebrafish larvae toxicity assessment, and the other three plates are tested with three different human reporter cell assays. Via non-target analysis, corresponding structures of masses in active fractions can be identified. This approach helps to identify peaks that covary with observed biological effects, suggesting these as candidate causative chemicals. This project pairs a stakeholder-engaged research study with evaluation of state-of-the-art analytical approaches to discover predominant bioactive chemical mixtures using a novel toxicity assessment tool. This study will provide relevant data to an environmental justice community coalition.

96: Cytochrome P450 (CYP)1B1 modulates hyperoxia response in adult mouse lung by reprogramming metabolism and translation

Cristian Coarfa, Baylor College of Medicine

Background: Oxygen supplementation is life-saving, but it can induce long-term pulmonary injury by triggering inflammation, with xenobiotic-metabolizing CYP enzymes playing a critical role. Murine studies showed that CYP1B1 exacerbates, while CYP1A1 and CYP1A2 protect from hyperoxic lung injury. Here we tested the hypothesis that Cyp1b1-null mice would revert hyperoxia-induced transcriptomic changes in WT mice at transcript and pathway level.

Methods: This study used C57BL/6J wild-type (WT) and Cyp1b1-null mice aged 8-10 weeks, maintained in room air (21% O2) or exposed to hyperoxia (>95% O2) for 48h. RNA profiling was conducted via Illumina MouseWG-6 v2.0 kits. Limma determined significantly changed probes determined at fold-change>1.5x and FDR<0.05. Enriched pathways were determined using Gene Set Enrichment Analysis (GSEA). Human lung transcriptome datasets were scored for each murine gene signature; phenotype associations were determined using Pearson correlation at $p<0.05$.

Results: Hyperoxia exposure led to robust and correlated responses in WT, Cyp1a1-, Cyp1a2-, and Cyp1b1-null mice. At transcriptome level, all CYP1 murine models reverted hyperoxia effects. Cdkn1a and Ccnd1 were induced by hyperoxia in both WT and Cyp1b1-null mice but reduced in Cyp1b1-null O2 compared to WT O2 mice. GSEA identified 69 hyperoxia-affected pathways and mitigated only in Cyp1b1-null mice, including lipid, glutamate, and amino acids metabolism. Hyperoxia gene signatures

correlated positively with Bronchopulmonary Dysplasia (BPD), but Cyp1b1-null mice hyperoxia mitigation signature correlated negatively with BPD.
Impact: Distinct Cyp1b1-null mice phenotypes after hyperoxia exposure are partially explained by lipid and glutamate metabolism, suggesting that CYP1B1 plays a pro-oxidant role in hyperoxia-induced lung injury.

97: A Physiologically Based Pharmacokinetic (PBPK) Modeling Framework for Mixtures of Dioxin-like Compounds

Qiang Zhang, Emory University

Background: Humans are exposed to persistent organic pollutants as mixtures. Predicting the toxicokinetics of major constituents in mixtures is essential for the risk assessment of dioxin-like compounds (DLCs). PBPK models traditionally focus on one compound; including additional compounds often requires tedious, error-prone manual work. This lack of scale-up flexibility is a major technical barrier to multi-compound mixture PBPK simulations. Here we reported the development of a human PBPK modeling framework that is flexible to accommodate an arbitrary number of DLCs.
Methods: Adapted from existing TCDD models, our model contains 4 diffusion-limited compartments – liver, fat, blood, and rest of body. Varying-length vectors of ordinary differential equations (ODEs) are automatically generated to track the tissue concentrations of multiple DLC congeners, while shared ODEs are used to account for common variables, including aryl hydrocarbon receptor (AHR) and CYP1A2. The mixture models were implemented in the free Octave program.
Results: Mixture simulations showed that the cross-induction of CYP1A2 accelerates the metabolism of DLC congeners. The tissue burden of each congener in the mixture is generally lower than single exposure, except for the liver where CYP1A2 is induced. The mixture PBPK model makes preliminary predictions for lifetime exposures to DLC mixtures at polluted sites. Using model-predicted tissue burdens of DLC congeners can make more accurate assessment of the TEQ values.
Impact Statement: We developed a highly flexible mixture PBPK modeling framework for DLCs which can be utilized upon further optimization as a quantitative tool to estimate tissue dosimetry and health risks of DLC mixture.

98: Native Communities Integrate Indigenous Science in Assessments of Agricultural Lands, Mine Waste Toxicity, Remediation Policy

Chris Shuey, Southwest Research & Information Center and University of New Mexico

Background: More than 10,000 abandoned uranium mines (AUMs) have been documented in the Western U.S., and a disproportionate number are on or next to Native American lands. Few of these AUMs have been fully remediated. Indigenous communities have increasingly sought collaborations with universities and NGOs to assess impacts of AUMs on tribal resources and cultural practices.
Methods: Four Native communities are partnering with the UNM METALS Superfund Research Center to assess agricultural lands, evaluate toxicity of mixed-metal mine wastes, participate in biomedical interventions, and develop remediation policies informed by traditional ecological knowledge. Listening sessions were conducted to learn about community concerns. Trainings in proper soil, plant and water sampling methods were held for local farmers and gardeners. Indigenous educators gave trainings on Native perspectives on water and land for METALS researchers. Diné community members provided critical cultural insights in the design of a zinc supplementation trial.
Results: Mine wastes in all four tribal communities contain elevated concentrations of metals, including uranium. Soil and plant sampling limited to specific farming areas revealed no indication of contamination of farmlands and produce from nearby AUMs, however. Surface water quality is degraded by Jackpile Mine. More than 50 residents of two Navajo communities participated in the Thinking Zinc clinical trial. Tribal ommunities engaged in remediation meetings.

Impact Statement: Direct participation of Indigenous communities in environmental assessments of agricultural lands and mine wastes, a biomedical clinical trial, and in government remediation meetings has increased awareness of tribal concerns about ongoing impacts of the Uranium Legacy.

99: STEEP (Sources, Transport, Exposure and Effects of PFAS) SRP: Deeper Connections through Community Engagement

Jaclyn S. Witterschein, University of Rhode Island Coastal Institute

STEEP continues critical work around contaminated groundwater in Cape Cod, Massachusetts, strengthening engagement through focused outreach, trainee-led communication, and community science.

Community Engagement Core (CEC) activities include the facilitation of a private well water-testing program and education programs centered on harmful health effects of PFAS. Following a first-phase study, STEEP cores provided individualized reports to well owners using a Digital Exposure Report-Back Interface (DERBI) from the Silent Spring Institute. Custom feedback combined with data collected through focus groups and phone interviews has enabled STEEP to create targeted outreach materials to address community concerns.

Products including tip cards, videos, and podcasts have been developed to inform a broad audience about contaminated well water, PFAS products in the home, and human health impacts. STEEP trainees have assisted in educational efforts through research translation shared via the STEEP website and social media platforms. STEEP CEC has established relationships with the Mashpee Wampanoag Tribe, concerned with PFAS in shellfish and fish, as well as with Cape Cod educators aiming to integrate PFAS into high school STEM curricula.

COVID restrictions necessitated flexibility and encouraged STEEP to further engage Cape Cod residents in a community-led science effort: participants and organized volunteers were trained to collect their own well water samples. Future project goals include expansion of testing to homegrown produce and locally caught fish, and a similar community-science model may be used for data collection.

100: Maternal exposure to benzo[a]pyrene, a harmful PAH pollutant, is associated with altered microbial metabolite pathways

Melissa Suter, Baylor College of Medicine

Fetal exposure to environmental toxins, such as polycyclic aromatic hydrocarbons (PAHs), is associated with the development of later-in-life disease; however, the mechanisms for this increased risk remain largely unknown. In this study we sought to determine if there are significant changes to the maternal and offspring gut microbiome with exposure to benzo[a]pyrene (BaP), a toxic and ubiquitous PAH. Female mice (C57BL7, n=7) were orally gavaged with BaP (30 mg/kg) within 12 hours of mating. Oral administration of BaP (or corn oil control) was repeated on gestational days 11, 12, 16 & 19, and stool samples were collected daily. Total microbial DNA from stool and appropriate negative controls were 16S-amplicon sequenced (V4). Reads were QCed, processed into ASVs and classified using DADA2 in R. PICRUSt2 was utilized for inferred pathway analysis. Comparisons were subjected to ANOVA and Posthoc Tukey-Kramer (correcting for multiple comparisons).

Although (1) alpha diversity (Shannon Index; $p=0.068$) and (2) taxonomic community composition (beta diversity) of BaP exposed dams was not significantly different, there was a significant decrease ($p<0.05$) in predicted aromatic hydrocarbon biosynthesis pathways in the BaP treated dams.

Environmental toxin exposure through ingestion can directly influence composition of the maternal gut microbiome and the inferred microbial metabolite pathways, resulting in changes in her offspring's gut microbiome ecology. Further studies on alterations of the offspring microbiome following in utero exposure to PAHs may provide insight of environmental chemical and microbiome interactions during early developmental windows.

101: Modeling environmental exposures to Polycyclic Aromatic Hydrocarbons (PAHs) using antibody-based RPPA profiling

Melissa Suter, Baylor College of Medicine

We have previously reported that increased placental levels of the ubiquitous PAH benzo[a]pyrene (BaP) are significantly associated with preterm birth (PTB). In this study, we determined changes in proteins, including epigenetic modifiers and levels of site-specific histone modifications, that are associated with placental BaP levels. Protein extracts derived from 77 placental samples were profiled using an antibody-based Reverse Phase Protein Array (RPPA) platform. Expression levels for a total of 258 proteins across a regular RPPA panel, an epigenetic modifier panel, and our newly developed histone modification panel were determined. Gas chromatography mass spectrometry (GC-MS) was used to determine absolute levels of BaP in the same set of samples. We applied Weighted Gene Co-expression Network Analysis (WGCNA) to identify five modules of proteins, clusters which might have a similar function or be involved in a common biological process. One such module significantly correlated with absolute BaP levels (r=-0.51, p=2x10-6). The two strongest correlated proteins in this module were VIM (vimentin) and phospho-BCL2. Separately, we performed machine learning regression using RPPA data to predict BaP exposure over 100 iterations where data was split into 70% training and 30% testing; the randomForest regressor yielded the best performance with a median R2=0.42. Similar to WGCNA, the top two most informative proteins were VIM and p-BCL2, with machine learning analysis also demonstrating that histone modifications contributed to the model, including H3K4me3, H3K9me1, and K3K4me20. In addition to the potential biomarker value, this study reveals that PAH exposure may have reprogramming effects on the epigenome.

102: Relations of urinary volatile organic compound metabolites with inflammation and immune cells

Clara Sears, University of Louisville

Background: Volatile organic compounds (VOCs) are ubiquitous environmental pollutants detected at several hazardous waste sites. Exposure to VOCs is associated with insulin resistance, diabetes, and cardiovascular disease. However, the effects of VOCs on systemic inflammation are unclear. We evaluated the relation of urinary VOC metabolites, individually and in mixtures, with circulating cytokines and immune cells among 625 adults (ages 25-70 years) from Louisville, Kentucky.
Methods: We quantified a) concentrations of 16 urinary VOC metabolites by liquid chromatography-mass spectrometry; b) blood immune cells by blood analyzer; and c) plasma cytokines by multiplex array. Using linear regression models, we estimated covariate-adjusted relations of individual VOC metabolites with ln-transformed cytokine concentrations and immune cells. We used quantile g-computation to estimate covariate-adjusted relations of urinary VOC metabolite mixtures with inflammation biomarkers.
Results: In separate models, interquartile range (IQR) increases in the urinary metabolites of crotonaldehyde, acrylonitrile, 1,3-butadiene, and acrolein were associated with 4.0 to 10% higher concentrations of several pro-inflammatory cytokines, including IL-6, IL-8, or MCP1. Higher concentrations of the propylene oxide metabolite were associated with lower IL-9 (-1.0% per IQR; 95% CI= -1.1, -0.1). In mixture analyses, a quartile increase in all VOC metabolites was associated with 8.6% (-15, -2.0% lower IL-10, an anti-inflammatory cytokine, and 5.1% (95%CI= 1.0, 11%) higher white blood cell count. We did not find strong evidence of a joint VOC mixture effect of IL-6, IL-8, or MCP1.
Impact statement: VOC exposure could promote systemic inflammation thereby increasing susceptibility to cardiometabolic disease.

103: A physical aquifer model evaluation of hydrogel beads for the cometabolic treatment of chlorinated solvents

Lewis Semprini, Oregon State University

Background: Chlorinated solvents and 1,4-dioxane are common groundwater contaminants that are difficult to remediate to low concentrations. In-situ bioremediation methods for these chemicals through aerobic cometabolism have shown promise. In this study a cometabolic Permeable Reactive Biological Barrier (PRBB) was evaluated in a physical aquifer model (PAM).

Methods: Gellan gum beads (~500g) co-encapsulated with Rhodococcus rhodochrous ATCC 21198 and a 1-butanol producing slow release growth substrate were packed into a 500 mL column (RB1) within a 50 L effective volume rectangular sand packed PAM. A funnel-and-gate structure was placed at the front of the RB1 column to direct groundwater flow into the reactive column. Isobutene, a reactive surrogate for 1,4-dioxane, was injected into the PAM along with 1,2-Dichloroethane (1,2-DCA). Hydrogen peroxide was added as a source of dissolved oxygen (DO).

Results: Consumption of DO and 1-butanol in the RB1 reactor demonstrated stimulation of ATCC 21198 within the gellan gum beads. Isobutene oxide in groundwater samples from RB1 and isobutene concentrations below the detection limit indicated cometabolic activity. Isobutene was detected at sampling locations adjacent to RB1, indicating flow bypassed the constructed PRBB. Approximately 65% of the 1,2-DCA entering RB1 was transformed. Mixing calculations indicated the PRBB received ~42-47% of the groundwater flow, despite representing 67% of the PAM's cross-sectional area.

Impact Statement: The study demonstrated the metabolic and cometabolic activity of the gellan gum beads for over 300 days after their emplacement in the PAM. The funnel-and-gate system successfully treated isobutene and 1,2-DCA that was channeled into the PRBB.

104: Communicating pollutants that threaten tribal identities: A pilot study of PFAS contamination
Emily Diamond, University of Rhode Island

Background: Indigenous communities who rely on the consumption of fish and shellfish are uniquely vulnerable to water contaminants such as PFAS. However, traditional public health guidance and risk communication strategies that focus on reducing consumption can threaten Indigenous cultural identities that value the harvesting of local fish and shellfish. This study seeks to understand and document the connection between tribal/Indigenous identities and a reliance on natural resources, as well as how the impacts of PFAS as a recently recognized public health concern threaten this connection. The goal is to develop risk communication strategies that respect and acknowledge tribal identities while mitigating exposure risks from PFAS in locally caught fish and shellfish.

Methods: Data was collected qualitatively through three focus groups in March 2021 with members of the Mashpee Wampanoag Tribe on Cape Cod (n=12 participants total). Participants were recruited through connections with a member of the Tribal Council, with a focus on incorporating perspectives of both traditional fishers and shellfishers (n=7) as well as non-fishing Tribal members (n=5). Focus group transcripts were analyzed using inductive thematic content analysis.

Results: Participants discussed the cultural importance of fishing and shellfishing and what losing access would mean for their cultural identities. We documented current PFAS risk perceptions as well as guidance on trusted messaging and sources for future risk communication.

Impact: It appears that Tribes will face unique challenges in adjusting their behaviors to minimize exposure to PFAS. This study offers guidance on designing communication strategies to take these challenges into account.

105: NIEHS Translational Research Story: Creating A New Framework in Genetics and Environmental Health Education for Nurses
Kathleen Vandiver, MIT

Background Translational research is the evolution of a research idea into concrete strategies that protect and improve human health. This presentation illustrates how the NIEHS Translational Research

Framework (TRF) diagram with its unusual concentric rings and descriptive milestones documented our research program's progress towards translational impact
Methods We chronicle MIT's translational research story in genetics and environmental health education for healthcare providers. The MIT story was traced by selecting key TRF milestones on the diagram's five concentric rings, starting from the center and moving outwards. Translation took years to accomplish and thus, applying the lens of TRF was particularly helpful.
Results The following TRF milestones are illustrated on the poster.
1. Fundamental Question: Will improving nurses' knowledge of the molecular function of DNA and Proteins assist nurses in translating environmental health to vulnerable populations?
2. Application/Synthesis: Prototype models of DNA and Proteins were utilized in two-day nurse workshops;
3. Implementation: The DNA/Protein models were redesigned for production, then manufactured, & US patents issued;
4. Practice: Models were piloted with nurses serving tribes;
5. Impact: Nurses' learning gains were published in the International Journal of Environmental Research and Public Health (IJERPH) Jan 2022 and an NIEHS R25 Short Course grant was awarded in Sept 2022 with Vandiver as PI. The first Short Course for professional nurses serving tribes in South Dakota is scheduled for Nov 2022.
This story aptly demonstrates the utility of the NIEHS Translational Research Framework in charting translational impacts in our environmental health science research to action.

106: Key Characteristics of immunotoxicants: A new approach to identify chemicals that cause immunotoxicity and enhance mechanistic understanding
Cliona McHale, University of California-Berkeley
Key characteristics (KCs), properties of agents or exposures that confer potential hazard to human health, have been developed for carcinogens and other toxicant classes. These KCs have been used to systematically assess a variety of agents for potential hazard. Recognizing that many of the mechanisms by which therapeutics and environmental agents impact immune function are well-understood, we sought to develop KCs for immunomodulatory substances that could be applied to improve hazard assessment. A group of eighteen experts was assembled, conducted a consensus-based synthesis of scientific evidence, and identified 10 KCs of immunotoxic agents: 1. Covalently binds to proteins to form novel antigens; 2. Affects antigen processing and presentation; 3. Alters immune cell signaling; 4. Alters immune cell proliferation; 5. Modifies cellular differentiation; 6. Alters immune cell-cell communication; 7. Alters effector function of specific cell types; 8. Alters immune cell trafficking; 9. Alters cell death processes; 10. Breaks down immune tolerance. The group conceptualized how the KCs could influence immune processes and contribute to immunosuppression or inappropriate enhancement, including hypersensitivity and autoimmunity. These KCs can be used to improve efforts to identify agents that cause immunotoxicity via one or more mechanisms, identify data gaps, develop relevant assays/biomarkers to evaluate immunotoxicity, and inform a comprehensive and mechanistic understanding of adverse effects of exposures on the immune system. The KC framework relates to "systems approaches for innovative and inclusive environmental health solutions" as it enables comprehensive and unbiased evaluations across multiple toxicant classes and complements approaches such as Adverse Outcome Pathways.

107: The impact of ecological growth strategies on plasmid transfer and degradation for bioremediation of polycyclic aromatic hydrocarbons
Maya Suzuki, Duke University
Bioremediation is a sustainable treatment approach for the removal of harmful contaminants from the

environment. This technology tends to be more cost effective and more environmentally friendly than alternative remediation methods such as dredging and excavation. Genetic bioaugmentation is a targeted bioremediation method that uses horizontal gene transfer to introduce relevant genes to indigenous microorganisms already adapted to a polluted environment to increase in situ contaminant biodegradative capacity. In this project, we aim to apply this approach to the treatment of polycyclic aromatic hydrocarbons (PAHs), a class of ubiquitous and recalcitrant hydrocarbon contaminants that are carcinogenic to humans and toxic to the environment. However, one significant challenge to this approach is the lack of understanding surrounding the ecological growth strategies of indigenous microorganisms and the resulting impact on in situ plasmid transfer and functionality. Thus, the objective of this project is to identify the impact of bacterial growth strategy on plasmid transfer and functionality for the purpose of targeted bioremediation. To investigate this, we use two bacterial hosts harboring mobile PAH-degrading plasmids (NAH7 and pNL1) and novel fluorescent-based conjugation tracking methods to determine the effects of bacterial growth strategies on genetic bioaugmentation. Overall, our results suggest that bacterial growth strategy can be stimulated by differential nutrient biostimulation and identifies potential bacterial targets for genetic bioaugmentation. This fills a critical research gap for the translation of genetic bioaugmentation into field application of precision microbiome engineering.

108: CYP2E1 is responsible for high dose 1,4-dioxane-induced oxidative stress and cytotoxicity and contributes to genotoxicity in the mouse liver

Vasilis Vasiliou, Yale University

1,4-Dioxane (DX), an emerging water contaminant, is classified as a group 2B liver carcinogen based on animal studies. A clear understanding of the DX carcinogenic mechanism is important for the development and evaluation of effective mitigation of this public health hazard. Studies from our group revealed that high dose DX exposure to mice in the drinking water for up to 3 months caused mild cytotoxicity and oxidative DNA damage in the liver, a process correlating with hepatic CYP2E1 induction and elevation of lipid peroxidation. To examine the functional role of CYP2E1 in DX-induced liver cytotoxicity and genotoxicity, in the current study, we exposed Cyp2e1-null (Cyp2e1KO) mice to high-dose DX in the drinking water (5000 ppm) for 1 week or 3 months. Both our short-term and longer-term DX exposure failed to cause liver cytotoxicity in male Cyp2e1KO mice. Compared to WT levels, while DX-induced hepatic oxidative stress was nearly absent in Cyp2e1KO male mice, DX metabolism to HEAA was reduced to ~15%. Intriguingly, high dose DX exposure induced several unique molecular changes in the Cyp2e1KO liver including: (i) differential changes in genes involved in inflammation and tumorigenesis, (ii) trending elevation in oxidative DNA damage, (iii) suppression of DNA damage repair response, and (iv) induction of oncoprotein β -catenin and progenitor marker cytokeratin 7. These findings suggest that CYP2E1 is responsible for high dose DX-induced liver cytotoxicity and oxidative stress and is the primary enzyme that metabolizes DX to HEAA; however, DX liver genotoxicity likely involves CYP2E1-independent oxidation pathway(s) as well.

110: Household allergen induced mucus production is enhanced by environmental exposure to low dose cadmium

Pooja Singh, University of Alabama-Birmingham

Background: Household allergens like house dust mite (HDM) and cockroach extract (CE) induces allergic sensitization of immune defense mechanism. Exposure to common household allergens and heavy metals (cadmium) have been major contributors to the severity or existence of chronic airway diseases. Cadmium exposure through cigarette smoke (CS), diesel exhaust or any other occupational and environmental sources effects lung health by inducing mitochondrial and oxidative stress and cellular DNA damage. It is associated with increased AHR and can contribute to the pathology of existing

diseases or infections. ANO1 which is a Ca2+ dependent chloride efflux channel other than CFTR in airway epithelial cells. ANO1 regulates goblet cell metaplasia and hyperplasia. In this study we demonstrate that cadmium mediated regulation of ANO1 is critical for mucus production in airway diseases.
Methods: 6-8 week old Balb/c mice were exposed to Cadmium (Cd) and/or Cockroach extract (CE) through intranasal administration. Sensitization and challenge were achieved with – saline, CE alone or, CE and Cd together. AHR was assessed 24h after the last allergen challenge. Lung histology and BAL analysis was performed 48h after the last allergen exposure.
Results: CE and Cd co-exposure during sensitization and challenge demonstrated increased AHR in mice. ANO1 expression was highly upregulated in mice exposed to CE or Cd alone. Mucus production was analyzed with expression pattern of MUC5AC in lung homogenates and tissue sections.
Conclusion: Our results demonstrate that environmental cadmium induced ANO1 expression and may further exacerbate airway diseases and accelerate adverse effects of household allergens.

111: UNC SRP Team Approach to Research Translation and Community Engagement Builds Connections Among Stakeholders and Scientists

Sarah Yelton, UNC Chapel Hill Superfund Research Program

The Community Engagement Core and Research Translation staff in the Administrative Core of the UNC-Chapel Hill Superfund Research Program (UNC SRP) actively collaborate to foster environmental health literacy associated with well water contamination. We facilitate the use of scientific findings in accurate, timely and meaningful ways to reduce exposure to harmful contaminants. Working with community-based organizations, SRP researchers, and local/state agency partners, our efforts inform locally relevant solutions to toxic metals contamination of well water.
With partners, we have identified high-risk areas for metals contamination and provided free well tests in these areas to prevent and reduce exposure to contaminated well water. We also developed resources for local and state health departments to use in impacted communities, to enhance understanding of harmful environmental exposures to toxic metals in well water. Additionally, we developed a digital interactive notebook to bring current research into high school classrooms, enabling students to learn about sources of and health implications associated with drinking water contaminants, including potential for increased susceptibility to COVID-19 and metabolic disorders.
Our shared expertise supports policy-relevant outcomes as well. Our community and agency partners informed development of NC ENVIROSCAN, a mapping tool that allows users to visualize trends that include environmental contaminants, sociodemographic information, environmental justice indicators, and health outcomes throughout North Carolina. With community partners, we also co-convened the NC Well Water Working Group to increase dialogue around issues related to well water contamination and potential solutions. A 2022 white paper outlined policy recommendations to protect well users.

112: Exposure to aqueous film forming foam (AFFF)-impacted groundwater alters the liver proteome in fathead minnow

Nicholas Hill, University of Rhode Island - Graduate School of Oceanography

Per- and polyfluoroalkyl substances (PFAS) are environmentally ubiquitous and exhibit adverse effects linked to reproductive toxicities, disruption to metabolic pathways, and oxidative stress in aquatic organisms. Mixture studies by mesocosm design offer opportunities to explore PFAS toxicity reflective of PFAS concentrations in real-world environmental settings. Historical use of aqueous film forming foam (AFFF) at Joint Base Cape Cod, Massachusetts resulted in PFAS recalcitrance and contamination of sediments, groundwater, and surrounding surface waters. Reproductively recrudescent male (n=3) and female (n=3) fathead minnows (Pimephales promelas) were exposed to AFFF-impacted groundwater under controlled conditions for 7 or 21 days through employing a mobile laboratory, with non-exposed

tissue collected at day 0. Livers were subsequently processed for PFAS extraction and 21 PFAS were quantified in both groundwater and liver by targeted HRLC-MS/MS. Precipitated protein pellets were resuspended in PBS (pH 7.4) and then processed for protein measurement by SWATH-MS. Exposure to the AFFF-impacted groundwater significantly modulated global protein expression in liver at 7 and 21 days compared to day 0. STRING pathway analysis conducted using zebrafish (Danio rerio) as the specie reference for Protein-Protein Interaction Networks Functional Enrichment Analysis with the highest confidence score (0.900) revealed significant (FDR <0.05) protein interactions related to fatty acid metabolism, cell-cycle progression, and oxidative phosphorylation. These data support the association of AFFF exposure and alteration in pathways involved in liver function.

113: Bioconcentration of PFAS in fathead minnows (Pimephales promelas) exposed to AFFF-contaminated groundwater

Nicholas Hill, University of Rhode Island - Graduate School of Oceanography

Exposure to per- and polyfluoroalkyl substances (PFAS) poses ecological risks to wildlife and negative health effects in humans. Historical fire training activity at Joint Base Cape Cod, Massachusetts, used aqueous film forming foam (AFFF) which resulted in PFAS contamination of sediments, groundwater, and hydrologically connected surface waters. A mobile laboratory was established to evaluate bioconcentration of PFAS from AFFF-contaminated groundwater by flow-through design. Fathead minnows (n = 24) were exposed to PFAS in groundwater over a 21-day period and PFAS burdens in liver, kidney, and gonad were derived at d1, d7, and d21 of exposure. A total of 21 PFAS were quantified in both groundwater and fish tissue by high-performance liquid chromatography tandem mass-spectrometry (HPLC-MS/MS). ∑PFAS concentrations in groundwater increased temporally, ranging from approximately 10,000 ng/L at d1 to 36,000 ng/L at d21. Relative compositions of PFAS functional groups in liver, kidney, and gonad shifted temporally from majority perfluoroalkyl sulfonamides (FASA) to perfluoroalkyl sulfonates (PFSA). By d21, mean ∑PFAS concentrations in tissues decreased in order of: liver > kidney > gonad. Generally, bioconcentration factors (BCFs) for FASA, perfluoroalkyl carboxylic acids (PFCA), and fluorotelomer sulfonates (FTS) increased with degree of fluorinated chain length, but this was not evident for PFSA. Perfluorooctane sulfonamide displayed the highest mean BCF (7,700 L/kg) in d21 kidney. The present research highlights tissue distributions of legacy and precursor PFAS and emphasizes bioconcentration of C4, C6, and C8 FASA during environmental exposures.

114: Automating a Leaf Segmentation Workflow using Machine Learning and CyVerse

Michelle Yung, University of Arizona

University of Arizona SRC Project 5 researchers grow plants in rhizoboxes, capturing photos of the leaves and roots on a weekly basis in order to evaluate growth patterns and identify best practices for phytoremediation of mine tailings. The current method of data processing involves calculating leaf area by manually segmenting the leaves from the images using image processing software such as Image-J. This manual process is time consuming and subject to inconsistency due to human error. Here we demonstrate a machine learning system that automates the leaf segmentation process as well as much of the data management and data processing, improving efficiency and reproducibility.
Researchers deposit their image data into CyVerse, an open science cyber-infrastructure for data storage and analysis. We trained a Mask-RCNN machine learning (ML) model to perform leaf segmentation, which is made available via a Streamlit web application that runs on CyVerse and provides a user-friendly interface for researchers to independently run the ML model on their data. On a dataset of 192 photos, the model is performing with an average DICE score of 85%, and we will continue to explore techniques to improve accuracy. We have also introduced the use of QR codes for sample management to automate manual data management tasks, such as renaming and organizing files and managing metadata. Our work presents a sustainable model of a machine learning system that

automates and streamlines data processing and management workflows using CyVerse and is directly accessible and usable by researchers without any machine learning expertise.

115: Mechanism of Arsenic Driven Small Airways Disease
Kevin G. Dsouza, University of Alabama-Birmingham
Methods: Human bronchial epithelial cells (BEAS-2B) which were exposed to sodium arsenite (10uM), with or without pretreatment with JQ1 (5uM). BRD4 expression and extracellular matrix (ECM) markers were analyzed using immunofluorescence staining, western blotting and PCR techniques. Additionally, in vivo studies were conducted using a murine model specifically developed to study the effect of direct arsenic exposure to lungs. We performed histological analysis, lung function and measurements for collagen deposition in lung tissue in order to identify any evidence of lung airway inflammation and remodeling upon arsenic exposure.
Results: Arsenic exposure resulted in increased expression of BRD4 and ECM markers both in-vivo and murine models. Murine studies were consistent with increased airway hyperreactivity and small airways disease based on lung function measurements and histology. Pharmacological inhibition of BRD4 mitigated the effects of arsenic exposure in a cell culture and murine model as evidenced by decreased ECM production and airway remodeling.
Conclusion: Our studies indicate that Arsenic exposure mediated airway disease is mediated via BRD4 and pharmacological inhibition of BRD4 may be of clinical significance in arsenic exposed individuals with airway disease.
Future directions: The role of BRD4 in environmental induced lung disease has a broader scope and needs to be further investigated.

116: Community Engagement and Research Translation at the ULSRC
Joy Hart, University of Louisville
Background: The University of Louisville's Superfund Research Center (ULSRC) community engagement and research translation initiatives primarily focus on health impacts of volatile organic compounds and interventions on individual and systemic policy levels. Community partnerships and modifications to our multi-pronged approach enabled us to continue bi-directional engagement during the COVID-19 pandemic.
Methods: Our work includes community advisory boards, community science projects, knowledge exchange sessions, community conversations, one-on-one technical assistance, and participation in community-led meetings and initiatives. We produce newsletters, infographics, story maps, fact sheets, and social media content. As a result of COVID-19 driven public health concerns, ULSRC expanded our engagement capacity to include virtual platforms, learning from and with our partners.
Results: Community advisory board meetings, knowledge exchange sessions, and community conversations took place online, maintaining existing and adding new participants. We expanded some initiatives that were already virtual. For example, we extended the art and literature showcase to include both children and adults. Transition to online formats by several community groups allowed our team to maintain connections. ULSRC's transition increased our capacity to offer new events. We mitigated persistent obstacles, such as "zoom burn-out," through e-mail, phone calls with key partners, social media, and continued public documentation of ULSRC activities. ULSRC resumed some in-person events once our partners did so, incorporating many lessons learned during the height of COVID-19.
Impact statement: Collaborating with community partners, we deepened our capacity to respond to uncertainty, maintain relationships, and develop new pathways for creating healthier environments.

117: Laser Mid-Infrared Frequency Comb Spectroscopy: A Novel Technology for Medical and Environmental Diagnostics

Sergey Mirov, University of Alabama-Birmingham

Exhaled human breath contains over 1,000 volatile organic molecules (biomarkers) whose combinations reflect the metabolic effects of diseases, including infectious, cardiovascular, neurodegenerative, and oncological. The analysis of human breath can also be used for the detection, assessment, and evaluation of the effect on human health of hazardous substances. Rapid and reliable mapping of breath molecules could revolutionize modern medicine by providing accurate, non-invasive, and real-time diagnostics of diseases, including early diagnoses critical for successful treatment. Also, direct atmospheric probes can help detect hazardous substances in trace (part-per-million to part-per-billion) amounts. Existing technologies cannot accurately identify and analyze multiple biomarkers in human breath in real-time. In our laboratories, we develop a laser technology that builds this game-changing capability. The core of our innovative approach is a new frequency-comb laser technique that expands the groundbreaking work in optical frequency combs (2005 Nobel Prize in Physics) into the mid-infrared spectral region where organic molecules exhibit their strongest responses. The laser detection method - Dual Comb Laser Spectroscopy - combines superior spectral resolution, high speed, broadband coverage, and massive parallelism of data collection. In our recent pilot studies of breath samples collected from healthy as well as COPD patients, we have demonstrated highly accurate real-time detection of CO2 and H2O as well as trace molecules, such as CH4, NO, CO, N2O and their isotopologues containing isotopes: 13C, 18O, 17O, 15N, and 2H (deuterium) - with an unparalleled sensitivity down to part-per-billion.

118: Check Your Dirt NC: Helping NC Gardeners Understand and Address Environmental Health Risks from Gardening

Sam Cohen, Duke University

Community and home gardening are healthy activities, and vegetable gardens can provide cheap and nutritious food for gardeners and their families and friends. However, chemical contamination of soil can present health risks to gardeners. Awareness of previous land use at the garden site, as well as ongoing or legacy contamination sources nearby, best practices to limit exposure, and options for soil testing can all help reduce health risks. The Duke University Superfund Research Center worked with North Carolina State Cooperative Extension's to create 'Check Your Dirt NC', an online decision tool for gardeners to assess their relative risks from chemical soil contamination in the garden. Gardeners respond to questions related to potential sources of contaminants (e.g. previous land use, imported materials or soils, etc.) and behaviors that can reduce exposure (e.g. application of mulch, addition of organic matter). The interactive tool provides information about relative risks as a color-coded text, based on answers to each question. After completing the survey, a tailored report is created summarizing responses and providing additional information on best practices and helpful links to outside resources. Since the launch in November 2021, over 330 gardeners have used the tool, representing 74 of North Carolina's 100 counties. More than half indicate that they plan to learn more about how their garden's land was used and to teach fellow gardeners what they learned. We also share summarized results with extension agents and master gardeners through the state to help tailor gardener training to reduce exposure.

119: Strategies to Communicate Fish Consumption Advisories and Associated Health Risks in Lower Cape Fear River

Sam Cohen, Duke University

The Lower Cape Fear River is a highly polluted waterway. The N.C. Department of Health and Human Services has issued fish consumption advisories for legacy pollutants such as mercury, other metals and PCBs which pose significant health risks, particularly for vulnerable populations such as children and pregnant women.

With a coalition of community partners, we conducted research on fish consumption patterns and effective messaging and channels of communication to inform and elicit safer choices, including household and bankside surveys, focus groups and key actor interviews. The results were then used to inform the development of targeted outreach campaigns. People are eating fish from the Lower Cape Fear River and many are subsistence consumers who depend on wild caught fish as an affordable source of protein. For many, fishing and eating fish is also an important cultural and recreational activity, so guidance suggesting not eating any fish will be ineffective. Messaging should instead encourage alternative behavior changes that can limit risk - in the survey of bankside fishers, most respondents said they were willing to eat fewer large fish, filet fish, buy fish from a market, and try other actions that could reduce health risks. Consistent with other research, we found that messaging is most effective when communicated through a combination of graphics or videos and simple and accessible text. This research and the resulting outreach campaign have generated valuable lessons that can inform future strategies to communicate the risks of eating contaminated fish in North Carolina, and more broadly

120: Trichloroethylene Metabolite Impacts RNA Expression of Immune Processes in a Macrophage Cell Model: Implications for Pregnancy Outcomes

Annella Benjamin, University of Michigan

Trichloroethylene is a Superfund contaminant associated with adverse pregnancy outcomes. We previously showed that S-(1,2-dichlorovinyl)-L-cysteine (DCVC), a trichloroethylene metabolite, downregulates transcriptional immune pathways in a macrophage cell model (THP-1). Because macrophages function in immune regulation and tissue remodeling during pregnancy, DCVC could adversely affect pregnancy outcomes. In this study we sought to 1) identify potential transcription factors that regulated macrophage responses to DCVC and 2) identify DCVC impacts on genes and pathways directly relevant to critical macrophage functions (e.g. phagocytosis). Briefly, THP-1 cells were differentiated into macrophages, treated for 24 hours with 5 µM of DCVC followed by immune stimulation with lipopolysaccharide (LPS). RNA was collected from four conditions: control, DCVC (5 µM), LPS (100 ng/mL), and DCVC (5 µM) + LPS(100 ng/mL). Transcriptomic profiling was conducted using RNA sequencing. EnrichR was used for transcription factor enrichment analysis. Genes impacted by DCVC after immune activation with LPS were enriched for binding sites of the transcription factors EGR1, TRERF1, CEBPD, and VDR ($p<0.05$). Gene set enrichment analysis revealed that DCVC altered expression of genes in pathways corresponding to the steps of phagocytosis. Individual phagocytosis genes downregulated by DCVC included: TNF ($p<0.05$, fold change = -3.49), TLR7 ($p<0.05$, fold change = -4.42), SYT7 ($p<0.05$, fold change = -4.77), and SELE ($p<0.05$, fold change = -4.02). Our results suggest that DCVC impacts genes associated with transcriptional regulation of immune processes, potentially increasing maternal susceptibility to intrauterine infection and disrupting immune homeostasis during pregnancy.

121: A Systematic Evidence Map of Chronic Inflammation and Immunosuppression Related to Per-/Polyfluoroalkyl Substance Exposure

Gabrielle Rigutto, University of California-Berkeley

Background: The ability to induce chronic inflammation and immunosuppression are two key characteristics of carcinogens and important forms of immunotoxicity. The National Toxicology Program (NTP) evaluated the immunotoxicity of two per- and polyfluoroalkyl substances (PFASs), PFOA (perfluorooctanoic acid) and PFOS (perfluorooctane sulfonate) in 2016. The pro-inflammatory and immunosuppressive effects of other PFASs remain largely uncharacterized.

Methods: We developed an expanded set of search terms based on those of the International Agency for Research on Cancer (IARC) and NTP to retrieve studies pertaining to the chronic inflammatory and immunosuppressive effects of PFASs. Studies were used to produce a series of systematic evidence maps presenting the current state of the scientific studies of PFAS-associated immunotoxicities.

Results: In total, 1155 PFAS studies were retrieved using our expanded set(s) of search terms, of which 321 qualified for detailed review. Using this data, we generated a series of evidence maps to visualize interrelationships of study types or immune outcomes vs. PFAS exposure type and exposure-response effects. We bolster supporting evidence that PFAS exposure may contribute to chronic inflammation. We also confirm PFASs' immunosuppressive properties as they are associated with decreased B-cell activation and altered levels of T-cell subtypes and immunoglobulins.
Impact : Our improved search strategy confirms that several common PFASs exhibit immunosuppressive effects and may also induce chronic inflammation, which suggests their potential contribution to carcinogenicity. This systematic evidence mapping approach, which calls for the development of inclusive search terms and rigorous evidence synthesis, can be applied to other key characteristics of chemical carcinogens

122: Stable water isotopes provide insight into As and U spatial variability in Northern Plains drinking water

Jacob Abbott, Union College

Arsenic (As) and uranium (U) contamination in drinking water affects millions of individuals across the US. This issue is particularly acute across rural populations where many people obtain drinking water from unregulated private wells. One specific location greatly affected by high levels of As and U in both surface and groundwater is the US Northern Plains. However, the environmental and anthropogenic factors responsible for the mobilization and heterogeneous distribution of As and U in the waters of this region remain poorly characterized. Groundwater recharge sources and the flow path of water supplying surface water can strongly influence the mobilization and accumulation of aqueous As and U. To understand how hydrologic process affect the distribution of these metals we relied on stable water isotopes (δ2H, δ18O, δ17O). Here we collected stream and spring water samples from over 30 locations across South Dakota and Nebraska and measured stable water isotopes (δ2H, δ18O, δ17O) to determine the sources of recharge/inflow to both surface water and groundwater (e.g., heavily evaporated surface water, snowmelt, precipitation). We observe strong positive correlations between As and U and stable water isotopes – a finding that suggests that mobilization of these elements is occurring under oxic conditions, mobilization is delocalized, and As and U are likely accumulating along the water's flow path. These results allow for greater understanding of how hydrology influences As and U occurrence in surface water and groundwater and can be used to help better predict areas at high risk for As and U contamination.

123: National User Resource for Biological Accelerator Mass Spectrometry

Bruce Buchholz, Lawrence Livermore National Laboratory

The National User Resource for Biological Accelerator Mass Spectrometry (AMS) provides ultra-sensitive 14C isotopic analyses for biomedical researchers with access entirely free for nearly all NIH-funded research. AMS is a specialized type of mass spectrometry that provides absolute quantitation of 14C by measuring the concentration of 14C/C with detection limits in real samples of a few attomol/mg enabling quantification of radiolabeled metabolites in complex matrices of cells and organisms. AMS allows studies to be conducted without perturbing metabolism leading to more relevant quantification of metabolic rates and pathways. It enables quantification of pharmacokinetic and metabolic properties of toxicants at environmentally relevant concentrations in model systems as well as the ability to quantify pharmacokinetics and other molecular endpoints directly in humans. These assessments can 1) improve risk assessment for toxicants, 2) address safety and efficacy considerations for therapeutic entities, 3) deepen understanding of xenobiotic and intermediary metabolism, 4) help understand the interactions between critical molecular pathways, and 5) improve efforts to model and predict various metabolic and biological states. The capabilities have been applied

in ADME, dose-response, mass balance, pharmacokinetic and metabolic pathway analyses, protein and nucleic acid adduct formation, and biomarker identification studies.

124: Research Translation: Uniting Academia, Government Agencies, and Industry to Advance the Environmental Sustainability of Mining

Rocio Estrella, University of Arizona

The Center for Environmentally Sustainable Mining (CESM) is an outgrowth of the University of Arizona Superfund Research Center (UA SRC). The CESM mission is to develop research and educational initiatives to enhance the environmental sustainability of mining in arid and semiarid environments. We emphasize collaboration with industry partners through industry-academic research cooperatives and are guided by a Technical Advisory Committee comprised of industry and consulting professionals who identify environmental issues of concern to the hard rock mining and rock products industries. Thus, CESM essentially acts as a pipeline for research translation of newly developed environmentally protective technologies to industry. CESM and the UA SRC share research efforts focused on a broad range of topics including accelerated ecosystem regeneration and monitoring of lands impacted by mine operations, erosion mitigation strategies, metal clean-up and recovery from industrial waste streams, and dust monitoring and mitigation. A research forum was organized in November 2022 to broaden this research translation network by defining new partnerships with government agencies who manage or regulate natural resources impacted by mining. Agencies in attendance included the Arizona Department of Environmental Quality, US Forest Service, Bureau of Land Management, Army Corps of Engineers, the Arizona State Mine Inspector, Arizona Fish and Game and others. Such creative academic-industry-government agency partnerships will accelerate our ability to identify critical technologies that can advance the sustainability of mining in a world where the transition to renewable energy systems has caused demand for critical metals to increase exponentially.

125: High resolving power mass spectrometry measurements of human serum reveal PEPA isobaric interference

Jeffrey R. Enders, North Carolina State University

Detection and quantitation of perfluoroalkyl substances (PFAS) in human biological fluids using liquid chromatography-mass spectrometry (LC-MS) requires sensitive and specific methods to help reduce the incidence of false positive and false negative reporting. High resolving power mass spectrometers have the potential to alleviate these issues by providing exact mass measurements and isotopic distribution information. In North Carolina, many of the PFAS of interest are manufacturing byproducts (e.g., GenX). Detection and quantitation of these species is compounded by the fact that standards may be unavailable or difficult to synthesize and as such there is not as much historical data for comparison. PFAS were detected and quantitated using a high resolving power mass spectrometry platform (Thermo Vanquish LC with a Thermo Exploris 240). Compounds were separated using a Phenomenex F5 LC column. Data were interrogated using Skyline and Thermo's FreeStyle software. In analyzing human serum from volunteers throughout North Carolina for a panel of 46 PFAS, a higher than expected positivity rate was observed for perfluoro-2-ethoxypropanoic acid (PEPA) in some populations. Upon closer examination it was determined that an isobaric interference of PEPA was actually the cause of the observed feature. This interfering compound had a near identical mass (difference of only ~15 ppm), a near identical peak shape, and near identical retention time on a fluorinated column. The isotopic distribution of the feature seems to indicate that the compound is chlorinated and may be 5-chloro-4-ethyl-2-hydroxy-benzenesulfonic acid (CASN: 104207-29-6, DTXSID00446126), though this compound has no known obvious industrial or contamination sources.

126: Alterations in Mitochondrial Lead (Pb2+) Uptake with Co-exposures to Uncouplers and Mitochondrial Calcium Uniporter (MCU) Inhibitors

Pooja Lalwani, Duke University

Lead (Pb2+) is a metal to which many people are exposed and causes developmental toxicity. The mitochondrial calcium uniporter (MCU) imports calcium ions. It is believed that this complex is also responsible for the influx of lead into the mitochondria, via molecular mimicry. Since our environment contains mixtures of damaging agents, it is important to consider multi-chemical exposures. In this study, HepG2 cells were exposed to lead alone and in mixtures with other mitochondria-damaging chemicals, including carbonyl cyanide-p-trifluoromethoxyphenylhydrazone (FCCP), a mitochondrial uncoupler, and Ruthenium Red (RuRed), a dye that inhibits the MCU. We examined cell viability by analysis of dose-response curves at various concentrations. After 24 hours, lead alone, the mixture of lead and RuRed, and the mixture of lead and FCCP caused no decrease in cell viability. However, the mixture of all three exposures lead to a significant decrease (34%, p=0.001) in cell viability at elevated lead concentrations. After 48 hours, the co-exposure to elevated lead concentrations and FCCP caused a significant 35% decrease (p=0.015) in cell viability, and the mixture of all three showed a clear dose-response curve with significant decreases in cell viability across a range of lead concentrations. Currently, we are evaluating if calcium supplementation will rescue the decrease in cell viability, and analyzing lead uptake in the mitochondria via ICP-MS following our exposures. This research will provide more information on the toxicity of lead and its mechanisms directly on the mitochondria.

127: Biomarkers of metals are associated with risk of preeclampsia and maternal blood pressure during pregnancy

Amber Cathey, University of Michigan

Background: Elevated blood pressure (BP) and hypertensive disorders of pregnancy increase risk of early delivery and cardiovascular disease later in life. Environmental exposures may alter blood pressure during pregnancy and contribute to adverse health outcomes.
Methods: We utilized data on 644 women from the PROTECT Puerto Rico birth cohort. Urine samples were collected at up to three time points (18, 22, 26 weeks) for assessment of 14 metals, and BP was measured at numerous times through gestation during ultrasound appointments. Linear mixed effect models were used to regress diastolic/systolic BP on urine metals, included a random intercept, and were adjusted for maternal age, education, parity, pre-pregnancy BMI, gestational age at BP measurement, and specific gravity. Secondary analyses evaluated preeclampsia (PE) in association with gestational average metals. We also explored effect modification by fetal sex and preexisting hypertension.
Results: Systolic BP decreased by 0.90 (95%CI:-1.64,-0.15) and 0.51 (95%CI:-1.00,-0.01) mmHg with interquartile range (IQR) increases in cobalt and antimony exposure, respectively. Conversely, IQR increases in barium, manganese, nickel, and selenium resulted in increases in diastolic blood pressure by 0.61 (95%CI:0.10,1.13), 0.72 (95%CI:0.31,1.14), 0.72 (95%CI:0.13,1.32), and 1.17 (95%CI:0.54,1.79) mmHg, respectively. Increased odds of PE were associated with IQR increases in barium, cobalt, cesium, lead, and zinc. Notably, the association with cobalt was robust to exclusion of women with preexisting hypertension. Finally, numerous cases of fetal sex effect modification were observed.
Impact Statement: Elevated urine concentrations of various metals are associated with changes in maternal BP during pregnancy and increased risk of PE.

128: Examining Demographic Disparities in Wildfire Hazard and Risk in North Carolina through NC ENVIROSCAN

Raquel Winker, UNC Gillings School of Public Health

Background: Wildfire events are becoming increasingly common across many areas of the United States,

including North Carolina (NC). Wildfires immediately threaten nearby populations, and wildfire smoke can harm the overall health of exposed individuals. It is therefore critical to identify populations at increased risk of wildfire events, particularly those with socioeconomic disparities that may exacerbate impacts of wildfire events. We set out to test the hypothesis that certain regions of NC contain socioeconomic subgroups at increased risk of wildfire events.
Methods: Wildfire hazard potential (WHP) indices were analyzed across NC. These indices were updated in 2020 and incorporate several wildfire risk-relevant inputs, spanning vegetation and wildland fuels data, burn probability, projected intensity, and locations of previous fire occurrence. WHP indices were statistically evaluated with socioeconomic indicators across NC. NC ENVIROSCAN was used to visualize resulting combinations of WHP and socioeconomic indicators, highlighting populations with racial/ethnic disparities at heightened risk for wildfire events.
Results: When evaluated alone, WHP is generally greater in the eastern areas of NC. Additionally, heightened WHP was found in the southern region of NC that overlaps with existing tribal communities. When socioeconomic factors were incorporated, WHP was identified as elevated for populations in NC with higher percentages of the population living below the poverty level and who speak a language other than English.
Impact Statement: Wildfires are projected to impact certain populations with racial/ethnic disparities in NC, representing potential impending public health crises that should be considered in the planning of community preparations and response activities.

129: UA SRC Olympus – Streamlined Data Exploration
Anthony Vicenti, University of Arizona
The University of Arizona Superfund Research Center (UA SRC) produces a variety of biological, geophysical, and chemical data that require innovative management systems. Our Olympus server hosts a variety of applications intended to streamline the storage, exploration, and visualization of this data through standard analysis pipelines. By leveraging CyVerse as a data and analysis management system, we can bring a user-friendly experience to individual investigators, empowering them to explore their data and make new discoveries. Our current suit of applications includes Demeter (RNA sequencing alignment), Ares (DESeq2), Hermes (gene set enrichment and pathway analysis), Hera (geochemical data upload), and Artemis (geochemical interactive map). As we continue, we hope to expand our user base to other SRP groups and members to create a hub of data and analysis, facilitating high levels of collaborative research.

130: Using Healthcare Data to Identify Health Disparities: A Comparison Study of Superfund and Neighboring Site
Crystal Stephens, University of Alabama-Birmingham
Background:Inequities in pollution-attributable health disparities are similar in most urban areas throughout the United States, and encompass racial and socio-demographic differences. Individuals of color are the predominant occupants residing in close proximity to Superfund sites, and exhibit increased health risks, with significant differences in lung diseases compared to a neighboring control area, irrespective of smoking, socio-economic status, or demographics.
Methods/Results:We evaluated healthcare utilization and classification of disease (ICD-10 codes) of patients based on residential zip code. Zip codes 35207 and 35217 are considered the Superfund site, and zip code 35214, a neighboring comparison site. Utilizing the Enterprise Data Warehouse (Informatics for Integrating Biology and the Bedside (i2b2)), we conducted a retrospective analysis. Patient data was collected from those who obtained healthcare from the University of Alabama at Birmingham Health System. Logistic regression adjusted odds of any healthcare utilization by setting was used to compare the visits. Superfund area residents were 1.32 times and 1.31 times more likely to have

inpatient and emergency room visits, respectively compared to the neighboring site, and they (Superfund) were less likely to have outpatient visits, OR (0.86: 95% CI 0.80, 0.91). Residents also exhibited higher chronic pulmonary disease (12% vs. 9.8%).
Impact Statement:Results suggests an association between residing in the Superfund area and increased prevalence of chronic diseases. Also, residents are less likely to receive routine healthcare to better manage chronic conditions. These findings propose that external factors (e.g., pollution) may contribute to environmental effects on residents, and continued efforts to mitigate impact is necessary.

131: A unified pipeline for mapping phenotypes to chemical exposures for morphological, behavioral, and transcriptomic data

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20% of all Superfund sediment sites have categorized polycyclic aromatic hydrocarbons (PAHs) as a risk driver for remediation. PAHs can travel long distances to impact exposures and have been demonstrated to be cancerous, teratogenous, and have detrimental effects on the neurological system. What has yet to be extensively studied is the effects of specific PAHs at increasing concentrations on biological systems. Here we provide an analysis platform that links the PAH environmental exposure for 500 chemicals (150+ PAHs) via passive sampling to biological responses (endpoints) using a zebrafish model. Our workflow standardizes multiple calculations for dichotomous (morphological) and continuous (behavioral and transcriptomics) endpoints, including benchmark dose responses (BDRs), and regression model fits and quality. All tables are output in a database-ready format, and our results are visualized in an interactive portal called the Superfund Research Program Analytics compendium at http://srp.pnnl.gov. The tool allows users to explore and download many facets of the data, which includes chemicals across superfund sites, BDRs for endpoints, and differentially expressed genes and their functions across experiments (in development), to name a few. Our workflow and the resulting portal provide three major benefits to the Superfund community at large: 1) an end-to-end pipeline for processing various datatypes for BDR, 2) an easy-to-use interface for exploring specific hypotheses regarding PAHs and other chemical data from Superfund sites, and 3) a medium for making our program's data FAIR (findable, accessible, interoperable, and reusable) compliant.

132: Galena Park, Texas, A Fence-line Community Evaluating the Health Impacts of Industrial Pollution

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Previous research has conclusively revealed the health impacts of individuals living in "fence-line" communities. However, few studies have examined the health outcomes of communities at the nexus of exposures from industrial pollutants and extreme weather events such as flooding. Galena Park, Texas, is one such location that typifies environmental justice issues and the potential health effects from experiencing multiple hazards. This cross-sectional study (n=130) assessed the health outcomes using three methods, (1) the 12-item Short Form Health Survey, which generates a composite physical health score comparable to national means, (2) self-reported noncancerous chronic conditions, and (3) self-reported diagnosis of twelve different cancers. For this study, three risk levels (low risk: ≤5, medium risk: ≤10, and high risk: ≤13) were spatially created in which each one had a five-scale ordinal score. Study results showed that chronic conditions witnessed nearly a two-fold increased risk in the highest-risk locations compared to the lowest (POR 1.91; 95% CI 0.82-4.39) and a 50 percent increased risk of cancer diagnosis (POR 1.51; 95% CI 0.38-5.99). Additionally, individuals living within the higher-risk location had a 59% increased risk of diagnosis compared to the reference group even after adjusting for sex and age (POR= 1.59; CI= 0.39 - 3.52). The study revealed that relatively compact areas in close proximity to industrial pursuits and flooding events drove the majority of negative health outcomes. These findings

highlight the need for smart urban planning designs to improve health outcomes, especially within fence-line communities like Galena Park, TX.