Superfund Research Program: 35TH Anniversary Annual Meeting

Thursday, December 15, 2022

Poster Session II

201: Exposure to Aroclor 1254, Aroclor 1016, and non-Aroclor Cabinet Mixture Impairs Adipose Stem Cell Function

Jesse Liszewski, University of Iowa

PCBs have been associated with metabolic syndrome and endocrine disruption in epidemiological studies. While production of Aroclor mixtures have been banned since the late 70s, PCBs still persist within our everyday lives through biproducts from current manufacturing practices and volatilization from products that historically contain Aroclor mixtures and have yet to be replaced in older buildings. With evidence suggesting continual exposure to historical Aroclor mixtures along with new sources such as the silicone finish on cabinets, it is important to identify how these PCB mixtures influence cellular function. In this study, we focused on identifying the disruptive potential of historical Aroclor mixtures (1254 and 1016) and Cabinet Mixture on the immunomodulatory behavior and adipogenic potential of adipose-derived mesenchymal stem cells. The cells were pre-exposed to 5- and 10 uM concentrations of the mixtures for 48 hours, followed by either a four-day co-culture with CD3/CD28-activated peripheral blood mononuclear cells or a two-week adipogenic differentiation culture. We found that cells pre-exposed to the mixtures had slightly decreased immune resolving potential and presented decreased adipogenic potential through down-regulated expression of important adipogenesis genes, decreased lipid accumulation, and less production of adiponectin, a vital adipokine for metabolic health. These aspects are important as the pathology of obesity, a prevalent metabolic syndrome, is characterized by an inability for the resident stem cell niche to replace damaged adipocytes. This leads to overcompensation of mature adipocytes through hypertrophy, which is associated with adipose inflammation and decreased insulin sensitivity.

202: Advancing Probabilistic Risk Assessment Incorporating Biomonitoring, New Approach Methods, and Bayesian Modeling: A Case Study with Deoxynivalenol

En-Hsuan Lu, Interdisciplinary Faculty of Toxicology and Department of Veterinary Physiology and Pharmacology, Texas A&M University

Deoxynivalenol (DON) is a mycotoxin frequently found in grains, with reported toxicities including reduced body weight and reproductive effects. The current guideline value used traditional risk assessment approaches to derive a deterministic Tolerable Daily Intake (TDI) of 1 µg/kg-d, but data from human biomarkers studies of DON and its metabolites indicate worldwide and variable exposure, necessitating more sophisticated methods to quantify population risk. The WHO/IPCS has used DON as an example in deriving a probabilistic toxicity value, quantifying variability and uncertainty in population dose-response, in the form of the human dose with effect size M in the Ith percentile human (HDMI) of 2.9 [90% CI: 0.44-0.19] µg/kg-d, for M=5% decrease in body weight and I=1%. We extend this case study by incorporating Bayesian modeling approaches, in vivo toxicokinetic data to quantify inter- and intra-species toxicokinetic differences, and in vitro human population new approach methods to quantify intra-species toxicodynamic differences. Combining these together probabilistically, we improved the precision and accuracy of DON toxicity values while also deriving population dose-response functions for characterizing population risk. We converted the HDMI to biomonitoring equivalents, BEMI, in blood or urine to facilitate comparison with biomonitoring data. We derived an HDMI of 13 [2.7-63] µg/kg-d, with BEMI of 3.6 [0.98-12] µg/L in blood or 9.0 [1.8-43] µg/kg-d in urine, where the lower confidence bounds represent probabilistic TDIs. Overall, we demonstrate that combining Bayesian modeling, biomonitoring

data, and in vitro population-based new approach methods within the WHO/IPCS probabilistic framework leads to more accurate and precise risk characterization.

203: A Community-Engaged Approach to Maternal/Child Biomonitoring in Rural Colorado (MEMCARE-SLV)

Francesca Macaluso, Colorado School of Public Health

Background: As part of the Community Engagement Core (CEC) of the Metals and Metal Mixtures: Cognitive Aging, Remediation, and Exposure Sources (MEMCARE) Study, the Colorado School of Public Health is working in the San Luis Valley (SLV), a rural, bi-ethnic agrarian community in south-central Colorado to collect environmental and biological samples from pregnant persons and their newborns to better understand exposures to environmental heavy metals during a key developmental window.
Methods: MEMCARE-SLV is actively collecting repeated longitudinal measures of urinary metals in pregnant persons and their families (~60), along with concurrent water samples from local wells and exposure assessment surveys, to better characterize environmental exposures. In collaboration with Arizona State University, individual results are being mapped to community-level findings.
Results: This presentation will highlight key initial findings from the analysis of repeated longitudinal urine and water samples (n=7) and connect these findings with the broader environmental history of the region and other community-engagement activities being conducted by the study team in the SLV.
Impact Statement: The SLV's natural geology, as well as agricultural and mining activities, contribute to high levels of ambient heavy metals, which can pose short and long-term maternal/child health risks. Additionally, recent evidence suggests that extended periods of drought related to climate change may further increase heavy metal levels in drinking water. This work is of critical public health importance to inform communities, local public health officials, and healthcare providers of the risks that environmental metals pose during pregnancy and to strategize ways for reducing exposure.

204: Evaluation and Parameterization of Molecular Dynamic Force Fields for Per- and Polyfluoroalkyl Substances (PFAS)

Melissa Marciesky, University of Pittsburgh

Background: The strong carbon-fluorine bonds that lend useful amphiphilic properties to per- and polyfluorinated alkyl substances (PFAS), coupled with lack of experimental data, make them difficult to accurately simulate using molecular dynamics (MD).
Methods: We investigated the current accuracy and improved the default parameterization of three common MD forcefields: GAFF2, Amoeba, and CHARMM. A set of small, incremental "PFAS building block" molecules was defined to facilitate simulations: an increasingly fluorinated methane and building blocks for carboxylic and sulfonic acids. Amoeba forcefield parameters were generated from quantum mechanical (QM) data, descriptors for GAFF2 were generated through the antechamber/parmchk program in Amber 20, and descriptors from CHARMM were generated through Ligand Reader & Modeler. Larger PFAS, including PFOS and PFOA, were also evaluated based on QM interactions and using MD to prediction binding with liver fatty binding acid protein, for which experimental data were available.
Results: QM simulated homo-dimer and water-dimer interaction energies and torsional angle energies were compared, along with available experimental data from NIST (for enthalpy of vaporization and liquid density of the "building block" compounds). Our results show that auto-generated structures struggle to balance accuracy between vacuum and dynamic systems with increasing fluorination.
Impact statement: Our results convey the importance of proper parameterization for PFAS to achieve accurate MD simulations. In addition, our approach illustrates how lack of experimental data can be overcome through validating an appropriate level of theory via QM simulations that can be used as a "ground truth" to parameterize increasingly complex fluorinated molecules.

205: Characterization of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) mediated dysregulation of human hematopoietic differentiation using single cell transcriptomics

Isha Khan, Michigan State University

The role of AHR signaling in human hematopoietic differentiation is poorly understood. An in vitro culture system was used to study the effects of AHR activation by 1 nM 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) on hematopoietic differentiation of human cord blood CD34+ hematopoietic stem and progenitor cells (HSPCs) over 28 days. Single cell RNA-Sequencing (scRNA-Seq) and flow cytometry were employed to monitor changes in gene expression and cellular development. scRNA-Seq analysis suggested a decrease in development of cells of lymphoid and megakaryocyte-erythroid lineages and an increase in pro-myelocytes and monocytes in the TCDD-treated group, compared to vehicle (0.02% DMSO) treated cells. Flow cytometric analysis confirmed reduction in CD10+ (lymphoid progenitor) cells and an increase in CD14+ (monocyte) and CD66b+ (granulocyte) progenitors with TCDD treatment. Using differential gene expression analyses, we identified that genes critical for development of B-cells (EBF1), dendritic cells (BCL11A) were downregulated (log fold change difference > 0.25, p value < 0.01) by TCDD treatment. Additionally, transcription factor (TF) activity inference using bioinformatics revealed suppression of activity of TFs involved in M2 macrophage development (MAF, IRF4, STAT1, etc.). Gene set enrichment analysis showed TCDD treatment induced differential enrichment for pathways such as NF-kB signaling and for metabolic processes such as oxidative phosphorylation. In conclusion, this study identifies distinct gene expression programs in differentiating HSPCs that are modulated by AHR activation with TCDD treatment, thus leading to dysregulation of human hematopoietic differentiation and putative developmental immunotoxicity.

206: Influence of folate+B12 supplementation on arsenic methylation: A double-blinded, placebo-controlled trial in Bangladeshi children

Irene Martinez-Morata, Columbia University

Background: Exposure to inorganic arsenic (iAs) adversely affects children's health. iAs is methylated via one carbon metabolism (OCM) to mono- and dimethy- arsenical species (MMA and DMA), facilitating urinary As excretion. OCM is dependent on folate and B12. Randomized control trials (RCTs) demonstrated that folic acid (FA) supplementation increases As methylation in adults. This RCT in Bangladesh investigated the effects of FA+B12 supplementation on As methylation in children, a key developmental stage where OCM supports growth.

Methods: Participants (N=240 children, 8-11 y) switched to low As wells and received 400ug FA+5ug B12 or placebo daily for 12-weeks. GEE models were used to assess treatment effects on As species in blood and urine.

Results: The prevalence of folate and B12 deficiency was <20%. Overall, total blood and urine As decreased by 11.7% and 17.6% respectively likely due to well switching. Compared to placebo, increases in the concentration of blood DMA by 9.2% (p=0.003), and non-significant (NS) decreases in the concentration of blood iAs (2.2%) and bMMA (6.3%) were observed in the FA+B12 group. Similar changes in the relative distribution of As metabolites were observed in urine but NS. This may be due to limited statistical power and emphasizes the value of having blood As metabolite data.

Impact statement: This unique RCT confirms that FA+B12 supplementation increases iAs methylation in children as reflected by decreased iAs and MMA and increased DMA in blood. Nutritional interventions can improve nutritional status and may also improve As methylation and elimination in children.

207: Spatial predictive dispersion modeling of PM2.5 concentrations as surrogates for exposure in Colfax, LA

Martine Elisabeth Mathieu, NC State University

In Colfax, LA, a predominantly Black rural town where 90.2% of the community lives below the poverty line, several residents have experienced adverse health effects (thyroid, cardiovascular, respiratory, gastrointestinal, and skin) and household damage in an area surrounding an open burn/open detonation hazardous waste thermal treatment facility that accepts waste including soils from Superfund sites, fireworks, military ordnances, and munitions, resulting in emission of fine PM. To predict the spatial distribution of PM2.5 concentrations as surrogates for exposures and help Colfax residents understand their health risks from exposure to the facility emissions, we used AERMOD to model dispersion in Colfax from April 1st to June 30th, 2022. In our model, we used four types of input data: 1) 10-m resolution digital elevation terrain data from the US Geological Service National Elevation Dataset, 2) hourly meteorological data collected from the Alexandria airport, located approximately 30 miles from the facility, 3) community-informed data that provide the quantity of waste burned for the days and hours when the facility operated, and 4) PM2.5 field measurements from low-cost sensors PurpleAir set up in Colfax. A series of maps displaying the spatial distribution of PM2.5 concentrations for 8- and 24-hour averaging time over our 3-month initial study period were obtained. Our preliminary results showed that PM2.5 dispersion occurred over the Colfax community adjacent to the facility. The Rock, a high poverty predominantly Black enclave adjacent to the facility, was the most impacted. The average concentrations exceeded the EPA's annual ambient PM2.5 standard of 12 μg/m3.

208: Methods for Analyzing Environmental Mixtures Effects on Survival Outcomes and Application to Population-based Cohort Study

Melanie Mayer, Columbia University

Environmental mixtures studies consist of multiple continuous and correlated exposures with complex relationships on the outcome. While studies have compared the performances of statistical learning methods for modeling the effect of mixtures, survival outcomes have yet to be considered.
We compared methods in terms of bias/efficiency when evaluating individual exposure/complete mixture effects on survival outcomes. We considered Cox PH with/without penalized splines and Cox Elastic Net. Additionally, we applied discrete-time survival analysis approach to Gaussian Process Regression (GPR), Multivariate Adaptive Regression Splines (MARS), and Bayesian Additive Regression Trees (BART). We conducted simulations under several real-world scenarios and evaluated the effect of six metals on incident CVD in the Strong Heart Study (SHS) cohort.
In simulations where the PH assumption held, BART and MARS's estimates of the hazard ratio (HR) for an IQR change in the mixture had high bias and variance, resulting in higher RMSEs (0.3-5.2) compared to the other methods (0.1-0.9). When it was violated, RMSEs were comparable to other methods (0.2-0.3), other than GPR (0.1), while achieving higher coverage (>76%). In the SHS analysis, all methods found significant effects. However, MARS, BART and GPR estimated larger HRs with wider confidence intervals.
Impact Statement: While survival outcomes are highly relevant in health studies, it has been unclear how methods perform for analyzing environmental mixtures on survival outcomes. By evaluating them under this context, we will guide future studies' choice in statistical modeling, shed light on how equipped we are at for this scenario and support future methodological development.

209: Association of Volatile Organic Compound Exposure with Blood Pressure in National Health and Nutrition Examination Survey (2011-2018)

Katlyn McGraw, Columbia University

Background: Volatile organic compounds (VOCs) are ubiquitious environmental pollutants generated from a variety of sources, such as superfund sites, coal fired plants, consumer and household products, and tobacco smoke. Exposure to VOCs has been associated with cardiovascular disease (CVD) risk factors, such as increased blood pressure (BP); however, limited research has been conducted in the

general population.
Methods: We hypothesized that higher levels of VOC exposure are associated with higher BP. We combined four cycles of data from the National Health and Nutrition Examination Survey over the years 2011-2018 for a final sample size of n=7,432 participants. Utra-Performance Liquid Chromatography Mass-Spectrometry was used to measure 31 urinary VOC metabolites. Metabolites were adjusted for urinary creatinine to account for differences in dilution. Linear regression models adjusted for age, sex, race, education, BMI, smoking status, HDL, cholesterol, triglycerides, diabetes, blood pressure medications, eGFR, and NHANES cycle year were used to estimate associations between VOC metabolites and BP.
Results: Participants were 52% female, median age of 47 years, 32% had hypertension, and 7.2% had diabetes. We found an interquartile range increase of 1,3-butadiene metabolite, DHBMA, was associated with a 0.54 mmHg higher (95% CI: 0.2, 1.1) systolic BP. In subgroup analysis, this association was independent of age and was stronger in women, non-tobacco users, Mexican Americans, and individuals not diagnosed with CVD.
Impact: Exposure to VOCs, particularly 1,3-butadiene, may be a relevant, yet understudied environmental contributor to CVD risk in the general population.

210: Evaluation of Haemogregarina crocodilnorum Infection as a Biomarker of Adverse Health Impacts of PFAS in American Alligators (Alligator mississippiensis)
Zachary McLean, NC State University
Per- and polyfluoroalkyl substances (PFAS) are persistent organic contaminants linked with adverse immune health outcomes in humans and animals. We demonstrated that increased concentrations of PFAS are associated with increased innate immune activity and autoimmune-like phenotypes in American alligators. We sought to systematically quantify numbers of Haemogregarina crocodilnorum, an apicomplexan blood parasite, and evaluate whether parasite infection was associated with PFAS concentrations and adverse phenotypes. Because some human auto-immune diseases are associated with low parasite infection, and host-parasite dynamics can be impacted by environmental factors and health status of the host, we hypothesized that H. crocodilnorum would be decreased in alligators with elevated blood PFAS concentrations. To address this hypothesis a comparative study was conducted by collecting blood samples from animals at Greenfield Lake, a site connected to the Cape Fear River, and Lake Waccamaw (LW), a site located in the adjacent Lumbar watershed with low PFAS contamination. Following quantification of blood PFAS concentrations, whole blood slides were stained, and H. crocodilnorum infected red blood cells were scored. H. crocodilnorum infections in each infected animal were significantly lower in alligators from Green Field Lake. Correlation analysis revealed a negative correlation between PFAS concentrations and H. crocodilnorum. This work provides novel evidence that PFAS exposure can alter health biomarkers and host-parasite dynamics, important groundwork for establishing the utility of H. crocodilnorum as a biomonitoring tool of organismal and ecosystem health. Ongoing analysis is evaluating correlations between H. crocodilnorum abundance, PFAS concentrations and health-related in alligators.

211: Changes in California arsenic and uranium community water concentrations relative to US EPA regulation
Danielle N Medgyesi, Columbia University
Background. Enforcement of current US EPA maximum contaminant levels (MCLs) for water arsenic (wAs; 10µg/L) and uranium (wU; 30µg/L) in community water supplies (CWS) began in 2006 and 2008, respectively. Prior, the MCL for wAs was 50µg/L and no MCL existed for wU.
Methods. We leveraged data from the California Office of Environmental Health Hazard Assessment to evaluate CWS with ≥1 annual average concentration (2005-2013) every 3-years (wAs N=2,013; wU

N=617). We used quantile regression to estimate the percentage change and 95% confidence intervals (95CI) for 3-year average wAs/wU concentrations at the highest percentiles (90th, 95th, 97.5th). We also evaluated differences by source type and population served.
Results. Between 2005-2013, 12% (wAs) and 10% (wU) of CWS had ≥1 annual average above respective MCLs. Arsenic at the 95th percentile (wAs95th) decreased by 11% (95CI=-21%, -0.6%) in 2008-10 and 23% (95CI=-31%, -6%) in 2011-13, relative to 2005-07 (14µg/L). Likewise, wAs90th and wAs97.5th significantly decreased over time. At the highest percentiles, wAs was 4-5x greater for CWS using groundwater versus surface water; decreases were marginally stronger among groundwater systems (pinteraction90th=0.11). Adjusting for source type, reductions were similar across population served. We found no significant reductions in wU even at concentrations ≥MCL (wU95th=30µg/L). wU90-97.5th was 3-3.5x higher in groundwater versus surface water.
Impact Statement. The highest wAs concentrations in California CWS decreased over time, congruent with enforcement of the reduced MCL. However, there was limited evidence that wU decreased over time, potentially suggesting an absence of mitigation efforts to comply with the MCL.

212: Water arsenic and uranium exposure and risk of cardiovascular and chronic kidney diseases in California

Danielle N Medgyesi, Columbia University

Background. High levels of arsenic in drinking water (wAs) have been linked to cardiovascular disease (CVD) and chronic kidney disease (CKD), but risks at lower levels near the maximum contaminant level (MCL=10µg/L) remain uncertain. Another water contaminant, uranium (wU; MCL=30µg/L), is particularly nephrotoxic but there are few epidemiologic studies to understand health effects.
Methods. The residential addresses of women in the California Teachers Study at enrollment (1995-1996) were linked to community water system (CWS) boundaries to estimate average wAs and wU exposure (2005-2013). Incident cases of CVD (myocardial infarction, stroke, revascularization procedures) and CKD (stages 1+) were identified with statewide hospitalization records (1995-2018). Among participants with the same residential address 10-years after enrollment (N=40,100), we separately modeled wAs and wU exposure using penalized splines to estimate hazard ratios (HRs) and 95% confidence intervals (95CIs) for CKD and CVD risk using Cox proportional hazard models, adjusting for baseline age, menopause/hormone use, BMI, smoking status, exercise, self-reported health, socioeconomic status and urbanicity.
Results. Relative to average wAs (1µg/L), exposure ≥97.5th percentile was associated with CVD risk (5µg/L: HR=1.09, 95CI=0.95-1.24; 10µg/L: HR=1.35, 95CI=1.01-1.81); total cases=4,191. Increased wU exposure was not associated with CVD risk. However, wU exposure ≥97.5th percentile was associated with CKD risk (15µg/L: HR=1.16, 95CI=1.02-1.31, REF: average=3.7µg/L); total cases=4,001. Excess risk at the highest wU exposure was consistent among advanced CKD (stages 4+, cases=625). We observed no association between wAs and CKD.
Impact Statement. Exposure to wAs and wU near MCLs may be associated with CVD and CKD risk, respectively.

213: Using StoryMaps to Illustrate the Cumulative Impacts of Environmental Harms

Haley Metcalf-Wade, University of Louisville

Background: Superfund and other hazardous land uses are more likely to be located and disproportionately concentrated in areas with higher shares of racialized minorities and economically burdened residents. Individuals living and working in proximity to these sites, therefore, experience cumulative impacts in several ways. 1. Spatially concentrated hazardous land uses means multiple sources and types of hazardous exposures. 2. Impacts from exposure compound with other layers of harm caused by structural inequality. 3. Harm accumulates over time. Impacted residents and those

who represent them need accessible information to address and mitigate the variety of cumulative impacts of hazardous land uses such as Superfund sites. Using StoryMaps to share information about environmental harms can be impactful and supplement other sources of information.
Method: StoryMaps provide impacted residents with a geographic and visual depiction of historical, social, and environmental contexts of several Superfund sites in Kentucky, reflecting a variety of cumulative impacts. We include analyses of the sites' regulatory status. A community advisory board reviews each StoryMap to provide feedback regarding content and usefulness before public release. Google Analytics allows us to analyze user information to determine the level of outreach.
Results: Preliminary results indicate that the community advisory board members find the StoryMap content useful for learning more about each site's social and environmental context, and outreach is moderately successful.
Impact: This project creates resources for residents to address and mitigate environmental harms at individual and policy levels, thereby contributing to a systems approach to problem solving.

214: Reactive Membrane Synthesis for Capture and Degradation of Toxic Water and Air Pollutants
Rollie Mills, University of Kentucky
The need for clean water and air has become prominent in recent years due to the widespread presence of toxic chemicals, such as perfluorooctanoic acid (PFOA) and trichloroethylene (TCE) in environmental sources. Exposure to such compounds can result in a weakened immune system, neurological problems, and birth defects in humans, thus source filtration and contaminant removal is becoming increasingly vital for health longevity. To combat this problem, novel responsive materials were synthesized to capture and degrade these pollutants from water and air sources. Commercial microfiltration membranes were functionalized with poly(N-isopropylacrylamide) (PNIPAm), a thermo-responsive polymer that can exhibit both hydrophilic and hydrophobic behavior, depending on the temperature of the system. The resulting membranes utilized a temperature-swing adsorption/desorption process to effectively remove PFOA from water samples above the lower critical solution temperature (LCST) of PNIPAm. Then, below the LCST, the system can release the adsorbed contaminant to obtain a concentrated sample for further treatment. For TCE treatment in industrial water and air sources, similar reactive membranes were synthesized using zero-valent iron-palladium nanoparticles. With these particles, the membranes can dechlorinate PCBs and other harmful chlorinated compounds via electron-transfer reactions, thus significantly lowering the toxicity of such pollutants. The synthesis of these membranes shows exciting advances in creating the next generation of filtration systems for environmental remediation. This research is supported by the NIEHS SRP and by the NSF RAPID program.

215: Perfluorooctanesulfonic acid (PFOS) tissue distribution and elimination in mice is unaltered in mice lacking Liver or Intestinal Fatty Acid Binding Protein (FABP)
Seyed Mohamad Sadegh Modaresi, University of Rhode Island
Per- and polyfluoroalkyl substances (PFAS), such as perfluorooctane sulfonic acid (PFOS) are common persistent environmental organic pollutants. Many PFAS are detected and accumulate in liver, but the mechanisms by which PFAS interact with hepatocyte proteins, and how these interactions can affect their distribution and retention in liver are poorly understood. Fatty acid-binding proteins (FABPs) make up between 1% and 5% of all soluble cytosolic proteins and are crucial in lipid-mediated biological processes. No study has addressed whether FABPs in liver or intestine are a critical mechanism for PFAS distribution and elimination in vivo. We hypothesized that PFOS distribution to liver would be decreased in mice lacking Fabp in either liver or intestine. To test the hypothesis, we performed in vitro binding studies using liver tissues and administered a single dose of PFOS (5 mg/Kg) to wild-type, L-Fabp-/-, or I-Fabp-/- mice (n=3/group). Serum, urine, and fecal samples were collected at different timepoints until

day 65. Tissue PFOS levels were measured by LC-MS/MS. For in vitro binding assays, the fraction unbound (Fu) was similar for liver tissues from three groups, indicating that FABP is not critical for determining PFOS tissue binding. Serum, liver, intestine, lung, brain, skeletal muscle, and urine PFOS concentration was similar between groups. Preliminary data from a second study also indicated no role for LFabp for liver PFOS levels after a single dose of 0.1 or 0.5 mg/kg PFOS. Taken together, Fabp deletion did not influence tissue PFOS binding in vitro or after a single PFOS dose in vivo.

216: Impact of Probiotics on NDMA-induced Mutations & Injury-Induced Inflammation
Aimee C. Moise, MIT
Exposure to environmental mutagens is a major health concern worldwide. These chemicals substantially increase the risk of developing cancer, and we are interested in methods to reduce or mitigate these effects. Probiotics have been shown to suppress the formation of diet- or genetically induced cancers. Additionally, in vitro evidence suggests antigenotoxic and antimutagenic effects of probiotics. Here we examined the effects of treatment with probiotics on tumorigenesis and in vivo induction of mutations caused by exposure to the environmental contaminant N-nitrosodimethylamine (NDMA). Using CD-1 mice, we evaluated whether in utero treatment with probiotics reduces the formation of liver tumors in animals exposed to NDMA as neonates. We observed a marked decrease in tumor burden in NDMA-exposed mice treated with probiotics. Next, we evaluated the impact of probiotics on the initiation and promotion stages of cancer development. Using the ROSA26-GFP Direct Repeat (RaDR) mouse model, we can detect large-scale sequence rearrangements introduced during homology-directed DNA repair. We observed increased RaDR mutations in NDMA-exposed mice treated with probiotics compared to untreated animals. Studies with CD1 mice revealed that probiotics increase the frequency of NDMA-induced point mutations. To evaluate the promotion stage, we exposed mice to the liver inflammatory agent carbon tetrachloride. Transcriptomic analysis reveals that probiotics dampen induction of pathways induced by carbon tetrachloride exposure. Interestingly, many of these pathways are related to DNA replication, DNA repair, and cell cycle control. Overall, we interpret these results as indicating that probiotics suppress the promotion stage of cancer development, rather than the initiation stage.

217: Role of Alkylated Polycyclic Aromatic Hydrocarbons in Mixture Toxicity from a Legacy Creosote Site
Ian Moran, Oregon State University
Creosote is a pesticide used to preserve wood products. While creosote is a common contaminant, the toxic effects of weathered creosote are poorly understood. Alkylated PAHs are abundant constituents of creosote and many petroleum products. While less is known about the toxicity of alkylated PAHs than their parent compounds, alkylated PAHs have been shown to contribute substantially to the toxicity of PAH mixtures in the environment. The goal of this study is to understand the contribution of alkylated PAHs to the toxicity of a complex, weathered mixture from a legacy creosote site. Using passive samplers deployed at a former creosote facility, chemical mixtures are collected from the surface water. Sampler extracts are analyzed by gas chromatography - tandem mass spectrometry for unsubstituted and alkylated PAHs. To assess toxicity, embryonic zebrafish are exposed to sampler extracts and a suite of behavioral and morphological endpoints are observed. A twelve-month sampling campaign at the site has demonstrated substantial temporal variability in chemical abundance and toxicity. Alkylated PAHs constituted 83-89% of measured PAHs in all samples. Fractionation of sampler extracts by gel permeation chromatography revealed that the alkyl-containing fracton matched the toxicity of the whole mixture while the unsubstituted PAHs were split across multiple fractions. While further confirmation is necessary, these results suggest that highly abundant alkylated PAHs are responsible for

driving toxicity rather than routinely monitored parent PAHs. Understanding the role of alkylated PAHs can inform remediation and improve our ability to protect human and ecosystem health.

218: Diffusive Fluxes of Persistent Organic Pollutants Between Arctic Atmosphere, Surface Waters and Sediments

Ian Moran, Oregon State University

Like other arctic communities, Yupik residents of Sivuqaq (St Lawrence Island), Alaska are disproportionately exposed to pollutants from sources including global atmospheric transport and formerly used defense sites (FUDS). Troutman Lake, adjacent to the native village of Gambell was used as a disposal site during the decommission of the adjacent FUDS, leading to community concern about chemical exposures. In collaboration with community partners, this study utilized passive sampling devices deployed at eight locations in Troutman Lake. Air, water and sediment pore-water deployed samplers were analyzed for unsubstituted and alkylated polycyclic aromatic hydrocarbons (PAHs), brominated and organophosphate flame retardants and polychlorinated biphenyls (PCBs). PAH concentrations were low and comparable to other remote/rural locations. The majority of PAHs were in deposition from the overlying atmosphere into Troutman Lake. Brominated diphenyl ether 47 was detected in all surface water samplers while triphenyl phosphate was detected in all environmental compartments. Both were at concentrations equivalent or lower than other remote locations. Of particular interest, we measured higher atmospheric concentrations of tris(2-chloroethyl) phosphate (TCEP) (0.75-2.8 ng/m3) than previously reported in the literature for remote Arctic sites (0.017-0.56 ng/m3). TCEP was found to be in deposition to Troutman Lake at magnitudes ranging from 290 to 1300 ng/m2/day. No PCBs were detected in this study. These findings can help us to understand the fate of anthropogenic contaminants in dynamic Arctic systems with both global and local sources of modern and legacy pollutants.

219: Comparative hazard potential of environmentally relevant alkylated polycyclic aromatic hydrocarbons (PAHs)

Mackenzie L. Morshead, Oregon State University

Background: With an increasing demand for fossil fuels and a growing frequency of wildfires, polycyclic aromatic hydrocarbons (PAHs) are an environmental contaminant of growing concern. While PAHs are typically present in complex mixtures, concern has primarily focused on unsubstituted PAHs. Understanding the toxicity of alkylated PAHs is important for a comprehensive understanding of the hazard potential of this diverse chemical class.

Methods: 73 alkylated PAHs were screened for morphological and behavioral effects in a high-throughput developmental zebrafish assay. Embryos were exposed to 12 concentrations from 0 to 100uM (n =14) and screened for morphological effects using 10 morphological endpoints, and behavior using a larval photo motor response. The aryl hydrocarbon receptor (AHR) is often implicated in the toxicity of PAHs and the induction of cytochrome P4501A is an excellent biomarker of AHR activation. Embryos were evaluated for spatial Cyp1a expression patterns using an AHR-responsive reporter line.

Results: Of the 73 alkyl PAHs tested, 31 were morphological hits, 15 were behavior and morphology hits and 6 were just behavior hits. 12 of these 73 compounds have been detected in the environment, our screening results will be compared against their or similar compound's environmental concentrations to ascertain risk.

Impact Statement: This is the largest set of alkylated PAHs yet to be screened. Results from this study will enhance our ability to identify structure-activity relationships to move toward predictive hazard assessment of PAHs.

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220: Understanding Elemental Profiles in Environmental Samples from the Elizabeth River, VA
Samantha Murphy, Duke University
Background: Ecosystems worldwide are affected by metal contamination from anthropogenic sources and effects are still being understood. Metal contaminated sites from industrial pollution in the Elizabeth River, VA provide unique sites to examine biological effects of exposure to metal mixtures in organisms. Sediment levels from Pescara Creek were measured previously and found to be elevated in metals, most notably lead. Our objective is to compare metal concentrations in sediment, water, and fish tissues between Pescara Creek (PC) and reference site (King's Creek (KC)), to determine if toxic metals are accumulating in Atlantic Killifish and determine tissue specificity of a given metal within and between populations.
Methods: Fish, sediment, and water samples were collected at each site. Fish were dissected to collect brain, liver, kidney, gills, heart, and muscle. Samples were analyzed using ICP-MS for concentrations of lead, cadmium, arsenic, selenium, mercury, manganese, vanadium, zinc, and copper.
Result: Lead is 2-5 times higher in tissues from PC compared to KC that parallels higher exposure to lead at PC compared to KC. Copper, manganese, and zinc accumulates highly in tissues of Pescara Creek fish. We conducted principal component analysis and calculated the fraction of each element per total metal burden per tissue, which showed high tissue specificity in element accumulation ratios.
Impact Statement: Metal contamination is ubiquitous worldwide. Effects of metal contamination are still unfolding and are unique based on the mixture of metals present. The individualistic nature of ecosystem localized exposures makes it crucial to understand how individual systems are impacted.

221: Spatially dense hazardous air pollutant sampling through mobile monitoring in environmental justice communities
Toriq A. Mustapha, Texas A&M University
Air pollution exposure is a substantial environmental risk factor accounting for an estimated 7 million premature deaths annually. Exposures disproportionately impact vulnerable populations, such as environmental justice (EJ) communities near Superfund sites or industrial pollution point sources. High fidelity spatial patterns air toxic concentrations are often unattainable with existing stationary monitoring networks unless the sampling network is significantly dense, >1-2 nodes per km2. Mobile platform measurements provide highly-spatially resolved pollutant concentration data useful for evaluating exposure, as well as environmental policy and regulation. We designed a mobile sampling van equipped with trace gas measurement instrumentation utilizing Proton Transfer Reaction Mass Spectrometry (PTR-MS) that offers neighborhood-scale monitoring for a broad range of hazardous volatile organic compounds (VOCs) at very low detection limits. An earlier mobile monitoring campaign in 2015 in several EJ communities located along the Houston Ship Channel demonstrated VOC hotspots, including high concentrations of benzene in the Manchester neighborhood. Our subsequent sampling campaign in Manchester in 2021 demonstrated the presence of acrolein, benzene, toluene, xylenes and chloroform. In 2022, our mobile sampling in the Manchester and Channelview neighborhoods provided high spatial fidelity of benzene, toluene, styrene and xylenes with maximum concentrations at 22.71ppbv, 44.69ppbv, 48.11ppbv and 28.95ppbv respectively. These findings provide refined exposure measurements to address air quality concerns in EJ communities, as well as help inform risk assessment through hazard identification of real-world VOC mixtures. Moreover, using our newly developed mobile monitoring platform, we are poised to respond to environmental disasters, known to increase risk for VOC exposure.

222: Maternal exposure to polycyclic aromatic hydrocarbons causes lung dysbiosis in mice lacking the Cyp1a2 gene - A potential protective role.

Deven Narke, Baylor College of Medicine

Polycyclic Aromatic Hydrocarbons (PAHs) are complex mixtures of chemicals that are found in automobile exhaust, industrial effluents, and superfund sites. Maternal exposure to PAHs is known to exacerbate lung injury in neonates through the activation of Cyp1a/1b1 enzymes. The Cyp1a2 enzyme, predominantly expressed in the liver, is specifically known to be protective against PAH-induced lung injury. However, little is known about the effect of prenatal PAH exposure on the lung and intestinal microbiome and the role of the Cyp1a2 enzyme in modulating these microbial communities. We hypothesize that the Cyp1a2 enzyme protects against prenatal PAH exposure-induced lung injury by maintaining eubiosis. Timed pregnant wild-type (WT) (C57BL/6J) and Cyp1a2 null mice were orally administered a PAH mixture of benzo[a]pyrene (BP) and benzo[b]fluoranthene (BbF) (7.5mg/kg each) or the vehicle corn oil (CO) once daily on gestational days 16-19. The offspring were exposed to room air for 14 days after birth. Mice were sacrificed on postnatal day (PND) 15 and microbiome analysis was performed on the lung and intestinal contents using 16S rRNA gene sequencing. Prenatal PAH exposure altered lung beta diversity and relative abundance of commensal bacteria in Cyp1a2 null mice but not in the WT mice. However, prenatal PAH exposure showed no significant change in the intestinal beta diversity and relative abundance of commensal bacteria in Cyp1a2 null and WT mice. Our study suggests that prenatal PAH exposure causes dysbiosis in the lung microbiome in the absence of the Cyp1a2 gene hinting towards a potential protective role.

223: mpower: An R package for power analysis of exposure mixture studies

Phuc Nguyen, Duke University

Background: Researchers need to estimate statistical power as part of good study planning. Estimating power with Monte Carlo simulations is flexible and applicable to complex study designs. However, it is not straightforward to code a simulation for non-experienced programmers. To simplify this process, we present an R package for power analysis of studies involving mixtures, which can be easily modified for other complex data settings.

Method: This package runs power analysis given a data generative model and an inference model. It can estimate a data generative model that preserves dependence structures between variables, which is important in exposure mixture studies. It easily interfaces with several existing and newly developed analysis strategies for assessing associations between exposures to mixtures and health outcomes. Users can generate power curves to assess the trade-offs between sample size, effect size, and power of a design. Advanced users can easily integrate customized data generative and inference models. It also implements parallelism to speed up the simulations.

Results: We demonstrate the utility of the package through several examples using synthetic data and mixtures data from NHANES. Users with basic knowledge of R can conduct power analysis using Monte Carlo simulation in only a few lines of code.

Impact Statement: We provide an R package that can simulate mixed-typed data with realistic dependence structures and allows researchers to easily conduct power analysis for a large class of statistical models. Through several examples, we show our approach's strengths over closed-formed power equations in the presence of multicollinearity.

224: Understanding the mechanism of adsorptive selectivity of Arsenic over Phosphate by functionalized organometallic molecules

Obinna Nwokonkwo, Arizona State University

Adsorption-based technologies are promising for remediating contaminated water. Unfortunately, the co-occurrence of target contaminants and their less-toxic counterparts creates significant competition for the often-limited binding sites on conventional adsorbents, thus impinging on removal efficiencies. In this work, we performed ab-initio calculations to understand the key factors that drive selectivity for

arsenate As(V) over phosphate P(V) by functionalized ferrocene in its neutral (with Fe in +2 state) as well as its oxidized state (with Fe in +3 state). Our calculations show that both As(V) and P(V) adsorption energies are exothermic and favorable on the neutral and the oxidized ferrocene. However, adsorption energies on the oxidized ferrocene were more exothermic than those on the neutral molecule, indicating that oxidized ferrocene binds oxoanion molecules more strongly than the neutral form. Moreover, As(V) had more exothermic adsorption energies than P(V), indicating a ferrocene preference for arsenic binding. Furthermore, the functionalization of ferrocene with functional groups of different electron withdrawing/donating characters had varying charge effects on the ferrocene molecule. In particular, the more strongly electron-withdrawing groups favored binding As(V) and P(V) away from the functional group, while the reverse was the case for the weaker electron-withdrawing groups. These observations highlight the appealing potential for the use of ferrocene in the selective removal of contaminants from water in competition with similar species. Moreover, obtaining varying binding behaviors using different functionalization opens the door to designing even more complex advanced materials. Overall, the development of these advanced materials will improve the efficiencies in adsorption technologies for water-remediation.

225: Variation in Pollutant Concentration Across Multiple Media at Abandoned Urban Brownfields
Brendan O'Leary, Wayne State University
Background: The nationwide prevalence of brownfields, with often unknown types and levels of contaminants, highlights the need for novel field screening methods. Vegetation at brownfields is an integrator of field levels of contamination – impacted at varying levels by contaminant presence and concentration in the soil, water, and air phases." Phytoscreening, the use of plants to determine the presence of contaminants, can provide a natural link to quickly screen pollutant presence in complex urban environments that often present many site-specific access limitations. Sampling naturally occurring vegetation offers a pragmatic method for evaluating pollutant presence at urban, impacted facilities.
Methods: Plant tissues including stems, leaves, tree cores, and roots were taken from naturally occurring vegetation and subsurface media including soil, soil vapor, groundwater, and sewer pipes were sampled at two urban brownfields in Detroit, Michigan at different times of the year between 2019-2021.
Results:Chemicals of concern were found in all plant samples at various concentrations among tissue types. Co-located soil and vegetative sample concentrations showed conflicting results with several soil samples below the detection limit. Sampling vegetation in close proximity to the chemical release varied and depended on site conditions and land use.
Impact Statement: The United States Environmental Protection Agency (U.S. EPA) estimates that there are over 450,000 sites of subsurface pollution in the United States. Phytoscreening can provide a natural link to quickly screen pollutant presence in complex urban environments with many site-specific access limitations.

226: Understanding the influence of Critical Zone age on contaminant reactivity along a fluvial chronosequence in the Oregon Coast Range
Chelsea Obeidy, University of Oregon
Critical Zone (CZ) processes are recognized as drivers on the sustainability of soil and water resources. However, how the stage of pedogenesis impacts contaminant reactivity and mobility in soils at the landscape scale has been minimally investigated. The primary goal of this study was to quantify how soil age and depth influence contaminant reactivity. To achieve this goal, soils from a fluvial chronosequence in the Oregon Coast Range (3.5, 20, 69, 140, 200, and 908 ky) from two depths (30 and 100 cm) were subjected to arsenic (As) adsorption isotherms, with As removal from solution serving as a proxy for soil-

contaminant reactivity. Chemical extractions were conducted on dosed soils that targeted amorphous and crystalline Fe-oxides to identify the dominant host phase. Data revealed that 20 ky soils from a 30 cm depth had the greatest affinity for arsenic sorption (8,474.5 mg kg-1). Chemical extractions showed that the dominant host-phase of sorption was amorphous Fe for all soils. Amorphous Fe-minerals with high surface area sorbed more arsenic than the larger quantities of crystalline Fe oxide minerals that accumulated through pedogenesis. Because the mode, extent and minerals governing contaminant sorption determine solid-aqueous phase partitioning, this knowledge will assist in improving models for predicting CZ processes that govern the sustainability of soil and water quality.

227: The Environmental Integrity Framework: Building Informative Models Relevant to Local Needs
Nnamdi Osakwe, NC State University
Background: While federal and state regulations require specific contaminants to be monitored regularly, certain contaminants pose little to no exposure risk to certain communities. Conversely, other contaminants that are locally-relevant may be ignored in monitoring and reporting practices at the city and county-level. In this study, we compare the water quality (WQ) of the metropolitan area of Raleigh to rural areas in NC using the Environmental Integrity Framework's (EIF) scoring method. Our method seeks to provide relevant insight and highlight the unique contaminants impacting these communities.
Methods: We applied unsupervised machine learning methods to local WQ data to create dynamic weights for relevant contaminants and generate WQ scores for metropolitan and rural areas in NC.
Results: We applied this method to local environmental monitoring data and generated WQ scores for comparison. Our method highlights contaminants that contribute the most to poor WQ and assess relationships with human-health outcomes within these communities.
Impact Statement: Owing to the devastating effects and public outcries over various environmental justice (EJ) crises in the US, there have been solid efforts towards the development of EJ screening tools to assist risk assessors and stakeholders. Despite these developments, EJ screening tools often do not include a human-health guideline/reference metric for monitored contaminants, are limited in scope to national standards of environmental quality, and as a result can fail to address unique concerns of communities. We are developing the EIF as a dynamic scoring methodology that seeks to address these needs by providing clear and community-relevant information.

228: Achieving the Human Right to Water in California: evaluating cumulative groundwater threats
Clare Pace, University of California-Berkeley
Background: A significant number of Californian's rely on drinking water from largely unregulated water sources such as domestic wells and systems serving fewer than 5 households. Statewide, communities reliant on domestic wells are disproportionately Latinx, socioeconomically disadvantaged, and at greater likelihood of water contamination. However, limited research has evaluated the cumulative groundwater threats faced by domestic well communities.
Methods: To address this data gap, the UC Berkeley Community Engagement Core Water Equity Science Shop refined our domestic well communities layer by using a tiered spatial analysis approach to create a high-resolution statewide dataset of domestic well reliance based on well address data. This layer was intersected with data from the 2020 Census and a cumulative drinking water threats dataset we developed using California Department of Pesticide Regulation data for 124 pesticide active ingredients applied between 2011-2019 that threaten groundwater and data from California State Water Board locating PFAS sources (airports, landfills, wastewater treatment facilities).
Results: Statewide analysis indicates that 293,423 domestic wells drilled since 1970 serve up to 2.9 million people. Approximately 44% of wells are located within one mile of at least one groundwater threat (pesticide application or PFAS source) and over half of these "at-risk" wells are also located in a disadvantaged community with median household income at or below 80% of the statewide median.

Impact Statement: This analysis supports monitoring and sampling efforts to identify communities at risk of cumulative groundwater threats and informs statewide funding efforts to achieve the human right to water.

229: Using zebrafish to assess the intersectionality of immuno-cardiotoxicity following developmental PFAS exposure

Shannon E. Paquette, Brown University

Macrophages are well-characterized as sentinel immune cells that coordinate cellular responses to injury and infection. However, recent developments in cardiac macrophage biology have broadened our understanding of this critical cell type in heart development and function. Still, it is not known how perturbation of macrophages affects heart health into adulthood. Here, we reveal in larval and adult zebrafish as well as in adolescent mice that macrophages reside at the sinoatrial node, where they couple to nodal cardiomyocytes via connexin-45. Using a combination of histology, echocardiograms, electrocardiograms (ECGs), and physiological stress tests, we demonstrate that loss of embryonic macrophages significantly disrupts adult heart health and function, leading to arrhythmia and fibrosis. Adult irf8st96/st96 macrophage knockout zebrafish have significant disruption in epicardial integrity, detachment, and expansion, known indicators of heart stress or damage. Mutant zebrafish also exhibit increased vimentin, a mesenchymal signature of fibroblast activation. Longitudinal analysis of echocardiographic measurements reveals significant age- and sex-specific changes in irf8 mutant heart function, including arrhythmia with notable variability in diastasis time as well as consistently prolonged isovolumic relaxation time. ECG traces of macrophage mutants following a 1-hr swim tunnel-based endurance test also reveal increased prevalence of arrhythmic features. This data demonstrates a functional importance of macrophages in heart function and serves as a foundation to study the intersection of how contaminant-induced immunotoxicity may disrupt heart health.

230: Effect of Polyacrylic acid (PAA) Coating of Ferrihydrite on the Particle Stability and Biodegradation of Perfluorooctanoic Acid (PFOA)

Jinhee Park, Princeton University

PFAS can be defluorinated by Acidimicrobium sp. Strain A6 (A6), an autotroph that uses ammonium as electron donor and solid Fe(Ⅲ) as electron acceptor. While supplying ammonium is relatively easy, supplying an iron oxide phase into a groundwater system is more challenging. Iron oxides are typically positively charged, sorbing onto the negatively charged sediments. To overcome this challenge, ferrihydrite was coated with polyacrylic acid (PAA, which is non-toxic), changing zeta potential to negative. Four PAAs, with different molecular weights (2.1K, 6K, 240K, and 450K), were used to coat ferrihydrite. Particle size and stability of the PAA-coated ferrihydrite were determined using dynamic light scanning and electrophoretic light scanning. Zeta potential was determined as a function of pH and PAA loading. The lowest negative zeta potential was achieved for a PAA/ferrihydrite ratio > 1/5 (w/w), and pH = 5.5. To test the bioavailability of PAA-coated ferrihydrite to A6, incubations were conducted with and without PAA-coated ferrihydrite, and 1 mg/L of PFOA. More ammonium oxidation and fluoride production were observed in all PAA-treated samples over 50 days of incubation vs. the untreated controls, with the 6K and 450K-treated samples showing the highest PFOA degradation rate, which were selected to assess their transport in column studies. Results confirm that PAA-coated ferrihydrite improves particle stability and have a positive impact on A6 growth and PFOA degradation. The presence of PAA coatings resulted in significantly less buildup of ferrous iron in solution, which may be the reason why PAA has this positive effect on A6.

231: Gestational exposure to phthalates and phthalate replacements in relation to neurodevelopmental delays in early childhood

Seonyoung Park, University of Michigan

Background: Phthalates are endocrine-disrupting chemicals that have been linked to changes in child neurodevelopment. However, sex-specificity has been reported inconsistently, and little is known about the impact of recent phthalate replacement chemicals.

Methods: Our analysis included mother-child pairs (N=274) from the PROTECT birth cohort in Puerto Rico. Phthalate metabolites were measured in multiple maternal urine collected during pregnancy. Neurodevelopment was measured at 6, 12, and 24 months of age using the Battelle Developmental Inventory-2nd edition (BDI), which provides scores for adaptive, personal-social, communication, motor, and cognitive domains. Multivariable linear regression was used to examine associations between phthalate metabolite concentrations and BDI scores, adjusting for maternal age, maternal education, child age, and specific gravity. Sex-specificity was assessed with sex*exposure interaction terms and stratified models.

Results: All five domains were associated with mono-3-carboxypropyl phthalate (MCPP) at age 24 months, suggesting a holistic developmental delay related to this metabolite. Sex-specificity existed for all timepoints (p-interaction<0.2), in general, showing stronger associations among boys. For example, metabolites of a recent phthalate replacement, di-2-ethylhexyl terephthalate (DEHTP), were differentially associated with Adaptive domain (boys -7.53%/IQR, 95%CI:-14.58,-0.48 vs. girls -0.85%/IQR, 95%CI:-5.08,3.37), and Cognitive domain (boys -6.05%/IQR, 95%CI:-10.88,-1.22 vs. girls -1.93%/IQR, 95%CI:-4.14,0.28) at 6 months.

Impact statement: Our study will have a significant impact on public health given growing concerns regarding their adverse health effect due to the ubiquitous use of phthalates and the emerging use of phthalate replacements. Especially, understanding the sex-specificity of such an impact will fill the important knowledge gap and help identify more vulnerable populations.

232: Magnetic Nanoparticles and Nanocomposites for Environmental Remediation

Pranto Paul, University of Kentucky

Magnetic nanoparticles (MNPs) and their nanocomposites can provide unique solutions to environmental and biomedical problems. The magnetic nanoparticles enable for energy to be delivered remotely to the material using an alternating magnetic field (AMF). This localized energy can be used to drive processes to enhance material performance, including disruption of binding interactions, increased reactivity, manipulation of biological systems and assemblies, etc. Here, we will highlight a few diverse applications (e.g., low energy sorbent regeneration, enhanced reactivity, virus inactivation, etc.). For example, decades of use of halogenated chemicals in product manufacturing and commercial applications have been connected to detrimental health impacts. In response to these, we have applied magnetic nanocomposite for the reversible capture of halogenated contaminants such as perfluoroalkyl substances (PFAS) by regenerating the nanocomposite through an AMF.

233: The Occurrence and Solubilization of Naturally-Occurring Hazardous Contaminants in the Subsurface of the North Carolina Piedmont

Hannah Peel, NC State University

North Carolina has around 2.3 million residents that rely on private wells as their primary source of drinking water, and therefore are at a higher risk of exposure to naturally-occurring, hazardous contaminants from the underlying groundwater and geology, particularly arsenic, chromium and vanadium. Indeed, it is estimated that between 76,000 and 112,000 people in North Carolina may be exposed to arsenic levels in drinking water from private wells that exceed regulatory standards set by the EPA. To better assess the risks and develop contaminant models that may be used for remediation, a much better understanding of the complex subsurface chemical environment is needed. Representative sites from the North Carolina Piedmont were selected, where soil and saprolite

cores were drilled and collected along with groundwater samples. Subsamples of the cores were analyzed by X-ray spectroscopic methods to determine the concentration, oxidation state, and phase of these potentially hazardous elements at sequential depths to study how and under what conditions they become mobilized and available for human consumption. This basic understanding of the solubilization and redox chemistry is vital for developing both mechanistic of contaminant flow and predictive geospatial models, which may in turn be used to identify vulnerable communities and develop methods for remediation.

234: Conditional Stability Constants for Synthetically Derived Glycolipids
Susan D. Perez, University of Arizona
Metals present in aqueous solutions from industrial processes like mining pose risks to human and environmental health because metals are not biodegradable and risk accumulation in soil and water resources. Rhamnolipid biosurfactants have proven potential as materials for green remediation processes for metals such as Ni, Pb, and Zn. Rhamnolipid has previously shown preferential binding over more abundant harmless cations (such as Ca and Mg) and can selectively remove these environmentally concerning heavy metals. Previously, rhamnolipid was biosynthesized as poorly defined and low purity mixtures, but recent developments in organic chemistry have enabled the synthetic production of high-quality single congeners of rhamnolipids and other glycolipids such as xylolipid and galactolipid. The stability constants that describe the metal-rhamnolipid interaction strength have been described for biosynthetic rhamnolipid only and no data exists for synthetic glycolipids. This project seeks to determine the conditional stability constants of three synthetically derived glycolipids (rhamnolipid, xylolipid, and galactolipid), with Ni, Pb and Zn to establish the potential of these materials for metal remediation applications.

235: Knocking Out the Zebrafish CYP1B1 Gene Alters Metabolomic Profiles and Neurobehavioral Functions
Dante Perone, Oregon State University
Background: Cytochrome P450 1B1 (CYP1B1) is an enzyme responsible for metabolizing a broad range of xenobiotic and endogenous substrates including those vital to the eye. Moreover, CYP1B1 mutations have been implicated in the onset of primary congenital glaucoma (PCG). PCG alters the vasculature of the ciliary bodies and trabecular meshwork surrounding the lens leading to poor aqueous flow. The resulting increase in intraocular pressure damages the optic nerve causing vision loss. Further research examining CYP1B1's mechanistic role in PCG is required to explore novel therapeutic strategies.
Methods: CYP1B1's role in PCG was explored in vivo using CYP1B1-KO zebrafish by performing behavioral assays and untargeted liquid chromatography mass spectrometry-based metabolomics. Behavioral assays were performed on zebrafish at larval and adult stages.
Results: KO zebrafish showed a significant differential response when compared to their wild-type (WT) counterparts in multiple behavior assays performed at larval and adult life stages. During the larval photo-motor response (LPR) assay KO zebrafish displayed elevated movement in response to both light and dark stimuli. In vision driven adult behavioral assays KO zebrafish displayed differential responses to videos of both schooling zebrafish and a predator. In addition, untargeted metabolomics analysis of whole larval zebrafish revealed significant differences in nucleoside and amino acid compounds.
Impact Statement: Our model explores how endogenous chemicals impact the physiology of the eye. This can be a tool to be systematically used to test the impact of chemicals on physiology.
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236: Comparing the Respiratory Burst In Vivo, In Vitro, and Ex Vivo After Exposure to Per- and Poly
Drake Phelps, NC State University

The United States Environmental Protection Agency currently estimates that there are more than 12,000 per- and polyuoroalkyl substances (PFASs), which are used to produce non-stick cookware, food contact materials, hydro- and oleophobic textiles, and more. Due to their unique chemistry, they are ubiquitous and persistent in the environment, making exposure to PFASs commonplace. It is estimated that 98% of Americans have detectable serum levels of multiple PFASs. These compounds have also been detected in wildlife, illustrating their wide- reaching impact. It is well established that these compounds are immunotoxic; however, previous research has focused largely on the effects of PFASs on the adaptive immune system, leaving a knowledge gap on what is known about the effects of these compounds on the innate immune system. To bridge this gap, we utilized an in vivo larval zebrash model, an in vitro human neutrophil-like cell culture model, and primary neutrophils exposed to PFASs ex vivo to investigate innate immune function after exposure to environmentally relevant PFASs. The respiratory burst was measured as a functional readout of innate immune function. Neutrophils induce microbicidal reactive oxygen species through the respiratory burst to defend the host against pathogens. Data show that some PFASs are capable of inhibiting the respiratory burst in vivo, in vitro, and ex vivo. Potency was similar among the model systems, indicating potential evolutionary conservation. Current studies are exploring whether exposure to PFASs confers susceptibility to infectious disease, and what mechanisms may be responsible for this immunosuppressive phenotype.

237: Early Life Participation in Cognitively Stimulating Activities and Risk of Depression, Anxiety in Late Life

Xinye Qiu, Harvard T. H. Chan School of Public Health

Background: Little is known about the associations between early life positive behaviors and late life mental health. We aimed to investigate if higher levels of engagement in cognitively stimulating activities in early life is associated with lower risk of depression and/or anxiety in late life. Methods: This is a non-clinical cohort study of 2,187 participants (average age: 63 yrs.) using the St. Louis Baby Teeth cohort. Participants' current depression/anxiety condition and early-life factors were measured via web-based questionnaires administered over June 22, 2021 - March 25, 2022. An established measure of frequency of participation in common cognitive activities over childhood (age<18 yrs.) was utilized to construct an early-life composite activity score for each participant. Current depression/anxiety condition was assessed via Patient Health Questionnaire (PHQ-9) and Generalized Anxiety Disorder Screener (GAD-7). Logistic regression was applied to estimate the odds ratio (OR) of risk of depression/anxiety with increased activity score. Results: Each 1 unit increase in early-life composite activity score was associated with an OR of 0.54 (95% CI: 0.38 – 0.77) of late-life depression, but an OR of 0.94 (95% CI: 0.61 – 1.43) of late-life anxiety, adjusting for age, sex, race, parental education, childhood living arrangement and family socioeconomic status (SES). Impact: More frequent participation in early-life cognitively stimulating activities is associated with reduced risk of late-life depression in a group of older adults. Building community-based better access to cognitive activities enrichment and improving parental awareness may be considered as effective early-life interventions for late-life depression.

238: Dusty-plasma-assisted modeling of natural fiber adsorbent for Mn(II) and Cd(II) from multi-metal aqueous system

Renjith Rajan Pillai, University of Alabama-Birmingham

Plasma surface modification is a green and efficient method to tailor the surface properties of different materials. The present study reports the plasma surface modification of non-woven soy and carbon fiber mat prepared by the wet-laid process to achieve improved heavy metal adsorption efficiency. The fiber mat surfaces were modified by incorporating ethylene diamine tetra acetate (EDTA) groups to capture metallic contaminants, with special attention to Mn (II) and Cd (II). A reactive mixture of ethylene

diamine and acetic acid was provided as the precursors to generate plasma, producing EDTA in situ inside the plasma chamber. The substrates were placed inside the chamber with EDTA plasma formation. This could lead to the deposition/modification of the substrate with EDTA. The plasma-assisted formation of EDTA was confirmed using NMR spectroscopy. Subsequently, the heavy metal adsorption studies were performed in multi-metal contaminated aqueous systems. The plasma surface tailored fiber mat surfaces before and after adsorption experiments were characterized using different techniques such as XPS, FTIR, Keyence microscopic imaging, and SEM. More reliable evidence for improved heavy metal adsorption efficiency of the plasma processed mat was obtained from the AAS/Inductively coupled Plasma Assisted Mass Spectroscopy (ICPMS) technique. The effect of different parameters such as temperature, pH of the medium, and contact time was also studied. Taken together, this work reports a new green approach to producing functionalized fiber mat surfaces with improved heavy metal adsorption capability.

239: Effects of Diverse Environmental Factors on Polychlorinated Biphenyl Biodegradation Potential for Bioremediation in Contaminated Sediments

David Ramotowski, University of Iowa

Polychlorinated biphenyls (PCBs) are persistent organic pollutants that were once widely employed as dielectric fluid, industrial coolants, and lubricants. While production was banned in 1978, PCBs continue to persist in soils and sediments. Biphenyl dioxygenases, encoded by the bphA gene, are known to catalyze the initial step in aerobic PCB biodegradation. Mutations in environmental bphA sequences may lead to shifts in substrate and congener specificity, potentially allowing for biodegradation of wide ranges of PCB congeners and other persistent organic contaminants. The purpose of this study is to compare bphA diversity at two sites: New Bedford Harbor, MA (NBH), a Superfund site with historic Aroclor 1016 PCB contamination, and an Aroclor 1248 PCB-contaminated wastewater lagoon in Altavista, VA (AVL). Sediment DNA was extracted from 47 NBH and 14 AVL samples. Quantitative PCR was performed to determine bphA abundance, which ranged from <1 to 3.7x105 copies per gram sediment in NBH. bphA was amplified by PCR, cloned, and sequenced from a subset of NBH and AVL, which revealed potential novel bphA genes from NBH. High throughput 16S rRNA sequencing was performed on samples from five different locations at each site to assess microbial diversity via the DADA2 pipeline and monooxygenase potential using PICRUSt2.

This research aims to quantify and compare the influence of environmental factors including salinity, pH, and tidal action on aerobic PCB biodegradation potential. This will assist in treatment development and delivery through existing or potential newly identified microorganisms, which will reduce PCB exposure in humans through volatilization and bioaccumulation.

240: A Systematic Approach Model to Address Indoor Air Contamination from Sewer Networks Near Superfund Sites

Nader Rezaei, University of Kentucky

Subsurface sewer systems can serve as pathways for pollutants to migrate from contaminated soil and groundwater into indoor spaces, exposing occupants to inhalation risks. Several studies have reported considerable health-relevant concentrations of contaminants in the sewer gas that migrated indoors. Some focus on the factors that contribute to transport from soil and groundwater into sewers, and finally into the buildings. Critical factors include sewer elevation relative to subsurface contamination elevation, deteriorated infrastructure, pipe cracks, and defected fittings. Sewer and plumbing imperfections provide pathways for contaminants to enter the sewer systems and migrate along the pipeline in both sewer liquid and sewer gas. Studies have shown when vapor-forming chemicals such as volatile organic compounds are present, a higher rate of mass transfer in the gas phase results in higher concentrations of contaminants throughout the pipeline. Although a few mass transfer models have

been developed to explain this phenomenon, there is a lack of a systematic approach to detect, track, and measure contaminants in sewer pipelines. As part of this study, which included a research collaboration with the United States Environmental Protection Agency (US EPA, Region 9), a systematic framework was developed to navigate the migration of pollutants through sanitary sewer systems located around hazardous waste sites. This study also aimed to investigate an approach to mitigate indoor air contamination from sewer gas. The study was conducted at a contaminated site where several reports had revealed the nearby residential areas being impacted by trichloroethylene (TCE) contaminated groundwater proceeding from the site. This study helps to understand this transport phenomenon in a greater depth and develop an approach model to help find solutions under different local and operational conditions. Additionally, this study implemented a mitigation technique to reduce TCE exposures in indoor air and included pre- and post- sampling and analytical evaluations.

241: Early disruption of vitamin D receptor signaling induces developmental behavior deficits in zebrafish

Morgan Ritter, NC State University

Vitamin D is a fat-soluble vitamin that can be obtained through the diet or UVB conversion of 7-dehydrocholesterol to pre-vitamin D3 in the skin followed by metabolic activation to vitamin D3. Vitamin D genomic responses are mediated through ligand binding with VDR/RXR binding and subsequent interaction(s) with the vitamin D response elements (VDRE) to facilitate gene expression/repression. Recently it has been demonstrated that VDR signaling additionally modulates neurodevelopment and vital neural processes. The VDR itself has been identified within amygdala, hippocampus, thalamus, cortex and substantia nigra and expression of 1α-hydroxylase, one of the enzymes necessary to convert inactive vitamin D to the active form, has also been identified within the brain. Studies have linked developmental vitamin D deficiency (DVD) with early onset of schizophrenia and autism. Our lab is interested in the impacts of Vitamin D Deficiency (VDD) on early brain development and function. In this study we take advantage of select well established behavioral assays to investigate how developmental disruption of vitamin D receptor signaling modulates larval zebrafish behavior. We induce disruption of VDR signaling at 3 different time points (24, 48 & 72 hpf) and show behavioral alterations in acoustic startle and locomotor activity at 6 dpf and show those locomotor activity alterations persist to 28 dpf. Understanding windows of sensitivity for vitamin D and defining alterations at those timepoints is likely to aid in establishing a linkage between developmental VDD and neurobehavioral outcomes in relation to developmental origins of health and disease (DOHaD).

242: Green-engineered clays for the remediation of benzene and hazardous environmental samples

Kelly J. Rivenbark, Texas A&M University

Following natural and man-made disasters, high levels of benzene and other persistent organic pollutants can be detected in the environment surrounding the site of impact, posing a significant risk to human health. Remediation methods with activated carbons are limited in their effectiveness due to benzene's negligible retention to most surfaces. To address this problem, two montmorillonite clays were amended with a mixture of chlorophyll (a) and (b), and their binding profiles were assessed using in vitro, in silico, and well-established ecotoxicological bioassay methods. In vitro and in silico studies indicated that the addition of chlorophyll to clay surfaces increased the adsorption and retention of benzene through π-π stacking and alkyl-π interactions. The inclusion of chlorophyll-amended clays in the culture medium significantly prevented the mortality of C. elegans by 98-100% and enhanced the growth rates of L. minor. These novel clays were also tested for their ability to remediate water samples from a Superfund site containing mixtures of pentachlorophenol, naphthalene, and other chemicals of concern. Exposure to these samples decreased the growth of L. minor by 97%. Importantly, the inclusion of 0.5% chlorophyll-amended clays protected the plant by 50%. Further studies are ongoing to identify

additional lipophilic contaminants that can be sequestered by green clays. Ongoing studies suggest that these novel sorbents can be utilized during disasters and emergencies for air purification, skin protection, and soil remediation.

243: Companion Animals as Sentinels of Per- and Polyfluoroalkyl Substance (PFAS) Exposure and Associated Health Biomarkers

Kylie Rock, NC State University

Central North Carolina (NC) has been highly contaminated with per- and polyfluoroalkyl substances (PFAS), in part due to the presence of an active fluorochemical production facility, Fayetteville Works. While there is clear evidence of PFAS contamination in the surrounding environment, little is known about the exposure profiles and health impacts for humans and animals that reside in nearby communities, especially for more novel replacement PFAS like the perfluoroalkylether acids (PFEAs). Companion animals share various aspects of the indoor and outdoor environment with their owners, giving them considerable potential for investigating links between long-term environmental exposures and health outcomes. The goal of this study was to evaluate PFAS exposure and health biomarkers in dogs and horses that reside in Gray's Creek NC, within fifteen kilometers of Fayetteville Works, using LC/HRMS and blood chemistry assays. All serum samples had detectable levels of PFAS, and concentrations were significantly different between species (dogs > horses), drinking water source (well > bottled), and classes of compounds (PFSAs > PFCAs > PFEAs). In dogs, serum levels of emerging PFEAs are significantly impacted by sex and weight, suggesting that their bioaccumulation potential may be influenced by sex differences in body composition. Health biomarkers also varied by species and PFAS class, and collectively suggest that aspects of the immune system, liver, and kidney function are altered with changes in alanine aminotransferase, amylase, globulin, glucose, and sodium observed. These findings provide novel data for two different companion animal sentinels with unique exposure profiles and their associated health outcomes.

244: Presence and Variability of Contaminant Mixtures in Vulnerable Karst Groundwater Systems

Elienisse Rodriguez-Medina, University of Puerto Rico-Medical Sciences Campus

Karst groundwater systems serve as important source of water for many communities across the nation and the world. The same characteristics that make these aquifers highly productive also makes them vulnerable to contamination. The Karst Region of Northern Puerto Rico (KR-NRP) is among the areas with the highest groundwater extraction in the island and shows widespread contamination with multiple contaminants. Little is known on the presence of these contaminants as mixtures and how potential exposure to mixtures may vary in space and time. This work assesses the presence and distribution of targeted contaminant mixtures in the groundwater of the KR-NPR. Samples collected from groundwater in the region are analyzed for chlorinated volatile organic compounds, 3 phthalates, and nitrates. Results shows the presence of multiple mixtures in groundwater with a total of 84% of the samples with two or more contaminants. Over 80 different types of mixtures, with up to concurrent contaminants were found in groundwater. The mixtures vary spatially and temporally. These variations have an impact on the total potential exposure and the application of effective remediation technologies.

245: Development of Functionalized Sorbents for Rapid Response Vapor Intrusion Mitigation

Preetom Kishore Roy, Wayne State University

Many post-industrial urban centers in the U.S. contain numerous sites contaminated with volatile organic compounds (VOCs). These compounds can contaminate soils, shallow groundwater aquifers and, through vapor intrusion, negatively affect human health. Various soil vapor extraction strategies can be used to remove soil vapors from below foundations before they enter a structure; however, these are

generally costly and require significant time to deploy and run to completion. For a rapid response mitigation technique, we are developing modified air purifiers equipped with engineered sorbents optimized to remove VOCs from structures that have an immediate need based on high VOC concentration measurements from a sensor network. Although traditional air purifiers are not specifically designed for VOC removal, many include a sorbent material such as granular activated carbon or zeolite clay. Organosilica materials have been shown to have extremely high sorption capacities for organic chemicals, in some cases sorbing more than 4 times the sorbent weight in associated organic compounds. Sorption screening tests were conducted using various organosilica, activated carbon, and zeolite media to determine the VOC sorption capacity of TCE, PCE, benzene, and toluene from air and water phases. Results were modeled using Freundlich, Langmuir, and Temkin isotherms to interpret sorption parameters and capacities for the activated carbon, zeolite, and organosilica. Activated carbon sorption capacities for benzene and toluene were modeled to be 94 and 32 milligrams per kilogram (mg/kg), respectively, compared to several orders of magnitude higher sorption capacity for organosilica.

246: Transcriptomic Responses and Teratogenicity in Developing Zebrafish Exposed to Portland Harbor Superfund Site Passive Sampling Extracts

Christian Rude, Oregon State University

Background: The Portland Harbor Superfund Site (PHSS) is an area of active remediation along the Willamette River in Portland, Oregon. Its proximity to residential and recreational areas requires precise resolution of contaminant concentration and toxicity to ensure remediation adequately protects human health. PHSS provides a unique challenge because numerous sources drive varying contaminant levels across limited spatiotemporal scales.

Methods: High-density polyethylene passive sampling devices (HDPE PSDs) were deployed for 30-day periods in nine locations across six months in and around PHS. After chemical characterization, serially diluted PSD extracts were utilized in static waterborne exposures to dechorionated zebrafish from 6 – 120 hours post fertilization (hpf). Morphological assessments revealed site-specific phenotypes including edema, malformed snout, and a rarely observed “wavy” notochord malformation. To inform the molecular response behind site specific toxicities, we conducted RNAseq on 48 hpf zebrafish exposed to 0.75% PSD extract dilutions from two sites with diverging phenotypes.

Results: While the treatments had similar differentially expressed genes (DEGs), more robust changes were observed in the more toxic treatment. The molecular response to zebrafish exposed to polyaromatic hydrocarbons (PAHs) and oxygenated PAH account for some but not all of the response seen to the PSD extracts. We hypothesize that non-PAH-attributable DEGs arise from mixture effects or additional unidentified toxicants.

Impact: The ability of developing zebrafish to detect differential toxicity in analytically similar samples underscores the utility of pairing PSD extracts with developmental zebrafish assays for toxicity sensing in complex environmental mixtures. This research was funded by NIEHS awards: P42ES016465, P30ES030287, and T32ES007060

247: Temporal and Spatial Mapping of Ambient Volatile Organic Compounds to Inform Respiratory Hazard

Mariana Saitas, Texas A&M University

Mobile air sampling is an emerging approach to characterize hazardous air pollutant exposure at fine spatial resolution. Currently, there is a lack of information for real-time ambient air pollutant concentrations, especially for a broad range of volatile organic compounds (VOCs) at baseline and after environmental disasters. We hypothesized field-based mobile air sampling could inform risk assessment through improved characterization and hazard identification of VOC mixtures. We developed a dual

approach for mixtures assessment. First, using autoGC monitoring data from the Texas Commission on Environmental Quality (TCEQ) site in Manchester, TX, located nearby the Houston Ship Channel, we selected the predominant VOCs measured in 2021 to create a designed mixture for laboratory-based hazard identification. Next, to accurately reflect temporal and spatial variation of VOC mixtures across a range of communities with unique point sources, we developed maps of sampling routes for longitudinal mobile measurements in 2022-2023. Locations include Manchester, Somerville, and the Joppa and Singleton communities in Dallas. Data collection is ongoing using our mobile laboratory equipped with a proton transfer reaction time-of-flight mass spectrometry (PTR-ToF-MS) for high-resolution VOC sampling coupled with a Magellan MX-500 weather system to track location, temperature, humidity, wind speed and direction. Subsequent mixtures emulating ambient exposure data will be created and compared with our designed mixture to assess respiratory hazard using our airway model composed of 16HBE cells grown and differentiated at air-liquid interface.

248: Chemical Uptake into Silicone Wristbands in a Natural Experimental Setting
Samantha Samon, Duke University
Silicone wristbands present a noninvasive exposure assessment tool; however, questions about their utility remain as validation studies are limited. We sought to evaluate the experimental rate of uptake of 125 organic pollutants from several chemical classes (i.e., polychlorinated biphenyls (PCB), organophosphate esters (OPEs), alkyl OPEs, polybrominated diphenyl ethers (PBDEs), brominated flame retardants (BFR), phthalates, pesticides, and polycyclic aromatic hydrocarbons (PAHs) over a five-day period. Adult participants (n=10) were asked to wear five silicone wristbands at the beginning of the sampling period and remove one wristband each day. The number of chemicals detected increased minimally over time (day1=59; day2=67; day3=68; day4=75; day5=78), but uptake into the silicone wristbands was largely linear over time with the majority of compounds having a positive slope. The experimental uptake rates obtained in this study were not correlated to predicted silicone-air partitioning coefficient, suggesting other variables are influencing uptake rates. Ambient concentrations of the chemicals, an individual's activity patterns/behavior, and the multiple environmental compartments being sampled (i.e., air and dermis), all could be reasons why there was no relationship between calculated uptake rates and the silicone-air partitioning coefficients. There is a current noticeable lack in the literature of both dermal-silicone partitioning and the role that activity and motion play in influencing chemical uptake into silicone. As silicone wristbands grow more prominent in the personal exposure assessment field, more research needs to be done to understand where the chemical load onto the wristband is coming from.

249: Incorporating the return of chemical exposure assessment data into Study Designs
Samantha Samon, Duke University
Reporting chemical exposure results to key stakeholders such as research participants or impacted communities is gaining attention as an essential and necessary step in chemical exposure assessment. In a statement made in 2018, the National Academy of Sciences, Engineering, and Medicine recommended the return of individual exposure assessment data, and the 2018-2023 strategic plan published by the National Institute of Environmental Health Sciences shares a similar sentiment. Overall, the exposure science community is seeking to increase community engagement and promote the return of chemical exposure assessment data as a means of reducing harmful environmental exposures. Reports returning chemical exposure assessment data aim to improve environmental health literacy, which in its simplest form is the ability to understand that environmental exposures may impact human health. However, this can be challenging due to the many unknowns regarding chemical exposure and human health effects; particularly when reports encompass a wide range of chemicals evaluated, and the exposure assessment tool used cannot be compared to the limited reference values available. Additionally,

limited resources are currently available to researchers interested in reporting chemical exposure assessment results to the stakeholders. Through the generation of multiple communities and participant-level reports, researchers at Oregon State University Superfund Research Center have developed key guiding principles for successfully returning results. These include recognizing and respecting community knowledge and history, setting participant expectations for what they can expect from the report, providing context for what the exposure assessment data means, and providing resources that report recipients can utilize to learn more.

250: Surface Modified Activated Carbon Cathode towards Enhanced Hydroxyl Radical Formation for Electrochemical Water Remediation

Stephanie Sarrouf, Northeastern University

Electrochemical advanced oxidation process (EAOP) is a promising strategy to degrade contaminants for water remediation. However, formation of hydroxyl radicals (•OH) during EAOP is a critical factor governing the overall effectiveness of this process and is directly associated with the surface chemistry of cathode materials. On the other hand, altering the surface properties of cathode material to optimize •OH formation is a challenging task. Here, we have comparatively adopted two approaches for the enhanced •OH formation. (1) The surface functionalities of activated carbon cathode were anodically regenerated using the electrode polarity reversal. In addition to the regeneration of surface functional groups at cathode surface, polarity reversal also helped in enhanced hydrophilicity which facilitates the mass transfer between the electrode and electrolyte facilitating the increase in •OH amount. (2) Moreover, we also employed cobalt (II/III) oxide for the surface modification of activated carbon cathode to be used as a heterogenous electrocatalyst, which addresses the sludge formation associated with conventional Fenton-like reaction, while significantly increasing the concentration of highly oxidizing •OH. The •OH quantification was achieved by the removal of benzoic acid using HPLC. In addition to experimental work, first principal simulations were also used to support the experimental findings. This work provides future insight about optimized initial conditions and operating parameters for contaminants degradation.

251: Disposition of arsenic metabolites in mice carrying human AS3MT: Low vs high exposure level

Mirek Styblo, University of North Carolina

Background: Mice have been used in laboratory studies examining adverse effects of exposure to inorganic arsenic (iAs). However, mice metabolize iAs more efficiently than humans. This difference makes it difficult to translate results of laboratory studies to humans. We have created a 129S6 mouse strain in which the Borcs7/As3mt locus was replaced with the human BORCS7/AS3MT locus. Initial studies showed that the pattern of iAs metabolism in the humanized 129S6 (Hs) mice resembled that in humans. Here, we provide additional data on iAs metabolism in Hs mice while focusing on iAs dose.
Methods: We exposed Hs male and female mice to 25 or 400 ppb iAs in drinking water. Wild type (WT) 129S6 mice served as controls. We measured concentrations of iAs and its metabolites, methylarsenic (MAs) and dimethylarsenic (DMAs), in urine and tissues.
Results: At both exposure levels, Hs mice excreted less total arsenic (tAs) in urine and retained more tAs in tissues than WT mice, with the highest tAs concentrations found in kidneys, liver and spleen. The Hs females retained more tAs in tissues than Hs males, especially after exposure to 400 ppb iAs. Fractions of tAs represented by iAs and MAs were significantly greater in urine and tissues of Hs mice as compared to WT mice. tAs concentrations in tissues of Hs mice resembled those predicted for human tissues by a physiologically based pharmacokinetic model.
Impact: This data will guide future studies using Hs mice to examine effects of iAs exposure in specific target tissues or cells

252: Metabolomic alterations associated with phthalate exposures among pregnant women in Puerto Rico

Ram Siwakoti, University of Michigan

Background: Phthalates are a group of ubiquitous synthetic chemicals linked to adverse pregnancy and birth outcomes. Limited evidence has linked phthalate exposures with metabolic perturbations in humans. In this study, we examined associations between urinary concentrations of eight phthalate metabolites and plasma metabolic markers in pregnant women.
Methods: We used 327 untargeted maternal plasma metabolites identified and annotated in a nested case-control study involving 100 women enrolled in the Puerto Rico PROTECT longitudinal birth cohort. The metabolomic profile of each woman was linked to their urinary phthalate measurements collected at three timepoints across pregnancy. The associations between geometric mean of each urinary phthalate metabolite concentration and individual plasma metabolites were assessed using multiple linear regression adjusted for urinary specific gravity, age, and pre-pregnancy body mass index, with adjustment for multiple comparisons using a false discovery rate of 0.1.
Results: Phthalate metabolites of di(2-ethylhexyl) phthalate (DEHP), dibutyl phthalate (DBP), mono (3-carboxypropyl) phthalate (MCPP), and mono-ethyl phthalate (MEP) were statistically significantly associated with 12, 4, 32, and 16 known metabolites, respectively. For instance, DEHP, MCPP, and MPP were associated with multiple fatty acids which are considered to play a role in inflammation and preterm birth. Phthalate metabolites were also associated with ceramides, diglycerides, phosphatidylcholines, and organic acids with varying magnitude- and direction of associations.
Impact Statement: In this study, we observed that multiple phthalate metabolites were linked to altered lipid, amino acids, and organic acids metabolome in pregnant women, which will be important in elucidating their toxic mechanisms.

253: Metal exposure, lung function and epithelial airway injury in the Strong Heart Study

Marisa Sobel, Columbia University

Arsenic and cadmium are associated with decrements in lung function. The mechanisms through which they influence lung disease are not fully understood. There is evidence that club cell-16 (CC16), a marker of epithelial airway injury, may play a role. We hypothesized that metals are associated with epithelial airway injury, measured via CC16, and that CC16 will modify the association between urinary metals and lung function in the Strong Heart Study, a population of American Indians. We included participants with urinary metals at baseline (1989-1991) and spirometry testing at Visit 2 (1993-1995) (N= 798). CC16 was measured from Visit 2 serum samples by ELISA. We used linear regression to assess associations between urinary metals, serum CC16, and spirometry. Median (IQR) levels of CC16 were 28 (19.3-43.6) µg/l. Participants with lower CC16 were younger and more likely to be smokers. After adjusting for age, sex, location, education, and smoking status, the mean difference (95%CI) of CC16 per IQR in urine cadmium levels was -0.08 (-0.15, -0.02) µg/L. CC16 did not modify the association of cadmium with FEV1/FVC, FEV1 or FVC. Arsenic was not significantly associated with CC16. However, CC16 modified the association of arsenic with FEV1/FVC but not with FEV1 or FVC. The mean difference (95%CI) of FEV1/FVC was 2.30 (0.79, 3.80) % for lower CC16 levels and -0.79 (-2.27, 0.68) % for higher CC16 levels. These data support that CC16 can be influenced by certain metals or modify the association of metals with lung function outcomes.

254: Parent material weathering drives arsenic bioavailability

Boyoung Song, University of Arizona

Sulfidic mine tailings contain originally deposited sulfide minerals and secondary ferrous, ferric, and sulfate weathering product minerals that host arsenic (As). The rate at which oxidative weathering of sulfides generates acid and drops pH is governed by the parent materials (e.g., types of sulfides and

carbonates in the original tailings deposit). Likewise, the types of secondary minerals formed are principally driven by pH and hydraulic flux, which then controls (through neophase formation) the bioavailability of As. We hypothesize that the bioavailability of As depends on the tailing parent material (PM), which, in turn, controls Fe host mineral speciation. Tailings depth profiles were collected from three mining sites and analyzed for pH, mineralogy by X-ray diffraction (XRD), and Fe, As, and S speciation via X-ray absorption spectroscopy (XAS). Depth-dependent variation in pH was correlated to As oxidation state. However, mineralogical variation in PM and weathering profile was confirmed by XRD, with specific variation in the types and prevalence of sulfide and carbonate minerals in the PM. The near neighbor atomic environment of As exhibits distinct patterns of sequestration as a function of both site and sampling depth, suggesting that As bioaccessibility is also linked, not only to the weathering environment, but also to the specific PM assemblage. The hypothesized link between PM and bioaccessibility of As in the weathering products is being tested in upcoming experiments. Thus, an accurate description of the PM initially deposited in mine tailings is critical for an accurate risk assessment.

255: Comparative assessment of PFAS binding affinities for serum albumin across species using Differential Scanning Fluorimetry

Hannah Starnes, NC State University

Background: Per- and poly-fluorinated compounds (PFAS) are a diverse class of over eight thousand different synthetic chemicals that can be toxic and bioaccumulate in humans and wildlife. Toxicokinetic data, including PFAS-protein binding affinity values, are limited to a subset of PFAS congeners. More information is needed to understand PFAS bioaccumulation in humans and other biota.
Methods: To address this lack of binding affinity data, we developed a high-throughput in vitro differential scanning fluorimetry (DSF) assay for determining relative binding affinities of human serum albumin for multiple classes of PFAS. We have expanded the use of this assay to test the hypothesis that there are important species-specific differences in albumin binding of PFAS.
Results: We have evaluated PFAS binding of purified serum albumin from experimental and livestock species. Here we report results demonstrating the utility of this DSF assay to compare binding affinity of human, rat, porcine and bovine serum albumins for a representative library of PFAS chemical structures. We have identified significant differences in binding affinities for individual compounds across these species.
Impact Statement: Our determination of significant differences in albumin binding across species will strengthen the relevance and applicability of in silico computational modeling of PFAS fate, transport, and distribution. Additionally, our findings will increase confidence in validity of extrapolations of laboratory toxicity testing to human toxicity.

256: Thermal Reactivation of Spent Granular Activated Carbon (GAC) from PFAS Remediation Sites

Stefanie Starr, NC State University

Thermal reactivation of spent granular activated carbon (GAC) is a management strategy that permits GAC reuse. This study aims to identify conditions that effectively mineralize PFAS during the thermal reactivation of PFAS-laden GAC. Thermogravimetric analysis (TGA) experiments with PFAS, PFAS/hydroxide mixtures and PFAS/natural organic matter (NOM) mixtures in the absence and presence of GAC have been conducted to determine the thermal stability of nine PFAS (PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, and 6:2 FtS) in their sodium or potassium salt forms. Off-gases are collected with impingers (soluable compounds) and SUMMA canisters (volatile compounds). Analysis is completed using ion chromatography, with liquid chromatography-mass spectrometry, and high-resolution gas chromatography-mass spectrometry. Results to date show that thermolysis of all tested perfluoroalkyl acids (PFAAs), PFAA salts and PFAA salt/hydroxide mixtures in the absence of GAC was

complete at temperatures used to reactivate GAC. In contrast, thermolysis of adsorbed PFOA/PFOA-K and PFOS/PFOS-K was not complete at 800°C. In the presence of Ca(OH)2 and NaOH, fluorine recoveries as CaF2 and NaF in the residue of the TGA pan increased to >50% for PFOS-K, whereas fluorine recoveries for PFOA-K remained <10%. Fluorine recoveries as volatile fluoroalkanes and fluoroalkenes in the SUMMA canisters were greater for PFBA sodium salt (~30%) compared to PFBS potassium salt (~10%). Results from fluoride, targeted LC-MS and GC-MS analysis accounted for up to ~80% of the fluorine content of the initially added PFAS.

257: Urinary paraben and phenol concentrations associated with inflammation markers among pregnant women in Puerto Rico

Savannah Sturla, University of Michigan

Exposure to phenols and parabens may contribute to increased maternal inflammation and adverse birth outcomes, but these effects are not well-studied in humans. This study aimed to investigate relationships between concentrations of 8 phenols and 4 parabens with 6 inflammatory biomarkers (C-reactive protein, matrix metalloproteinases (MMP) 1, MMP2, MMP9, intercellular adhesion molecule-1 (ICAM-1), and vascular cell adhesion molecule-1) repeatedly measured across pregnancy in the Puerto Rican PROTECT birth cohort. Exposures were measured using tandem mass spectrometry in spot urine samples. Serum inflammation biomarkers were measured using customized Luminex assays. Linear mixed models and multivariate regression models were used, adjusting for covariates of interest. Effect modification by fetal sex and study visit was also tested. Results are expressed as the percent change in outcome per interquartile range increase in exposure. Numerous significant negative associations were found, for example, between triclosan and MMP2 (-6.18%, CI: -10.34, -1.82), benzophenone-3 and ICAM-1 (-4.21%, CI: -7.18, -1.15), and bisphenol-A and MMP9 (-5.12%, CI: -9.49, -0.55). Fetal sex and study visit significantly modified several associations. Our results suggest that phenols and parabens may disrupt inflammatory processes pertaining to uterine remodeling and endothelial function, with important implications for pregnancy outcomes. The negative relationships may implicate that these exposures contribute to the downregulation of regulatory immune cells or inflammatory imbalances through downstream mechanisms. More research is needed to further understand immune responses in an effort to improve reproductive and developmental outcomes.

258: Isolation of pure cultures for metabolizing 1,4-dioxane at environmentally relevant concentrations

Youneng Tang, Florida State University

Background: 1,4-Dioxane was commonly used as a stabilizer of chlorinated solvents and as a solvent in several commercial and industrial processes, leading to widespread groundwater contamination. The unique physical and chemical properties of 1,4-dioxane have created challenges in efficiently removing it from water. Bioremediation is a promising method for treating 1,4-dioxane contaminated water as it is potentially cost-effective and eco-friendly. About 20 bacterial strains have been reported in the literature to metabolize 1,4-dioxane. Almost all of these strains were enriched and then isolated under high concentrations of 1,4-dioxane (i.e., hundreds of mg/L) following common enrichment and isolation practice. However, most of them cannot sustain growth in contaminated groundwater since the environmentally relevant concentrations of 1,4-dioxane at most polluted sites are much lower than 1 mg/L.

Methods: The objective of this work was to isolate and characterize 1,4-dioxane-metabolizing pure cultures by periodically spiking 1,4-dioxane at low concentrations (i.e., <1 mg/L) during the enrichment.

Results: This strategy has led to the isolation and characterization of six pure strains closely related toDokdonella sp., Acinetobacter sp.,Saccharibacteria (TM7) phylum, Afipia sp., Nitrobacter sp., and Pseudonocardia sp., respectively.

Impact Statement: Compared to the 1,4-dioxane degradation kinetics reported in the literature, the strains that we isolated have high biomass yields, low decay coefficients, low half-maximum-rate concentrations, and low maximum specific 1,4-dioxane utilization rates. These are characteristics of microorganisms living in environments with low substrate concentrations (i.e., environmentally relevant 1,4-dioxane concentrations).

259: Assessing the Impact of Green Infrastructure on Community Recovery from Tropical Storm Imelda in Houston, Texas

Zhihan Tao, Texas A&M University

Recently, cities globally have experienced increasingly frequent environmental hazards such as flooding and sea-level rise, due to global climate change. Expensive costs related to post-disaster urban recovery remind us of the importance of building resilient cities (Li and Buckle 1999, Klein, Nicholls et al. 2003). Green infrastructure (GI) has been repeatedly shown to reduce flood risks if multiple mechanisms are utilized to provide stormwater management benefits. Surface runoff reduction and absorption performance have been a focal point of the current GI-related literature, while the social aspects of GI have received little attention (Mekala, Jones et al. 2015, Cinderby and Bagwell 2018). This study assesses the community recovery patterns of local business visits during and after tropical storm Imelda in Houston, Texas. It utilizes mobility data to track daily and weekly foot traffic of points of interests (POI) such as grocery shops, restaurants, etc., in inundated areas during Imelda to evaluate recovery times and post-disaster status of businesses in affected communities. POIs with differing levels of accessibility to GI are compared to those without to access analyze the impact of GI on recovery patterns of businesses from flood disasters caused by Tropical Storm Imelda. Initial findings suggest that a closer proximity of a POI has a better performance of visitations rates and business recover after being flooded. The results of the analysis provide quantitative evidence to the economic benefits of GI on local business and flood recovery speed and patterns.

260: Interfacing Activated Carbon and Modified Titanium Dioxide towards Efficient H2O2 Generation for Electrochemical Water Remediation

Amir Taqieddin, Northeastern University

In-situ eelctrogeneration of Hydrogen Peroxide (H2O2) is a crucial step for the development of effective water treatment technology. Generating larger amounts of H2O2 leads to increasing the concentration of hydroxyl radicals (•OH) for pollutant degradation. The rates of H2O2 generation are directly proportional to the performance of the cathode material and its design within the electrochemical cell. To address this, substantial research has been carried out over the years to develop efficient, inexpensive, and environmentally friendly cathodes. Here, we will present a novel design of composite cathode material that consists of activated carbon and chemically modified oxygen deficient titanium (III/IV) dioxide. Our work is focused on performing reactive molecular dynamic and quantum chemistry simulations to understand and advance the physicochemical behavior of the proposed electrodes. First, we will show the coupled electronic and energetic interactions between the interfaced activated carbon and titania representing the optimized interfacial configuration between both surfaces. Following, we will use the optimized electrode for generating H2O2. We quantify the generated H2O2 by computing the reaction pathways and barriers of H2O2 generation at the surface of the electrodes. Overall, the performed computations and physics-based analysis display a novel cathode composite for increasing the generation rate of H2O2. Eventually, the proposed new electrode will help in advancing the efficiency of electrochemical water treatment and in increasing contaminant removal rate.

261: Groundwater evolution and redox-sensitive elements (Mn, As) at a groundwater research site in metavolcanic rocks in the Charlotte Terrane, North Carolina Piedmont.

Sadeya Ulfat Tashnia, University of North Carolina-Charlotte

The meta-volcanic Carolina Terrane (CT; central NC), exhibits groundwater manganese and arsenic above and below health-based advisories. Geologic control is a primary influence, yet contrasting As & Mn can occur in the same map-scale rock unit indicating significant local-scale factors. The NC Zoo Research Station features wells along a hilltop-valley transect, including bedrock wells that mimic drinking water wells and shallow wells tracing groundwater evolution. Pumped and discrete-depth samples were analyzed for redox-sensitive elements (RSEs). Groundwater evolves from oxic, slightly acidic (pH 5.7, DO >3 mg/L, alkalinity <0.7 meq/L) at hilltop to anoxic, slightly alkaline (7.6, <0.5 mg/L, >4 meq/L) in the valley setting. As site-wide arsenic was ≤1 ug/L, significance to higher-As settings could not be tested. Mn increased from shallow-mid saprolite (<20 µg/L) to deeper saprolite (82 to 740 µg/L). Topographic influence was observed on average Mn, from the hilltop(16 µg/L) to midslope(28 µg/L) to valley(342 µg/L) setting. 5 of 10 wells exceeded the EPA SMCL (50 µg/L) and 3 the HBSL (300µg/L) guidelines. Arsenic (≥0.3 µg/L) with some apparent association to Mn occurred in the valley setting. Mn in mixed & anoxic wells (≥347 ug/L) was inversely associated with DO & nitrate, and directly with alkalinity, consistent with redox conditions favoring MnO2 reduction. Findings from this well-constrained site provide insights for investigating RSEs' occurrence in the CT and Piedmont. For example, can As and Mn co-occur, or occur in a predictable sequence? Moreover, the occurrence of other RSEs in groundwater (e.g., Cr, V).

262: High Performance Analyzer in Vapor-phase for Detection of Volatile Organic Compounds (VOCs) in Plumbing Systems

Hong Cheng Tay, University of Kentucky

Background: Vapor-forming chemicals migrating from subsurface sources into indoor spaces can result in increased concentrations of volatile organic compounds (VOCs) in indoor air. Previous research has identified that preferential pathways, such as piping systems that penetrate through building foundations, can carry VOCs. Impact Statement: This study aimed to develop a systematic approach to investigating and understanding the entry of sewer gas into indoor spaces from different pathways. Building occupants are likely to be unaware of exposure to VOCs from plumbing piping and hazardous waste assessments commonly overlook this exposure pathway. Methods: The objective of this study is to design and test a pipe model that consists of common pipe fittings. Experiments that modify internal pressure and chemical concentrations have been conducted to generate a basic understanding of gas leaking out from the system. This study incorporates the use of a high-sensitivity chemical analyzer for the detection of VOC concentrations in the gas phase. The analyzer (AROMA-VOC) uses a method known as Cavity Ring-down Spectroscopy (CRDS) coupled with thermal desorption to provide real-time monitoring of chemical concentrations. Multiple analyzer modes encased within the instrument allow it to measure VOC concentrations from different sources of media including liquid/gas samples. Result: Eight calibration curves with the r-squared value higher than 0.98 is generated. Pressure and concentrations experiments have identified two reactions, such as adsorption and diffusion, that behave dominantly in the pipe model. Leakage has been detected along the sampling period as VOCs were escaping from the system.

263: Evaluating the impact of short-chain PFAS exposure on B cell development and antibody production

Krystal Taylor, East Carolina University

Per- and polyfluoroalkyl substances (PFAS) are synthetic chemicals used in myriad manufacturing processes and products. Two long-chain PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS), have been categorized as presumed immune hazards to humans and immunotoxicity data were used to derive US drinking water health advisories. Manufacturers have

moved to short-chain PFAS under assumptions of lower bioaccumulation and toxicity. Previously, we evaluated impacts of PFOA exposure on B cell development associated with suppression of T cell-dependent antibody responses (TDAR). PFOA exposure impacted marginal zone, follicular B cells, and plasma cells and led us to explore perfluorohexanoic acid (PFHxA) and perfluoro-2-methoxyaacetic acid (PFMOAA), short-chain PFAS of concerndrinking water. Adult male and female C57BL/6 mice were given PFHxA or PFMOAA (0, 0.5, or 50 mg/kg) via gavage for 30 days, a duration sufficient to suppress the TDAR. Animals were immunized and one day after dosing ended, splenic B cell subpopulations were determined via flow cytometry. The TDAR was suppressed by 0.5 and 50 mg/kg of PFHxA and by 50 mg/kg PFMOAA. Marginal zone, plasmablasts, follicular, and memory B cell subclasses were impacted by exposure, consistent with our PFOA observations. Our data indicate overall B cell numbers were not affected by PFAS exposure, but changes in numbers of B cell subsets suggest that differentiation and proliferation of B cells may be impacted. Currently, we are developing ex vivo naïve B cell protocols to determine if naïve B cell activation and metabolic reprogramming are targeted by PFAS exposure.

264: Leveraging the chemo-physical interaction of halorespiring bacteria with solid surfaces to enhance halogenated organic compounds bioremediation

Yu Ting, University of Maryland-Baltimore County

There is a lack of fundamental understanding on how microbial breakdown of chlorinated organic compounds is influenced by the presence of sorptive surfaces. To fill this critical knowledge gap, our research team of chemical/environmental engineers and microbiologists is investigating the fundamental mechanism of microbial dechlorination of chlorinated organics on sorptive surfaces and developing quantitative models to optimize the materials engineering design for pilot and full-scale bioremediation applications at contaminated groundwater and sediment Superfund sites. A PCB and PCE dechlorinating organism, DF-1, was grown up in batch reactors to serve as inoculum source for biokinetic experiments. In order to maintain a steady-state culture for long periods the growth medium was formulated by identifying factors required to optimal growth such as salinity and redox potential. A column packed with perchloroethylene (PCE)-coated sand was built to provide a steady state concentration of PCE and study the dechlorination kinetics at fixed dissolved concentrations. A range of carbon based material surfaces were prepared and characterized for surface area, electron accepting/donating capacity, and iodine sorption. The system has been successfully enriching DF-1 population density as high as 1.09×108 cells/mL while PCE level held at 0.05-0.1 mM with consistent halo-respiration activity of TCE and DCE formation. Further attempts to enrich DF-1 cells will be conducted by testing the upper-limit of the system capacity. Sorption and biokinetics data from the experimental studies with optimized materials will be synthesized into advanced site models to predict material behavior for field-scale remedial applications.

265: Understanding combined effects of PAH exposure and inflammation in an in vitro 3D respiratory model

Teresa Valdez, Oregon State University

There is increased emphasis on understanding cumulative risk from the combined effects of chemical and non-chemical stressors. Recent animal studies have identified pulmonary inflammation as a possible modifier and risk factor for chemical toxicity in the lung after exposure to inhaled pollutants; however, little is known about specific interactions and potential mechanisms of action. In this study, primary human bronchial epithelial cells (HBEC) cultured in 3D at the air-liquid interface (ALI) are utilized as a physiologically relevant model to evaluate the effects of inflammation on toxicity of polycyclic aromatic hydrocarbons (PAHs), a class of contaminants generated from incomplete combustion of fossil fuels. Normal HBEC were differentiated in the presence of IL-13 for 14 days to induce a profibrotic phenotype similar to asthma. Fully differentiated normal and asthmatic phenotype HBEC were treated

with benzo[a]pyrene (BaP; 1 – 40 ug/ml) or 1% DMSO/PBS vehicle at the ALI for 48 hrs. Cells were evaluated for cytotoxicity, barrier integrity, and transcriptional biomarkers of chemical metabolism and inflammation by quantitative PCR. Asthmatic phenotype cells treated with BaP show significantly ($p<0.05$) increased cytotoxicity and inflammation and significantly ($p<0.05$) decreased barrier integrity and metabolic capacity compared to normal cells. Additionally, RNA sequencing data showed that many genes were uniquely significantly expressed in asthmatic phenotype cells exposed to BaP. Future studies will explore mechanisms of toxicity from global transcriptomics. These data are the first to evaluate the role of inflammation from pre-existing disease and PAH exposure on pulmonary toxicity in a physiologically relevant human in vitro model.

266: Hepatic metabolism of heterocyclic amines contributes to induction of glucose production and gluconeogenic gene expression in hepatocytes

Kennedy Walls, University of Louisville

Heterocyclic amines (HCAs) are mutagens generated when cooking meat at high temperatures or until well-done. Their major metabolic pathway involves hepatic N-hydroxylation via CYP1A2 followed by O-acetylation via arylamine N-acetyltransferase 2 (NAT2). NAT2 expresses a genetic polymorphism that results in clinical differences in metabolizing its substrates, including HCAs. Recent epidemiological studies reported that HCA exposure may be associated with higher incidence of insulin resistance and type II diabetes. However, effects of HCAs on insulin sensitivity or glucose homeostasis remains unknown. We hypothesized that 1) HCAs alter glucose homeostasis (and insulin sensitivity) in human hepatocytes, and 2) hepatic metabolism of HCAs contributes to this effect. Cryopreserved human hepatocytes or HepG2 (hepatocellular carcinoma) cells were treated with HCAs (MeIQ, MeIQx, or PhIP). Glucose production was measured via glucose oxidase assay, and gluconeogenic gene (G6PC and PCK1) expression was analyzed via qRT-PCR. To investigate the role of HCA metabolism, we co-treated HepG2 cells with MeIQx and 3-methylcholanthrene (3-MC), a cytochrome P450 inducer, and measured gluconeogenic gene expression. We also compared glucose production in HCA-treated hepatocytes with distinct NAT2 acetylator phenotypes. HCAs induced gluconeogenic gene expression in hepatocytes and HepG2 cells. This effect was more pronounced in HepG2 cells following co-treatment with 3-MC. Additionally, HCAs increased glucose production in hepatocytes, and this was augmented in hepatocytes with rapid NAT2 acetylator genotype, compared to intermediate and slow acetylators. These results suggest that HCAs may contribute to development of hyperglycemia and insulin resistance. Additionally, the metabolic effect of HCAs is augmented by hepatic and NAT2-mediated metabolism.

267: In vitro release of 4-OH-PCB 52, a human relevant PCB metabolite, from a novel polymeric implant system

Hui Wang, University of Iowa

Background: Past literature suggests that airborne PCBs lead to adverse neurobehavioral outcomes (i.e., development of ADHD, ASD, or anxiety). These airborne PCBs are easily metabolized to hydroxylated metabolites (OH-PCBs), with different metabolites forming in rats and humans. Our overarching goal is to inform upon and define the role of OH-PCB metabolites in neurotoxic outcomes following PCB exposure during adolescence. To attain this objective, we plan to expose rats to the human OH-PCB metabolite using novel polymeric subcutaneous implants. Methods: The implants were prepared using polymers and contained low (1%), medium (5%), and high (10%) levels of 4-OH-PCB52. The implants were incubated with 10% serum in PBS and kept in a 37°C shaking water bath for 28 days. The daily release from the implants into the media was extracted using hexane and MTBE (9:1, v/v), and was quantified using a UV-vis spectrometer. Results: The in vitro release analysis found overall similar trends of release in all three dose levels of the implant for the 28 days observed; the first day had the greatest amount of 4-OH-PCB52 released; the release rate showed a downtrend over time, and at around day 12

the release rate began stabilizing. By day 28, 77% to 91% of the total loaded PCB was released from the implant. Impact Statement: The current experiment demonstrates that the polymeric implants continuously release 4-OH-PCB52 and, thus, can be used to expose rats to this human-relevant PCB metabolite once implanted subcutaneously.

268: Inclusion of montmorillonite clays in environmental barrier formulations to reduce skin exposure to water-soluble chemicals from polluted water

Meichen Wang, Texas A&M University

Dermal exposures to environmental chemicals can significantly affect the morphology and integrity of skin structure, leading to enhanced and deeper penetration of toxic chemicals. This problem can be magnified during disasters where hazardous water-soluble chemicals are readily mobilized and redistributed in the environment, threatening the health of vulnerable populations at the impacted sites. To address this issue, barrier emulsion formulations (EVBTM) have been developed consisting of generally recognized as safe (GRAS) materials, with the inclusion of medical grade carbon or calcium and sodium montmorillonite clays (CM and SM). The adsorption efficacy of five highly toxic and commonly occurring contaminants of concern, including important hydrophilic pesticides (glyphosate, acrolein, and paraquat) and per- and polyfluoroalkyl substances (PFAS) were characterized. EVB showed properties such as high stability, spreadability, and neutral pH that were suitable for topical application on the skin. The in vitro adsorption results indicated that EVB and EVB-SM were effective, economically feasible, and favorable barrier formulations for hazardous chemical adsorption, as supported by high binding percentage, low desorption rates for an extended period of time, and high binding affinity. A pseudo-second-order kinetic model was best fitted for the adsorption process. The Freundlich model fit the adsorption isotherms with negative enthalpy values indicating spontaneous reactions involving physisorption. The study, with varying temperatures and pH, showed that the adsorption reaction was exothermic and persistent. The results indicated that EVB, and especially EVB-SM, can be used as effective barriers to block dermal contact from water-soluble toxic pollutants during disasters.

269: Legacy lead in urban soils: Co-occurrence with metal(loid)s and radionuclides, isotopic fingerprints, and bioaccessibility

Zhen Wang, Duke University

Anthropogenic lead (Pb) in soils poses risks to human health, particularly to the neuropsychological development of exposed children. Delineating the sources and potential bioavailability of soil Pb, as well as its relationship with other contaminants is critical in mitigating potential human exposure. Here, we present a holistic analysis of total concentrations, radionuclides of 137Cs and 210Pb, Pb isotopic compositions, and in vitro bioaccessibility of Pb and other metals and metalloids in surface soils sampled from Durham, North Carolina. Elevated Pb (>400 mg/kg) was commonly observed in soils near residential house foundation and along urban streets, which co-occurred with other potentially toxic metal(loid)s such as Zn, Cd, and Sb. In contrast, soils from city parks and suburban areas had systematically lower concentrations of metal(loid)s that were comparable to geological background. The activities of 137Cs and excess 210Pb, coupled with their correlations with Pb could indicate the persistence and remobilization of historical atmospherically deposited contaminants. The Pb isotopic compositions further indicated that house foundation soils had significant input of legacy lead-based paint, whereas urban streetside soils exhibited a clear mixed origin, dominantly of legacy leaded gasoline and atmospheric deposition. The in vitro bioaccessibility of Pb in contaminated urban soils revealed that over half of Pb in the contaminated soils was potentially bioavailable, whose Pb isotope ratios were identical to that of bulk soils, demonstrating the utility of using Pb isotopes for tracking human exposure to anthropogenic Pb in soils and house dust.

270: Impact of lead exposure on iPSC-derived microglia extracellular vesicles
Charlotte R. Wirth, Harvard TH Chan School of Public Health
An increase in global life expectancy has led to higher incidences of debilitating and incurable neurodegenerative disorders (NDs). NDs involve complex communication between neurons and microglia. The innate immune cell of the brain, microglia are highly responsive to changes in their environment and radically change their function in response to toxins. Although genetic predisposition and age are known risk factors for NDs, it has become increasingly clear that exposure to lead (Pb) can result in their onset. While microglia are known to readily release extracellular vesicles (EVs), or lipid bound particles containing biologically active cargo such as proteins, lipids, and nucleic acids which can alter recipient cells function, no work has been done to assess the impact of Pb on microglia EVs. We hypothesize that lead exposure alters microglia EV cargo. We characterized Pb exposure on microglia EV size, type, and cargo and predict the functional significance of these changes within recipient neurons. We exposed human induced pluripotent stem cell (iPSC)-derived microglia in culture to lead acetate. Proteomic analysis and Nano Tracking Analysis profiled Pb impact on microglia EVs cargo and number respectively. This work is the first to characterize the protein content of cultured iPSC-derived microglia EVs at baseline and in response to Pb. Our findings give insight into the interplay of Pb exposure and NDs, thus revealing a potentially novel process for Pb induced NDs in the complex mechanism behind ND onset and progression.

271: In search of native metal-accumulating plants to improve remediation of mine tailings in arid ecosystems
Tomasz Wlodarczyk, University of Arizona
Industrial activities lead to soil contamination with hazardous elements and to degradation of ecosystems around the world. Phytoremediation is plant-driven, “green” and community friendly technology that can mitigate environmental pollution by stabilizing and/or extracting the contaminants from the soil. An important first step in effective phytomanagement is a directed selection of the plant species to be used for specific land restoration, especially in the face of global change and land desertification. This study aims to identify desert-adapted metal-tolerant plant species in areas with elevated metal concentrations in soil across the U.S. Southwest.
Vegetation at three legacy mine sites was surveyed and assessed for the heavy metal accumulation capacity. To enable a rapid and effective screening, we employed an innovative and non-invasive approach with a portable X-ray fluorescence spectroscopy (pXRF) device. The plant surveys showed the presence of a diverse plant cover, including metal tolerant and accumulating species. The in situ measured concentrations of metals in numerous plant parts were combined with the biogeochemical characteristics of soil at each study location. By providing a better understanding of plant tolerance and metal uptake/exclusion strategies our results will inform site-specific phytomanagement efforts. Plants identified in the study have a potential to sustainably remediate metal-contaminated soils and can serve as an important global template for mitigating human and environmental health issues in arid regions affected by metal contamination.

272: Synergistic Material-Microbe Interface toward Deeper Anaerobic Defluorination of a C6 Perfluorinated Compound.
Yongchao Xie, University of California-Los Angeles
Microbial defluorination of per- and polyfluoroalkyl substances (PFAS) was previously reported in an anaerobic enrichment culture which can defluorinate 1 to 2 fluorine per parent compound (E)-perfluoro(4-methylpent-2-enoic acid) (PFMeUPA). When coupled with this defluorinating enrichment culture with electrochemical system supplying biocompatible electrodes, the accelerated degradation of the PFMeUPA and the enhanced fluoride release (up to 6 fluorine per PFMeUPA) were observed

suggesting the synergistic effect of the material-microbe interface on deeper defluorination. These synergies at the material-microbe interface surpassed the limitation of microbial defluorination and further transformed biodefluorination end products into deeper defluorination products, which could be less toxic and readily biodegradable in aerobic environments. Microbial community analysis suggested novel candidate species performing defluorination and direct electron transfer can be enriched in an electrochemical system supplying PFMeUPA as the sole electron acceptor. The aforementioned results confer a strong promise of the sustainable material-microbe hybrid system, which could be driven by renewable electricity for deeper PFAS bioremediation.

273: Arsenic exposure induces glucose intolerance in mice through gut microbiome
Yifei Yang, University of North Carolina-Chapel Hill
Arsenic (As) is a widespread toxic metalloid in environment and contributes to a number of human diseases, including diabetes. The association between inorganic As and diabetes has been established in numerous epidemiological studies. Gut microbiome plays a fundamental role in human health by regulating metabolic, and thus emerges as a promising target for therapeutic treatment for human health. Studies have suggested the role of the gut microbiome and Farnesoid X receptor (FXR) in the pathogenies and prevention of diabetes in both animals and humans. However, how iAs-altered gut microbiome affects diabetes risk remains to be determined. Here, we exposed 1 ppm and 50 ppm As to C57BL/6 and FXR-/- mice for 6 months and investigated whether As exposure induces glucose intolerance and whether As exposure affects the bile acid homeostasis. We found that As treatment can significantly increase blood glucose in both wildtype and FXR-/- mice and more severe glucose intolerance in FXR-/- mice than in wildtype mice. In addition, we observed altered FXR ligands following arsenic exposure. To prove the role of gut microbiome in inducing glucose intolerance, we transplanted As-treated male mice cecum feces to a new batch of C57BL/6 male mice and measured the blood glucose levels at 7 days and 1 month after fecal transplantation. In transplanted mice, we found glucose intolerance phenotype was transferred after microbiome transplantation. In conclusion, our results further underscore the key role of microbiome-bile acid-FXR axis in iAs-induced diabetes, and highlight the potential role of microbiome modulation in reducing iAs toxicity.

274: Characterization of PFAS released from paper-based food packaging and Municipal Solid Waste in gas phase under simulated landfill conditions
Yuemei Ye, NC State University
The presence of PFAS in the leachate generated at landfills that contain municipal solid waste (MSW) is well documented. This is not surprising as landfills receive a wide range of products that contain PFAS including, for example, carpet, food packaging materials and textiles. In contrast to leachate, there is no published information on the presence of PFAS in landfill gas although elevated PFAS has been reported in the ambient air at three landfills. The objective of this research is to measure the release of PFAS during the anaerobic decomposition of a variety of single use food packaging materials. Initially, 40 samples of various packaging materials, including packaging from fast food restaurants, various microwave popcorn bags, and paper plates, including some labeled ecofriendly, were collected and screened using Particle-induced gamma emission (PIGE). Eleven of the 40 samples showed a total fluorine concentration above 500 ppm. These 11 samples were then subjected to a methanol extract which confirmed the presence of 6:2 FTOH at greater than 1.5 ng/g. These 11 samples are being tested in reactors operated under anaerobic conditions and designed to simulate the high solids environment of a landfill. Each test material will be inoculated with a PFAS-free culture enriched on Whatman #1 filter paper. Preliminary results showed that 6:2 FTOH and 6:2 FTO are released to the gas phase under simulated landfill conditions from both the high and low fluorine substrates paper-based food packaging. 6:2 FTOH concentrations were 100 to 1000 high than landfill gas.

275: Foliar surfaces as aerosol pollution monitors: Methodological validation, enrichment, and factors influencing foliar retention

Kira Zeider, University of Arizona

Air pollution is one of the leading causes of death from noncommunicable diseases globally, and in Arizona, both mining activities and abandoned agriculture can generate erodible dust. This dust is transported via wind and can carry elevated levels of toxic pollutants. Communities have begun to use citizen/community-based monitoring techniques to measure metal(loid) concentrations and evaluate their air quality. Two studies were conducted using community science data from Gardenroots. The first study assessed the efficacy of foliar surfaces as compared to an inverted disc (frisbee) to sample aerosol pollutants in ambient air. Both the foliar and frisbee collection methods had a decrease in metal(loid) concentration as a function of distance from the retired smelter. Statistical calculations showed that the collection methods had similar mean concentrations for all the metal(loid)s of interest; however, the tests also indicated that the frisbee method generally collected more dust than the foliar method. The second study investigated the concentration of metal(loid)s on the leaves of backyard plants across three counties in Arizona, and whether plant family and leaf surface area affected collection efficacy. The enrichment factor results revealed that many samples were enriched and that the foliar samples were generally more contaminated than the yard and garden soil samples. Statistical analyses demonstrated that leaf surface area was the most influential factor for leaf collection efficiency when compared to plant family. This work can build capacity for local communities to monitor their contaminant exposure with statistically proven study techniques.

276: Cadmium Exposure Increases Permeability in the Lung Microvascular Endothelial Cells and Causes ALI

Huaxiu Zeng, University of Alabama-Birmingham

Source of Cadmium expose includes coal mine, diesel exhausts, smoking and welding. Environmental exposure to Cadmium can cause different types of respiratory disease. The known effects of Cadmium exposure on the lungs are the development of emphysema and COPD. This study demonstrated that Cadmium exposure increase permeability of lung microvascular endothelial cells and caused Acute Lung Injury （ALI）. 3D Human Lung Microvascular Endothelial Cells (HLMVECs) spheroid showed presence of cell junction protein β-catenin and ZO-1. HIMVECs spheroid permeability assay described increased permeability in Cadmium treated spheroids. Mice exposed to Cadmium demonstrated increased protein content and inflammatory cells in Broncho-alveolar Lavage (BAL). The H& E staining also has been shown ALI in the lung of mice treated with cadmium. These studies present the concept that Cadmium-induced permeability changes in the lung microvascular endothelial cells and causes ALI.

277: Polyethyleneimine-based Surface Treatment for Fabrication of Electrically Conductive Membranes

Wei Zhang, UNC-Chapel Hill

Electrically conductive membranes (ECMs) have been demonstrated in the literature as a promising tool to enhance the performance of membrane-based water/wastewater treatment technologies by e.g., reducing fouling potential or facilitating oxidation/reduction of difficult-to-remove species. Membrane surface functionalization with “active” conductive materials is a direct and effective approach to obtain membranes with electrically conductive properties. However, a surface functionalization strategy that can be used for most types of commercial membranes (e.g., reverse osmosis, nanofiltration, ultrafiltration, and microfiltration) is not available yet. To address this need, we report a facile and low-cost polyethyleneimine (PEI)-based crosslinking method that enabled rendering electrically conductive the surfaces of a broad range of commercial membranes (i.e., from microfiltration to seawater reverse

osmosis membranes) by using graphite. All synthesized graphite composite ECMs showed low sheet resistance (< 3 kΩ/sq), improved separation performance (i.e., solute rejection) and reduced water permeance compared with the insulating pristine membranes. The electrical conductivity of the graphite-coated membranes was demonstrated through 100% degradation of methylene blue (30 mg/L) in 50 min with a 5 V applied potential. It was also demonstrated that the PEI-based crosslinking method is suitable for "active" conductive materials other than graphite, including carbon nanotubes, reduced graphene oxide, activated charcoal, and silver nanoparticles. We also demonstrate that this proposed PEI-based crosslinking method is suitable for scaling up ECMs fabrication.

278: The effect of biochar on anaerobic PCE dehalogenation by a microbial consortium
Weilun Zhao, University of Iowa
Background. Tetrachloroethene (PCE) is a common groundwater pollutant. PCE can be dechlorinated anaerobically by a microbial consortium (SDC-9), which contains Dehalococcoides sp. However, anaerobic PCE dechlorinating cultures have a tendency to stall at cis-DCE and VC under both laboratory and field conditions. The purpose of this study is to evaluate whetherblack carbon materials can promote complete anaerobic PCE dechlorination to ethene by SDC-9.
Methods. Poplar biochar pyrolyzed at three different temperatures (500°C, 700°C, and 900°C) were tested in experiments with PCE- and lactate-fed SDC-9 cultures. PCE, TCE, cis-DCE, and VC, ethene, and methane concentrations were monitored gas chromatography. Biomarkers for anaerobic PCE-dechlorinating bacterial reductive dehalogenase genes (tceA and vcrA), and Dehalococcoides (Dhc) 16S rRNA genes were monitored by quantitative PCR in both the liquid phase and on the biochar. Overall microbial community structure changes were assessed with 16S rRNA gene sequencing.
Results. Cultures without biochar stalled at cis-DCE and VC. However, SDC-9 completely dechlorinated PCE to ethene in the presence of biochar. In liquid samples from cultures, dechlorination biomarkers (tceA, vcrA and Dhc 16S genes) increased slightly in the absence of biochar by increased by 4 orders of magnitude in the presence of biochar. Dechlorination biomarkers were found on biofilm DNA extracted from biochar. Methanogens and lactate-fermenting bacteria also colonized the biochar.
Impact statement. These results indicate that biochar could improve the performance of a PCE-dechlorinating consortium – perhaps by promoting the growth and activity of supporting microbial community members that play essential roles in growth and activity of Dehalococcoides.

279: Projecting the impact of community engagement-based green infrastructure interventions on flooding and contamination combining Delft 3D Mesh and L-THIA models
Rui Zhu, Texas A&M University
The City of Galena Park, TX has experienced severe flood damage and hazardous substance transferal during flood events due to its industrial and bayou proximity, significantly increasing health risks to its population due to these multi-hazard exposures. This project develops a participatory master plan which includes provisions for enhancing green infrastructure (GI) for a community in Galena Park. These GI interventions seek to lessen both flooding and contamination issues and improve public health outcomes. The adaptive GI toolkit and the relocation of residential areas with high flood-related risk are major strategies used to decrease flood vulnerability and decrease exposure to industrial contaminants in Galena Park. To assess the probable impacts of the master plan on flood and non-point source pollutants reduction, Delft3D-FM (for Flexible Mesh) is coupled with the Long-Term Hydrologic Impact Assessment Low Impact Development (L-THIA) model. L-THIA results show that after the completion of the retrofit, the annual average runoff will be reduced by 12.5%, and non-point source pollutants are expected to be decreased by 12.6%. From Delft3D model's results, we found that, under a Hurricane Ike scenario, the master plan reduces both the magnitude and the spatial extent of the flooding. Not only is

the overall maximum flood depth smaller with the master plan in place, but the amount of time the flooding lasts is also much shorter with the master plan.

280: Mitochondrial nucleoid dynamics following mtDNA damage
Dillon King, Duke University
Mitochondria contain multiple copies of mitochondrial DNA (mtDNA) that are each compacted into nucleoid structures by the protein Transcription Factor A Mitochondrial (TFAM). The mitochondrial genome lacks the nucleotide excision DNA repair pathway, making mtDNA particularly susceptible to UVC-induced lesions and bulky adducts formed after exposure to many environmental chemicals. Removal of these types of mtDNA damage is carried out through mitophagy and takes longer than removal of similar lesions from nuclear DNA. Recent studies have shown fission events that occur in the peripheral regions of mitochondria lead to mitophagy, while fission events in the midzone region stimulate biogenesis. Using qPCR, we have observed alterations in expression of genes that regulate mitochondrial biogenesis and mitochondrial function following UVC exposure. We are currently utilizing SNAP-tag fusion proteins to label TFAM before and after UVC-induced mtDNA damage to determine if there is preferential degradation of damaged mtDNA. To investigate whether structural changes in the mitochondrial nucleoid occur, potentially serving to signal the presence of damaged mtDNA, we are examining levels of mtDNA-TFAM nucleoid compaction following UVC exposure using atomic force microscopy. Our approach couples in vitro biochemical methodologies to assess physical parameters of the mitochondrial nucleoid alongside live-cell imaging techniques to decipher the cellular response to mtDNA damage. This research informs our understanding of how mitochondria respond to and deal with mtDNA damage.

281: The Role of Arsenate Reductases in Arsenate Detoxification and Accumulation in Plants
Josphat Kiunga, University of Massachusetts-Amherst
The prevalence of arsenic (As), mainly inorganic arsenate and arsenite, in the environment has led to the evolution of multifunctional enzymes involved in arsenic uptake, translocation, and detoxification in plants. Among these enzymes, arsenate reductase 2 (ACR2) and HIGH ARSENIC CONTENT 1 (HAC1) have been implicated in endogenous arsenic detoxification in plants. However, these two enzymes are yet to be fully characterized in high biomass, non-food oilseed crop Crambe abyssinica, a potential plant for phytoremediation of environmental arsenic. Our main aim is to characterize Crambe ACR2 (CaACR2) and HAC1 (CaHAC1) to gain a mechanistic understanding of their role in arsenic tolerance and accumulation. We hypothesized that 1) knockdown of CaACR2 and CaHAC1 genes by RNA interference (RNAi) approach will lead to an enhanced translocation of arsenate to the above-ground tissues by limiting the conversion of arsenate to arsenite in the roots and 2) their shoot-specific overexpression will lead to an enhanced reduction of arsenate to arsenite and thus increased As accumulation in shoot tissues. To test our hypothesis, we designed and cloned RNAi and overexpression constructs for CaACR2 and CaHAC1. Subsequently, Agrobacterium-mediated transformation was carried out and the selected transformants will be grown for at least two generations to get homozygous lines. Molecular, biochemical, and phenotypic studies will be carried out to decipher the mechanism of action of CaACR2 and CaHAC1 in Crambe. This transgenic approach is expected to aid in the development of a strategy to hyper-accumulate As in shoot tissues for the phytoremediation of arsenic-contaminated soils.

282: Harnessing wild C. elegans to identify natural variation in susceptibility to PFAS and heavy metal exposures
Tess Leuthner, Duke University
Individual genomic variation is a critical, but missing, aspect in identifying and characterizing adverse health outcomes of chemical exposures in human and animal populations. Here, we have harnessed the

natural genetic diversity of twelve wild Caenorhabditis elegans strains from the C. elegans Natural Diversity Resource (CeNDR) to determine the contribution of genetic variation to chemical exposure responses. We have focused on two important classes of chemical pollutants: heavy metals and poly- and perfluoroalkyl substances (PFAS). Both heavy metals and PFAS are ubiquitous drinking water contaminants of particular concern in North Carolina. Very little is known about the adverse effects of the >9,000 synthetic PFAS chemicals in production. Therefore, we are investigating how chain length, functional group, and other properties of PFAS may drive toxicity. We measured C. elegans growth rate as a toxicity endpoint after 48 hours of exposure to 13 PFAS chemicals (legacy and emerging compounds) and three heavy metals (Cd, As, and Pb). There is variation in EC50 values between PFAS compounds despite similar internal body burden. We also observe variation in response among the genetically divergent C. elegans strains within treatments, suggesting that underlying genetic variation contributes to response to exposures. In the future, we will pool 192 genetically divergent wild strains and conduct selection (exposure) and population-sequencing experiments to determine sensitivity or resistance of each strain, followed by genome-wide association studies to identify quantitative trait loci and potential gene candidates that are associated with variation in response to exposures

283: Detection of airborne VOCs using micropreconcentrator integrated with solid phase micro-extraction

Sujoy Halder, University of Louisville

Detecting toxic volatile organic compounds (VOCs) in environmental air is crucial because toxic VOCs promote adverse effects on human health, such as cardiovascular diseases, central nervous system dysfunction, cancer, etc. Gas chromatography-mass spectrometry (GC–MS) is widely used to detect these VOCs. However, the preconcentration process is necessary to detect trace VOCs in the air. Using a micropreconcentrator or solid phase micro-extraction (SPME) technique for VOCs analysis requires a large sample volume for concentration or approaches the instrument's detection limit. This work demonstrates the detection of VOCs by combining a microfabricated silicon micropreconcentrator with commercial SPME in a two-stage concentration process to achieve repeatable measurements of trace VOCs in the air.

A micro-electro-mechanical system (MEMS) based micropreconcentrator was designed and fabricated with micropillars in a microfluidic chamber to support sorbents and enhance heat transfer to the sorbents for rapid thermal desorption. The inside cavity was packed with porous carbon adsorbent. Gaseous VOCs were passed through micropreconcentrator where VOCs were adsorbed on the adsorbents at ambient temperature, then desorbed at 320 °C and collected to a volume of 50 mL in a glass syringe using synthetic air. SPME was performed for 15 minutes using 75 µm Carboxen/Polydimethylsiloxane (Car/PDMS) fiber. Then the fiber was inserted into GCMS to analyze compounds. The adsorption, desorption flow rates and thermal desorption temperature were optimized to increase the analytical accuracy of VOCs measurements. Finally, the optimized conditions were applied for measuring sub-ppb levels of benzene, toluene, ethylbenzene, xylene (BTEX), and trichloroethylene (TCE) in environmental air by GC–MS.

284: Uranium isotopes to trace sources and cycling of uranium in aquifers in the Northern Plains

Kathrin Schilling, Columbia University

In the Northern Plains, elevated concentrations of uranium (U) in drinking water reflect naturally occurring enrichment in aquifers, as well as the legacy of mining near tribal communities. Consequently, tribal communities impacted by U groundwater contamination are particularly interested in detecting the source of contamination. Concentrations of dissolved U is affected by multiple processes (e.g., dilution, adsorption, dispersion) and are poor indicators of redox-induced fate and cycling in

groundwater. Isotope ratios of dissolved U in groundwater, in tandem with concentrations, are invaluable for studying redox-induced (im)mobilization, and tracing uptake and human exposure. Here, we use U isotope ratios to characterize redox reactions in groundwater, acquiring unique mechanistic information about the reaction progress. We measured δ238U and U activity ratios of six groundwater samples collected from Pine Ridge Reservation using a Multi-Collector Inductively Coupled Plasma Mass Spectrometer. Groundwater U(VI) concentrations ranged from 20 µg/L to 30 µg/L and δ238U ranged from -0.12‰ to -0.33‰. These preliminary results provide "proof of concept" that crucial information obtained from U isotopic analysis along with U concentrations can be used to determine the fate and transport of U from their sources. The results show a general trend of 235U enrichment in these samples suggesting various extent of reductive U removal from groundwater. The U activity ratios [(234U/238U)] in the groundwater samples are above secular equilibrium value of 1 and vary from 1.60 to 2.04 suggesting "unsupported" 234U enrichment, which indicates a distal U source relative to the sampled well.

285: Detection of airborne VOCs using micropreconcentrator integrated with solid phase micro-extraction

Sujoy Halder, University of Louisville

Detecting toxic volatile organic compounds (VOCs) in environmental air is crucial because toxic VOCs promote adverse effects on human health, such as cardiovascular diseases, central nervous system dysfunction, cancer, etc. Gas chromatography-mass spectrometry (GC–MS) is widely used to detect these VOCs. However, the preconcentration process is necessary to detect trace VOCs in the air. Using a micropreconcentrator or solid phase micro-extraction (SPME) technique for VOCs analysis requires a large sample volume for concentration or approaches the instrument's detection limit. This work demonstrates the detection of VOCs by combining a microfabricated silicon micropreconcentrator with commercial SPME in a two-stage concentration process to achieve repeatable measurements of trace VOCs in the air. A micro-electro-mechanical system (MEMS) based micropreconcentrator was designed and fabricated with micropillars in a microfluidic chamber to support sorbents and enhance heat transfer to the sorbents for rapid thermal desorption. The inside cavity was packed with porous carbon adsorbent. Gaseous VOCs were passed through micropreconcentrator where VOCs were adsorbed on the adsorbents at ambient temperature, then desorbed at 320 °C and collected to a volume of 50 mL in a glass syringe using synthetic air. SPME was performed for 15 minutes using 75 µm Carboxen/Polydimethylsiloxane (Car/PDMS) fiber. Then the fiber was inserted into GCMS to analyze compounds. The adsorption, desorption flow rates and thermal desorption temperature were optimized to increase the analytical accuracy of VOCs measurements. Finally, the optimized conditions were applied for measuring sub-ppb levels of benzene, toluene, ethylbenzene, xylene (BTEX), and trichloroethylene (TCE) in environmental air by GC–MS.

286: Rural Appalachian Kentuckians Have General Concerns about Environmental Pollution

Dawn Brewer, University of Kentucky

Environmental Health Literacy (EHL) provides a framework through which vulnerable populations can assess their risk for environmental exposures and develop and implement strategies to mitigate negative effects of exposure. Rural Appalachian Kentuckians experience a dual burden of economic and health disparities, linked to years of resource extraction and the release of environmental pollutants. During the summer of 2020, the University of Kentucky Superfund Research Community Engagement Core (UK-CEC) distributed modified EHL surveys to a rural low-income population receiving emergency food boxes through a community organization (n=53). Respondents were white (92.6%) middle aged (average age 45) females (85.2%) with 55.65% reporting not having enough money to buy the food they need to feed themselves and their family. Results indicated concern with direct exposure to pollutants

at work and in the home but less concern with the health effects of more dispersed environmental pollutants in air and water, which were largely perceived as not polluted or not the cause of health problems. Simultaneously, most participants expressed concern with environmental pollutants; 62% considered environmental problems nearly as important as other problems in their family or neighborhood. Overall, the results from this survey suggest that low-income rural Appalachian Kentuckians are concerned with environmental pollutants, but not always aware of the route or health consequences of exposures. Future research should engage more directly with communities to tease out the qualitative nature of their concern, how they experience and understand exposures, and how their needs can best be met through culturally appropriate interventions.

287: Quantitative Structure Retention Relationships to Identify Per-/Poly-Fluoroalkyl Substances and Other Contaminants of Emerging Concern

Scott Simpson, St. Bonaventure University

On target analysis using liquid chromatography–high resolution mass spectrometry (LC–HRMS) is a valuable approach in characterizing for contaminants of emerging concern (CECs) in the environment. However, identification of these analytes can be quite costly or taxing without proper analytical standards. To circumvent this problem we utilize Quantitative structure-retention relationships (QSRR) models to predict elution order and retention times. Properties calculated from density functional theory (DFT) and the conductor-like screening model for real solvents (COSMO-RS) theory are used to produce our QSRR models, which can be calculated for virtually any analyte. We show that this methodology has been successful in identification of per- /poly-fluoroalkyl substances (PFAS) and other contaminants. Nontarget analysis using liquid chromatography– high resolution mass spectrometry (LC–HRMS) is a valuable approach in characterizing for contaminants of emerging concern (CECs) in the environment. However, identification of these analytes can be quite costly or taxing without proper analytical standards. To circumvent this problem we utilize Quantitative structure retention relationships (QSRR) models to predict elution order and retention times. Properties calculated from density functional theory (DFT) and the conductor-like screening model for real solvents (COSMO-RS) theory are used to produce our QSRR models, which can be calculated for virtually any analyte. We show that this methodology has been within 5% of experimental retention times.

288:

289:

290: Dechlorinated PCB Potency Compared to PCB126 with Respect to Programming Offspring Obesity and Diabetes

Sara Y. Ngo Tenlep, University of Kentucky

Background: Polychlorinated biphenyls, or PCBs, are mixtures of many different chlorinated compounds. They are not found naturally in the environment and are man-made. Previous studies have shown that PCBs can cross the placenta and enter breast milk of DAMs who have been exposed. Offspring are susceptible to PCB exposure during the in-utero period as it leads to differences in the offspring's body composition and glucose homeostasis.

Methods: We ordered ninety female ICR mice and split them into three treatment groups-vehicle control, vehicle biphenyl, and vehicle PCB126. The DAMs were exposed via oral gavage three times throughout the study-72 hours before mating, gestational day seven, and post-natal day seven. The DAMs and offspring weights were measured throughout the study in addition to the offspring body composition and glucose homeostasis. We sampled the liver tissue two weeks after the last exposure to study gene expression.

Results: We found that at twenty weeks of age the male offspring of PCB126-exposed DAMs had higher body weights and fat percentage but lower lean mases than the males in the other two groups. The males also showed differences in glucose homeostasis at zero-and thirty-minute marks. The female offspring were indifferent to maternal exposure at that age. DAMs and offspring livers showed overexpression of Cyp1a, NQo1 and under expression of Ahr.
Impact Statement: Early life exposure to environmental chemicals can have long-term consequences not always apparent until later in life. Dechlorinating PCBs to biphenyl could be an intervention strategy that causes less harmful effect in offspring.

291: Exploring the potential of low-cost passive sampling devices (SPATTS) for non-target assessment of PFAS contamination.

James Dodds, University of North Carolina

Persistent organic pollutants (POPs) are an ensemble of man-made chemical compounds that are resistant to degradation and known to cause adverse outcomes in human health, wildlife, and the environment. Specifically, PFAS contamination is an emerging environmental concern in the Cape Fear river basin in North Carolina due to local fluorochemical manufacturing and recent outflows which affect drinking water quality for nearby residents. Here we evaluate the efficacy of a low-cost passive sampling device (Solid Phase Adsorption Toxin Tracking, or SPATT) for spatial PFAS profiling using ion mobility spectrometry-mass spectrometry (IMS-MS).
SPATT devices were constructed using an embroidery hoop which encased two cloth meshes filled with 3 g of HP20 resin. SPATTs were conditioned in methanol/water and subsequently deployed at 5 locations along the Cape Fear River during the summer of 2016 and 2017. SPATTs were collected, rinsed, and stored at -4°C until 2022 when they were extracted and concentrated prior to LC-IMS-MS analysis. Preliminary results demonstrated that while legacy PFAS were observed in relative equal abundance at all sampling sites (PFOS, PFHxS, PFBS, and PFOA), emerging replacement compounds were localized predominantly downstream of the manufacturer (PFO4DA, GenX, Hydro-EVE, Nafion Byproducts, and NVHOS). These results are congruent with our initial hypothesis that emerging PFAS observed in the Cape Fear River are likely attributable to local fluorochemical manufacturing processes and corresponding outfalls. While these results are not quantitative, they effective highlight the potential utilization of SPATTs as low-cost passive sampling devices for PFAS assessment.

292: Incorporating Environmental Health Literacy through Educational Opportunities for Students

Crystal Stephens, University of Alabama-Birmingham

Background: Superfund Lung Ambassadors is an integral component of increasing environmental literacy among students. G. W. Carver High School is located 1.3 miles from the 35th Avenue Superfund site in North Birmingham, Alabama. Unfortunately, many residents are unaware that the area is a designated Superfund site. Training students to identify variables that impact environmental and lung health permits them to educate and gain the support of the community, increasing student and community awareness.
Methods/Results: Building connections with community partners broadens experiential learning, and the implementation of environmental knowledge helps engage students while cultivating future interest. Students will take value-added assessments to determine environmental knowledge increase. Students will also create and participate in a community service project that enlists other students, faculty, and potentially residents in the community. Materials are designed using a team approach to align with existing curriculum. This design helps ensure that topics addressed are appropriate and prompt critical thinking, as well as instill the importance of teamwork and communication.
Impact Statement: This program provides an avenue that implements innovative approaches to real world challenges students face. Community partners are able to invest in the education of students

while exhibiting a positive influence. By increasing environmental health literacy, students that are impacted by environmental misuse learn, engage, and explore facets of environmental health to strategize problem-based solutions. Students will emerge as leaders and be encouraged to continue training in fields of interest and those that contribute to promoting environmental health.

293: Developmental PFOS exposure dysregulates microglial-neuron interactions and promotes seizure susceptibility

Jessica Plavicki, Brown University

Microglia, the innate immune cells of the brain, are essential for responding to pathogens and injury, and also play critical roles in shaping brain development and homeostasis. Our prior work using zebrafish demonstrated developmental exposure to perfluorooctane sulfonate (PFOS) produces an activated microglial morphology and results in the upregulation of p2ry12, a G-coupled protein receptor involved in microglial activation and migration. PFOS-induced microglial activation resulted in a heightened microglial response to brain injury, which could be rescued by using optogenetics to drive microglia towards a homeostatic state. We found the neuronal signaling environment modulated microglial activation and that optogenetic silencing of the neurons was sufficient to normalize the microglial response to injury. To further examine the relationship between immunotoxic PFAS congeners and neuron-microglial communication, we exposed zebrafish larvae to perfluorooctanoic acid (PFOA), a 8-carbon PFAS with a carboxylic functional group. Exposure to PFOA did not alter microglial responses to injury or the neuronal signaling environment. We are currently performing electrophysiological recordings to better understand the impact of PFOS on neuronal signaling. Preliminary studies suggest seizure like activity following a chronic 8mM PFOS exposure, which is exacerbated by exposure to a convulsant at concentrations that do not elicit seizures in control larvae. Studies are underway to assess whether seizure like activity is present in larvae exposed to lower concentrations of PFOS. Together, our studies reveal a significant role of neuronal signaling in coordinating microglia functions, as well as a novel view of how structurally similar PFAS congeners differentially impact the CNS.

294: 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.

295: IoT-based Edge Computing (IoTEC) for Improved Environmental Monitoring: A Case Study of Real-Time Monitoring of Vapor Intrusion

Yongli Wager, Wayne State University

Exposure to volatile organic compounds (VOCs) is an important determinant of maternal-offspring health, with implications for preterm birth and associated adverse health outcomes. VOCs contaminate shallow soils and groundwater of post-industrial cities at Superfund, residential, commercial, and industrial properties, leading to exposures via vapor intrusion (VI). Currently, it is very challenging to assess VI due to the complexity and high cost of off-line sampling methods. Recent advances in sensor and communication technologies such as the Internet of Things (IoT) has allowed for the coupling of onsite contaminant monitoring with off-site data processing capabilities, permitting real-time data analysis and sharing of information for prompt decision-making. However, IoT-based environmental monitoring is constrained by many inherent features such as energy, bandwidth, and data management. This research considered a unique application of an IoT sensor network integrated with edge computing (IoTEC) for real-time monitoring of VI to compare data latency, energy consumption, and economic cost between the proposed IoTEC approach and the conventional sensor monitoring method. The results show that this new IoTEC monitoring approach, compared with the conventional IoT sensor network, could significantly reduce data latency by 13%, and the amount of data transmission decrease by an average of 50%. In addition, the IoTEC method can increase the duration of power supply by 130%. Collectively, these improvements could lead to a compelling cost reduction of 55%-82% per year for monitoring VI at five houses, with more houses leading to more significant savings.

296: Assessing the accessibility of personal care products free of common endocrine disrupting chemicals in the PROTECT study area

Sofia F. Contreras, University of Puerto Rico

Background: Participants of the Puerto Rico Test site for Exploring Contamination Threats (PROTECT) Program have expressed interest in learning about common endocrine-disrupting chemicals (EDC's) in personal care products (PCP) and what products are considered safer options. To fulfill this priority, we: a) identified PCP free of six potential EDC's (parabens, phenols, phthalates, parabens, triclosan, and triclocarban), b) explored accessibility to these products for PROTECT participants, and, c) prepared an understandable and accurate consumer product guide.
Methodology: As part of the Desafío Project requirement of the Trainee Program, from March 2022 to May 2022 we registered the availability of the three most used products (deodorants, bar soap, and liquid body soap) without the six potential EDC's in chain pharmacies, community pharmacies, megastores and supermarkets in the 21 municipalities of the PROTECT study area.
Results: We found a total of 683 products within the 3 categories. The most common type of product found was liquid body soap (41.9%), followed by deodorant (35.3%) and bar soap (22.8%). The majority were found in chain pharmacies (55.1%). We included each category's five most common products in an educational guide for PROTECT participants. This guide provides basic information on how to read ingredient labels in PCP, images, and price ranges of recommended products.
Impact: This guide provides a resource for PROTECT participants, collaborating clinics, and the general community in Puerto Rico to make safer decisions about personal care products.

297: Metal mixtures in private well water are associated with preterm birth in North Carolina

Lauren Eaves, University of North Carolina-Chapel Hill

Background. Prenatal exposure to metals in private well water may increase the risk of preterm birth. In this study, we estimated associations between concentrations of arsenic, manganese, lead, cadmium, chromium, copper, and zinc in private well water and preterm birth incidence in North Carolina (NC).
Methods. We leveraged the NCWELL database: 117,960 well water tests across NC taken between 1998

and 2019. Using birth certificates from 2003 to 2015 (n=1,329,071), we assigned the mean census tract-level concentration for each metal to each birth. We fit adjusted logistic regression models to evaluate associations between individual metals and preterm birth. We used quantile-based g-computation to estimate joint associations with a mixture of metals.
Results. We found that concentrations of lead and cadmium were individually associated with an increased risk of preterm birth. The OR comparing births in tracts where over 25% of tests were measured at or above the maximum contaminant level (MCL) to births in other tracts for lead (MCL=15 ppb) was 1.10 (95% CI 1.02,1.18) and for cadmium (MCL=5ppb) was 1.11 (95% CI 1.00,1.23)). A mixture of lead, cadmium, and chromium increased the risk of preterm birth as well (OR for increasing the mean tract-level concentration of each of these by one quartile: 1.02 (95% CI: 1.01,1.03)). The metal mixture effect was most pronounced among American Indian mothers, highlighting potential environmental justice concerns. Impact statement. Contamination of private wells with metals contributes to preterm birth. This study highlights the need for awareness and action around metal contamination of private wells.

298: scRNA-Seq analysis of human CD5+ innate-like B cells identifies PD-L2 as a putative mechanism of TCDD-mediated IgM suppression

Lance Blevins, Michigan State University

B lymphocytes are adaptive immune cells responsible for the production of antibodies and the release of pro- and anti-inflammatory cytokines. A previous report from our laboratory found that human, primary CD5+ innate-like B cells (ILB) were preferentially sensitive to 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD)-mediated immune suppression compared to CD5- adaptive B cells. Specifically, we demonstrated that CD5+ ILB were marked by elevated expression of aryl hydrocarbon receptor (AHR), programmed cell death protein-1 (PD-1), and its ligands. We also identified a putative role for AHR in the expression of PD-1 suggesting PD-1 may be important in mediating suppression of IgM secretion. However, CD5+ ILB are a heterogenous population of B cells that include regulatory populations which highly express PD-1 ligands. To elucidate AHR expression in different human B cell populations, naive, circulating CD19+ B cells were isolated directly from PBMC and enriched for CD5 expression. We then used single cell RNA-sequencing (scRNA-seq) to identify different B cell subsets found within human CD5+ ILB. We found that AHR expression was strongly correlated with expression of CD9 and IL10 as well as CYP1B1. Interestingly, CD9 is reported as a marker of IL-10 producing Bregs suggesting a role for AHR in Breg IL-10 production. We also show that isolated CD9+ B cells express significantly more PD-L1 and PD-L2 mRNA and protein compared to CD9- B cells. Finally, blocking PD-1/PD-Ligand engagement with a PD-1 specific antibody reverses TCDD-mediated suppression of IgM secretion. These findings were confirmed directly with qRT-PCR and flow cytometry. (Supported by NIH grant P42ES0049

299: Associations of phthalate mixtures and birth outcomes among women using exposomic sensors in New Hampshire

Skarlet Velasquez, University of Georgia

Humans are exposed to complex mixtures from a range of consumer products, including phthalates. Previous research has focused on associations between individual phthalate metabolites and pregnancy outcomes, however phthalate mixtures research is sparse. We measured phthalate concentrations using silicone wristbands among a subset of women (n = 410) in the New Hampshire Birth Cohort Study for ~1 week at 12 gestational weeks. We assessed the individual and joint associations of 6 maternal phthalate concentrations (DBP, DIBP, BBP, DNNP, DEP, DEHP) on five birth outcomes (birth weight, birth length, head circumference, ponderal index, and gestational age) using multivariable linear regression and Quantile g-computation. Sex-specific associations were explored in stratified models.
DEP was most strongly associated with birth outcomes: A doubling of DEP was inversely associated with

all birth outcomes: birth weight (-31.54, 95%CI: -51.99, -11.10), birth length (-0.15, 95%CI: -0.27, -0.03), head circumference (-0.11, 95%CI: -0.18, -0.04), ponderal index (-0.01, 95%CI: -0.02, 0.01) and gestational age (-0.09, 95%CI: -0.17, -0.02). Quantile g-computation results were consistent for DEP (weight: -0.499) while the overall joint phthalate association was positive for birth length [Overall Ψ: 0.505, 95%CI: 0.062, 0.948]. Sex stratified analyses followed a similar trend for boys. Pregnant women are exposed to a complex mixture of phthalates on a daily basis. Our results suggest that overall exposure to phthalates as a mixture is adversely associated with birth outcomes, and specifically DEP. A better understanding of environmental risk factors for adverse birth outcomes will help in the development of targeted intervention and prevention strategies.

300: PFAS are associated with elevated liver enzymes in participants of the GenX Exposure Study
Britney Paul Rajamanickam, NC State University

Background: High levels of per- and polyfluoroalkyl substances (PFAS) were found in residents along the Cape Fear River Basin, North Carolina (NC) residents. PFAS have been linked to hepatotoxic effects in animals including elevation of liver enzymes, but the epidemiological evidence has been inconsistent. We evaluated the association between serum PFAS and the liver enzymes alanine transaminase (ALT) and aspartate transaminase (AST) in a highly exposed population.
Methods: We investigated 477 individuals (ages >5) enrolled in the GenX Exposure Study between November 2017 and February 2019. Five PFAS detected in >75% of serum samples were included: PFOA, PFHxS, PFNA, PFOS, and Nafion Byproduct 2. Nafion Byproduct 2 is a polyfluoroalkyl ether sulfonic acid unique to the Cape Fe1ar Basin. We used linear regression to estimate covariate-adjusted associations between quartiles of serum PFAS levels and log-transformed liver outcomes.
Results: The sample included 336 Wilmington, NC residents and 141 Fayetteville, NC, residents; participant age ranged from 6 to 86 years and 61% were female. ALT was the more sensitive endpoint with most PFAS associated with elevation in ALT, though only PFOA and PFNA were statistically significant. Comparing the highest quartile to the lowest quartile, ALT levels increased by 15% (95% CI: 6%, 25%) for PFOA and 11% (95% CI: 2%, 30%) for PFNA. Though not significantly associated with ALT, Nafion Byproduct 2 had a significant trend (p=0.023).
Impact Statement: This small cross-sectional study of a highly exposed PFAS population suggests that many PFAS may contribute to adverse liver outcomes.

301: Exposure to novel perfluoroalkyl ether acids and legacy PFAS in Cape Fear Region, North Carolina
Nadine Kotlarz, NC State University

Background: Historic use of legacy per- and polyfluoroalkyl substances (PFAS) contaminated drinking water in the Cape Fear River Basin (CFRB), North Carolina (NC). A fluorochemical facility's discharges introduced novel perfluoroalkyl ether acids (PFEAs) including hexafluoropropylene oxide-dimer acid ("GenX") to the basin. The GenX Exposure Study is evaluating GenX and other PFAS exposure in CFRB residents.
Methods: In 2020-2021, we collected blood samples from 1,019 people six years and older. Participants included public drinking water users from New Hanover and Brunswick counties (i.e., the lower CFRB) and Pittsboro, and private well owners from Fayetteville, NC. We analyzed blood for 44 PFAS, including seven PFEAs.
Results: Participant age ranged from 6 to 93 years. Multiple PFAS were detectable in all blood samples. Among lower CFRB residents (n=282 recruited in 2020; n=232 in 2021), two PFEAs (Nafion byproduct 2, PFO5DoA) were frequently detected (>70%). Detection frequencies and concentrations in the lower CFRB decreased between 2020 and 2021. In Fayetteville (n=300), Nafion byproduct 2 and PFO5DoA were detected less frequently and at lower levels than in lower CFRB residents. PFEAs were rarely detected in Pittsboro (n=206); GenX was not detectable in any samples. PFOA, PFOS, PFHxS, and

PFNA median values in the three communities exceeded US national averages. In ~30% of participants, their summed concentration of legacy PFAS exceeded 20 ng/mL, the level of highest concern for health effects.
Impact Statement: The GenX Exposure Study characterized human exposure to novel PFEAs and highlighted the CFRB as having several populations highly exposed to legacy PFAS.

302: Videos as a tool to communicate the environmental exposure to pregnant women living in Puerto Rico through the Covid-19 Pandemic.

Chrystal Galán Rivera, Northeastern University

Background: The Puerto Rico Team for Exploring Contamination Threats (PROTECT) explores the relationship between environmental exposures and adverse pregnancy outcomes. The PROTECT Community Engagement Core (CEC) aimed to create engaging videos to explain environmental biomarkers to PROTECT participants and communities close to Superfund Sites and inform them how to prevent future exposures as a remote communication method due to the social- distancing caused by the COVID-19 Pandemic.
Methods: PROTECT scientists identified the chemicals of concern for participants: phthalates, bisphenol-A, pesticides, parabens, triclocarban, and triclosan. Each material considered the environmental contaminant definition and how these exposures can influence maternal-child health, potential exposure routes, related health outcomes, and accessible alternatives to reduce or prevent exposition.
Results: A total of six videos related to the topics of the most common environmental biomarkers during pregnancy were developed. The CEC community advisory board evaluated the content and ensure the risk communication principles for our audience. The evaluation results of the videos were outstanding; the video content (99%), audiovisual organization and illustration (98%), environmental health literacy (94%), action and application (95%), stimulation for learning (96%), and cultural adequacy (98%). A global score of 97% for the videos was obtained. The videos were shared through multiple social media platforms.
Impact statement: Videos can be an effective strategy for science communication, community engagement, environmental health literacy, self-education, and empowerment for women. This educational and communication approach focuses on reducing health disparities and inequalities, providing information that motivates individuals to act and participate in choices that affect their health.

303: 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.

304: Evaluating Individual Report Back by Study Nurses During COVID-19.
Nobel Hernández-Otero, University of Puerto Rico
Background: Community Engagement Core of the Puerto Rico Team for Exploring Contamination Threats (PROTECT) has been responsible for returning the research results to participants. The report-back has been associated with better retention of participants in research, individual and community empowerment, and motivation to reduce household exposures. Unfortunately, the COVID-19 pandemic affected the community's report-back process. This context moved the project to add the modality of report-back individually with the PROTECT study nurses.
Objectives: The principal aim of this project is to evaluate the experience and impact of individual report-back by nurses on a sample of PROTECT participants.
Methods: PROTECT identified 50 participants who have been in contact with the project for the last six months and had access to the Mi PROTECT web platform. Five nurses from PROTECT were responsible for providing their research results.
Results: We provided report back to 47 participants from December 2021 to January 2022, including one woman who experienced preterm birth. At present, we completed 21 evaluations of the process with participants (45%). The majority of participants (80%) felt oriented about their results. All participants (100%) agreed that reporting result is important to improve their quality of life.
Impact: Individual report back is an opportunity to promote environmental health literacy and knowing what toxic or chemical exposure occurred during pregnancy. It is also a viable alternative for health professionals to learn about the health implications of chemical and environmental exposures and their possible effects on pregnant women's and their offspring's health.

305: Urea Inhibits Formation of EPFRs
Lavrent Khachatryan, Louisiana State University
The number of studies related to Environmentally Persistent Free Radicals (EPFRs) chemistry and their environmental and health impacts is constantly growing. EPFRs have emerged as an important particulate matter (PM) component due to their special environmental and health effects, including the emissions from the thermal treatment of Superfund Sites. It has become clear that due to their toxicity and human health impact, the control of the EPFR formation and their release from various sources is of the utmost importance. At LSU Superfund Research Center, the control of EPFR formation and release has become one of the research goals. We report here the impact of urea on the EPFR formation and decay through laboratory adsorption studies on the model systems where particles containing metal centers (5% CuO/SiO2 - catalyst) were exposed to radical precursors (1-MCP, 1-monochlorophenol) and urea ((NH2)2C=O) at 230 °C in exposing chamber. Urea is a known air pollution control chemical used in many thermal treatment processes to reduce nitrogen oxides emission. A strong inhibition for formation of 1-MCP EPFRs has been detected with increasing of urea concentration up to 10 % (w) of PM mass. Loss of activity of Cu+2 towards EPFR formation in the presence of urea is likely due to the complexation of Cu 2+ by urea detectable by EPR. Formation of this complex prevents adsorption of EPFR precursor molecules on the surface bound OH groups. Alternatively, it is considered that formation of urea-copper complexes accelerates 1-MCP EPFR decay.

306: CROSSCUTTING FAIR DATA MANAGEMENT THROUGH A DYNAMIC METADATA REPOSITORY
Stuart Levine, MIT

Sophisticated data management is required to improve the rigor and reproducibility of large projects and adherence to FAIR standards provides a baseline for meeting these requirements. Although many existing repositories handle data in a FAIR-compliant manner, existing tools typically focus on discrete data types adapted for specific disciplines. Connecting these discrete data types, as well as novel data types, creates a challenge for multiomic projects, particularly those that span multiple labs and institutions. One promising solution is the SEEK architecture which allows for diverse metadata with linkage to established repositories. SEEK is limited, however, by a focus on the final deposition of data. Because data collection can occur over years, documenting accurate data provenance is essential. We have developed Network Extended SEEK (NExtSEEK), a modified wrapper around SEEK that allows for active data management. NExtSEEK's data model prioritizes connections between samples and defines discrete sample types that can be freely connected. These sample types are not limited to any specific field and can be adapted for a broad range of technologies and topics. Sample types in NExtSEEK are mutable to allow researchers to update sample records and add new metadata as required, allowing the collection of information alongside the experimental process, help maintain records through staff turnover, share metadata with collaborators, and allow for the integration of datasets. Data and metadata from NExtSEEK are easily exported to the public metadata repository FAIRDOMHub and can be linked to existing FAIR compliant repositories that hold the domain specific data files.

307: Evaluation of Haemogregarina crocodilnorum Infection as a Biomarker of Adverse Health Impacts of PFAS in American Alligators (Alligator mississippiensis)

Zachary McLean, NC State University

Per- and polyfluoroalkyl substances (PFAS) are persistent organic contaminants linked with adverse immune health outcomes in humans and animals. We demonstrated that increased concentrations of PFAS are associated with increased innate immune activity and autoimmune-like phenotypes in American alligators. We sought to systematically quantify numbers of Haemogregarina crocodilnorum, an apicomplexan blood parasite, and evaluate whether parasite infection was associated with PFAS concentrations and adverse phenotypes. Because some human auto-immune diseases are associated with low parasite infection, and host-parasite dynamics can be impacted by environmental factors and health status of the host, we hypothesized that H. crocodilnorum would be decreased in alligators with elevated blood PFAS concentrations. To address this hypothesis a comparative study was conducted by collecting blood samples from animals at Greenfield Lake, a site connected to the Cape Fear River, and Lake Waccamaw (LW), a site located in the adjacent Lumbar watershed with low PFAS contamination. Following quantification of blood PFAS concentrations, whole blood slides were stained, and H. crocodilnorum infected red blood cells were scored. H. crocodilnorum infections in each infected animal were significantly lower in alligators from Green Field Lake. Correlation analysis revealed a negative correlation between PFAS concentrations and H. crocodilnorum. This work provides novel evidence that PFAS exposure can alter health biomarkers and host-parasite dynamics, important groundwork for establishing the utility of H. crocodilnorum as a biomonitoring tool of organismal and ecosystem health. Ongoing analysis is evaluating correlations between H. crocodilnorum abundance, PFAS concentrations and health-related in alligators.

308: THE IMPACT OF THE PANDEMIC ON PREGNANCY, BIRTH EXPERIENCES AND MENTAL HEALTH IN PUERTO RICO

Irene Lafarga Previdi, University of Puerto Rico

Background: The specific aims of the project are: 1) Examine the impact of COVID-19 in pregnancy experiences and outcomes; 2) Examine the mental health impact of COVID-19 in pregnant women and mothers of children 12 months or younger; 3) Identify risk and protective factors among this population in Puerto Rico.

Methods: Participants were recruited from the Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) cohort which is composed of pregnant women and mothers from the northern karst region of Puerto Rico. The research had a mixed methods approach with a quantitative survey (n=184) and qualitative interviews (n=10); data collection was done remotely.
Results: Results from the survey (n=184) show that 20% gave birth alone, 39% were separated from their baby after birth, 21% experienced isolation before birth and 20% after birth. 54% were very worried about giving COVID-19 to their baby and avoided going out, receiving visits and canceled baby showers. The most reported sources of stress were health status, work situation and childcare, while the most reported coping mechanisms were watching TV or playing video-games, using social media and talking with loved ones. 42% reported that they frequently stopped enjoying activities that used to make them happy, only 21% considered seeking mental health support.
Impact statement: COVID-19 restrictions have changed initial plans for baby showers, birth and childcare. Physical distance measures have resulted in isolation and stress. We expect that findings can lead to development of interventions for community health centers and parents/ caretakers in Puerto Rico.

309: Epigenetic modifiers are altered with increased levels of polycyclic aromatic hydrocarbons (PAHs)

Melissa Suter, Baylor College of Medicine

We have previously reported that increased placental levels of the ubiquitous PAH benzo[a]pyrene (BaP) is significantly associated with preterm birth (PTB). Furthermore, we have shown that increased levels of placental BaP are positively correlated with histone methylation, and acetylation. These epigenetic modifications can contribute to alterations in placental gene expression. In this study we aimed to determine if the enzymes responsible for establishment and maintenance of these modifications were altered in association with BaP levels. Protein extracts were derived from 77 placentae samples and were utilized for Reverse Phase Protein Array analyses of 38 proteins involved in the post-translational modification of histones or chromatin remodeling. Data was normalized to total histone protein levels. Absolute levels of BaP were measured from the same samples using GC-MS. Pearson product moment correlation coefficients were determined using R Studio. We have previously shown that trimethylation of histone H3 were significantly, positively correlated with absolute levels of BaP on lysine 4 of histone H3 (H3K4me3; 0.585, p = 0.003) and lysine 9 of histone H3 (H3K9me3; 0.532, p=0.009). Here we find that levels of two histone demethylases, LSD1 (-0.317, p=0.007) and JARID1A (-0.347, p=0.003), are negatively correlated with BaP levels. We further found that EZH2, a histone methyltransferase, is also negatively correlated with BaP levels (-0.265, p=0.025). Our data reveal alterations to the placental histone code and the histone modifying enzymes in association with environmental exposures. Specifically, increased levels of BaP alters the epigenomic profile of the placenta, with likely ramifications for gene expression.

310: Treatment with harmful polycyclic aromatic hydrocarbons (PAHs) elicits distinct transcriptomic pathways in cultured primary trophoblasts

Melissa Suter, Baylor College of Medicine

Background: Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental toxins resulting from carbon combustion, and found in air, vehicle exhaust, drinking water, and soil We have previously shown significant differences in the accumulated absolute levels of these harmful PAHs in placentae from spontaneous preterm birts (PTBs) vs term births, as measured by mass spectrometry. In this study we aimed to determine if trophoblasts gene expression patterns vary with exposure to harmful PAHs.
Methods: Within 1hr from delivery, trophoblasts were isolated and cultured for 48 hours from term placentae. Trophoblast cultures were treated for 24 hours with DMSO (vehicle control), 10mM

Benzo[a]pyrene (BaP), 10mM Benzo[b]fluoranthene (BbF), 10mM Dibenzanthrene (DBA) or a mixture of all three and then harvested (N=7 replicates per treatment). RNA was extracted, RNA libraries were constructed, and bulk RNA-sequencing (transcriptomics) was performed with analyses by DESeq2.
Results: Using an unbiased transcriptomics platform to detect differential expression in all trophoblast genes expressed, harmful PAHs significantly perturbed 81 unique genes t (Fig.1b;-2<log2(fold-change)>2 and q-value <0.05; Wald hypothesis tests). Relative to DBA & BPF PAHs, BaP treatment accounted for the majority of transcriptomic variation, with significant alteration of 77 genes. Of note, expression of GPBAR1, a G-protein coupled receptor involved in the regulation of inflammation, was increased (>2-fold, q<0.05) with each PAH treatment.
Impact: Our data reveal a distinct transcriptional profile in trophoblast cells treated with BaP compared with other PAHs. Furthermore, unbiased analysis has revealed a unique gene in placenta (GPBAR1) associated with environmental exposures in utero.

311: Translating information at sites adjacent to a Superfund
Diana Rohlman, Oregon State University
Background: Cathedral Park is located adjacent to the Portland Harbor Superfund Site (PHSS; Portland, OR). In the harbor, the sediment, groundwater, surface water, and riverbanks are contaminated due to industrial activity from over a century. Given community concerns, the beach at Cathedral Park was sampled in 2002, with results showing contamination below levels of concern. Community groups requested this information be shared in a manner accessible to beachgoers, to address questions such as: “Can kids play in the sand? Is it safe to swim in the water?”
Methods: The Oregon State University Superfund Research Program formed an interagency working group, representing multiple stakeholders involved in decision-making around the Portland Harbor Superfund Site. A common messaging theme was selected, and sampling results were translated to address community concerns.
Results: Over two years the interagency working group developed messaging aligned with all PHSS decision-makers. Using design software, an infographic was developed to translate the results of the 2002 sampling at Cathedral Park beach and adjacent Superfund site. To accommodate requests for more information, the infographic included a QR code, directing readers to a mobile version of the infographic with live, clickable links to resources. The community focus groups revealed frustration with collaboration amongst decision-makers, yet relief and excitement that the infographic would be a useful tool for beachgoers.
Impact Statement: Publicly available data with high relevance to community concerns was translated into an infographic. The infographic was evaluated in a community focus group, finalized, and widely disseminated.

312: 3’ RNA-seq is superior to standard with sparse data but inferior regarding identified functions
Ryan McClure, Pacific Northwest National Laboratory
Background: RNA-sequencing is a powerful tool for examining gene expression patterns, but its cost and required depth means that it cannot be applied to all biological systems. Recently, the development of 3’ RNA-seq, focused on sequencing the 3’ end of transcripts, has allowed for the determination of gene expression levels with fewer sequenced reads. However, there is still an open question of how well 3’ RNA-seq can perform against standard RNA-seq, particularly for complex multi-cellular biological systems.
Methods: We compared 3’ RNA-seq data to standard in samples collected from embryonic zebrafish (48 hours post fertilization) exposed to elevated levels of Perfluorobutane sulfonamide. We aligned data from both methods, determined differentially expressed genes, compared the overlap of these genes and also examined how results were affected with sparse data. We also compared statistically enriched

functions within gene lists from both methods.
Results: We found that 3' RNA-seq showed better alignment to annotated regions of the genome. We also found that there was moderate overlap between the methods regarding differentially expressed genes but that 3' RNA-seq was better at working with sparse data (fewer reads). However, the differentially expressed genes identified by standard RNA-seq led to a greater number of statistically enriched biological functions.
Impact: These results identify experimental conditions where 3' RNA-seq may be advantageous compared to conditions traditional RNA-seq. Our conclusions will help guide future experiments using RNA sequencing across a range of biological systems to gain the most accurate and widespread knowledge of the response to environmental variables

313: Biomimetic plant material-based fungal nano-framework for PFAS remediation
Susie Dai, Texas A&M University
Background: Environmental persistent organic pollutants (POPs) like per- and polyfluoroalkyl substances (PFAS) are expensive to clean up. Traditional PFAS treatment by enrichment media primarily relies on incineration after PFAS are removed from the environment, which is costly and environmentally unfriendly. In this study, we have developed a plant-derived biomimetic material to treat PFAS contaminated water and achieved highly efficient PFAS adsorption and subsequent fungal biotransformation. As such, the material exhibits record adsorption capacity for the PFAS compounds (i.e., PFOA and PFOS) and diverse adsorption capability toward co-contaminants.
Methods: Cellulose and lignin were processed from corn stover to further prepare the nano-framework composite. The composite removed PFOA and PFOS from the aqueous phase and was subject to fungal degradation.
Results: The fungus grew on the PAFS enriched composite, and degraded the material and PFAS synergistically, which presents a novel nano-framework for PFAS remediation.The material can adsorb PFOA and PFOS with high capacities (3529 mg/g for PFOA and 4151 mg/g for PFOS) and sustain the fungal growth without any additional carbon source. This new material thus serves as the substrates and presents contaminants for in situ fungal bioremediation, promoting PFAS detoxification. Relying on inexpensive lignin and cellulose source, we implemented bioremediation in a sustainable and environmentally friendly manner.
Impact Statement: The highly renewable biomimetic composite material thus can potentially eliminate the treatment train approach when removing PFAS from the environment. The inexpensive, biodegradable sorbent presents a sustainable and environmentally friendly route to remediate and detoxify PFAS, whose principle can be broadly implemented toward low-cost bioremediation.

314: 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 Helath within the Community Engagement Core.

315: Addressing burden disparities for North Carolina private well users
Andrew George, University of North Carolina-Chapel Hill
Background: With more households reliant on private wells than any other state (Murray et al., 2022), securing clean drinking water is a direct concern for 2.5 million North Carolinians. Unfortunately, less than half of private wells in NC have been tested (Sanders et al., 2012), and when testing occurs, heavy metal contamination is present in over 25% of private wells (Eaves et al., 2022).
Methods: In 2016, the Community Engagement Core (CEC) of the UNC SRP piloted a project to support private well users in Stokes and Wayne Counties (Thomlinson et al., 2019). Building on this experience, the UNC SRP CEC joined with Virginia Tech and community partners to support private well users impacted by Hurricanes Florence and Michael in 2018. Based on this work, we are now implementing a new project in Union Co. NC, using participatory science (citizen science) and recruiting in communities of low-income and Black, Indigenous, or other People of Color (BIPOC).
Results: Since 2016, we have tested over 1,400 private wells in 17 NC counties. Of concern, our findings show low-income, BIPOC households have more than 10 times greater odds of not testing their wells, and four times greater odds of not using a treatment system, compared to high-income, white households (George et al., 2022, in preparation). Tests revealed contaminants exceeding a federal or state standard in over 67% of the private wells sampled.
Impact statement: We are documenting disparities in levels of private well testing and treatment as evidence of environmental injustice in NC.

316: Community Response Project: Determining Migration of a Tetrachloroethylene Contaminated Water Plume in a Houston Community
Lance Hallberg, UTMB
Houston is America's fourth largest city with the dubious distinction of having over a dozen Superfund sites. Among these is the Jones Road Superfund. This area includes residential neighborhoods, commercial and light industries. The principal source of drinking and bathing water comes from residential water wells. In the early 2000s, the Texas Department of Health was asked to investigate chemical odors plaguing a shopping center, including a dry-cleaning plant. Investigators discovered that dry-cleaning personnel disposed of waste perchloroethylene into the soil next to the building. Soil and groundwater samples were found to have been contaminated with perchloroethylene, trichloroethylene, trichloroethylene, and vinyl chloride. In September 2003, the Jones Road site was placed on the National Priorities List by the EPA. To mitigate exposure to these residences, a city water supply was provided. Nevertheless, many homes in the area are still on well-water. The Jones Road Superfund site is currently under EPA review and the community residents have requested that the EPA survey their groundwater once again to address continuing community concerns, However, the EPA has determined that at present the requested groundwater survey is not warranted. Consequently, the community has approached our CEC for help with the assessment of water and/or soil contamination. The CEC connected the community with an investigator from our group and funding was acquired. This

is an initial report of the community participatory research project to evaluate continued air intrusion and groundwater contamination at the Joans Road Superfund site by Perchloroethylene and its daught.

317: Sex-Specific Effects of Preconception Arsenite Exposure on Metabolic Phenotypes in C57BL/6 Offspring

Bingzhen Shang, University of North Carolina-Chapel Hill

Background: Chronic exposure to inorganic arsenic (iAs) has been linked to diabetes in humans and mice, but the role of iAs exposure prior to conception and its transgenerational effects are understudied. Our previous study showed that preconception exposure to iAs results in insulin resistance in male offspring of C57BL/6J mice, which was associated by altered gene expression in paternal sperm and the offspring tissues. This study investigated effects of preconception iAs exposure in first (G1) and second generation (G2) of mice.
Methods: C57BL/6J parent mice (G0) were exposed to 2ppm iAs in drinking water for ten weeks before mating. Body composition and diabetes indicators were examined in G1 and G2 adult offspring, including fasting blood glucose, fasting plasma insulin (FPI), glucose tolerance, and homeostatic models for insulin resistance (HOMA-IR) and beta cell function. ANOVA and nonparametric rank tests were used to evaluate phenotypic differences. Gene expression were assessed in germ cells from all generations and in offspring tissues using RNA-sequencing.
Results: Preconception iAs exposure induced diabetic phenotypes in offspring in a sex-specific pattern. G1 females developed insulin resistance characterized by increased FPI and HOMA-IR. In G2, insulin resistance was found only in males, and was associated with higher adiposity and lower lean mass. Transcriptomic analyses showed significant and more abundant altered gene expression in G0 and G1 oocytes as compared to sperm, suggesting potential germ cell- and generation-specific mechanisms.
Impact: This study is the first to link preconception iAs exposure to altered gene expression and metabolic phenotype across three generations.

318: Ex Vivo Exposures to Arsenite and Methylated Trivalent Metabolites Alter Transcription in Mouse Sperm Cells

Bingzhen Shang, University of North Carolina-Chapel Hill

Background: Chronic exposure to inorganic arsenic (iAs) has been linked to diabetic phenotypes in humans and mice. Our previous study suggested that preconception iAs exposure may contribute to the development of diabetic phenotype in mouse offspring via altering gene expressions in paternal sperm. However, individual contributions of iAs and its metabolites, monomethylated arsenic (MAs) and dimethylated arsenic (DMAs), to changes in sperm transcriptome cannot be determined using in vivo exposure. This study assessed transcriptomic changes in mouse sperm in response to acute exposure to iAsIII, MAsIII and DMAsIII, using an ex vivo model.
Methods: Freshly isolated C57BL/6 mouse sperm cells were exposed to 0.1 or 1 μM of the three trivalent arsenicals for 4 hours, and analyzed by RNA-sequencing to identify differentially expressed genes. Functional protein networks and pathways associated with expression of these genes were analyzed with Search Tool for the Retrieval of Interacting Genes/Proteins (STRING).
Results: Exposure to low concentrations of the trivalent arsenicals (0.1 μM) had greater effects on gene expression than exposures to 1 μM, with the most abundant effect being associated with exposure to 0.1 μM MAsIII. Four diabetes-related pathways identified in sperm in the published study found to be significantly enriched in the preconception exposure study, namely PI3K-Akt signaling, focal adhesion, ECM-receptor interaction, and Wnt signaling pathways, were among the significantly enriched pathways in the sperm exposed ex vivo to 0.1 μM iAsIII and MAsIII.
Impact: This study suggested potential As species-specific mechanisms for diabetogenic effects induced by prenatal iAs exposure via sperm cells.

319: Protein disulfide-isomerase associated 3 facilitates cadmium-induced lung fibrosis
Fu Jun Li, University of Alabama-Birmingham
We have demonstrated an increase in cadmium (Cd), a common component of cigarette smoke (CS) and environmental particulate matter (PM), in lung tissue from subjects with idiopathic pulmonary fibrosis (IPF). Citrullinated vimentin (Cit-Vim) secreted from Cd-activated lung macrophages, activate fibroblasts through TLR4 signaling and contributes to the pathogenesis of IPF. However, how does Cit-Vim translocate to membrane and secrete outside of the cells has not been understood. Endoplasmic reticulum (ER) stress characterized as an accumulation of misfolded proteins in the ER has been involved in Cd-induced oxidative stress and cell death. However, whether ER stress involves in Cd-induced pulmonary fibrosis is unknown. Protein disulfide-isomerase associated 3 (PDIA3), an ER anchored protein, associates with fibrotic mediators and airway hyperresponsiveness. Here, we found that two ER chaperone proteins, PDIA3 and calreticulin (CRT), were increased in a time-dependent manner after Cd exposure. Phenylbutyric acid (PBA), an ER stress inhibitor, prevented Cd-induced Cit-Vim production, ER stress proteins accumulation and lung fibrosis. Cd enhanced the binding of Cit-Vim with CRT and PDIA3 by using mass spectrometry and immunoblot analysis. By knocking down PDIA3 using siRNA, we found that PDIA3 was required for Cd-induced Cit-Vim membrane localization and secretion. PDIA3 deficiency attenuated Cd-induced ER stress-related misfolded proteins accumulation, a-SMA activation, collagen deposition and cytokine production. A specific PDIA3 inhibitor also inhibited Cd-induced Cit-Vim secretion and pulmonary fibrosis in mice. In conclusion, our results demonstrate the important role of PDIA3 in Cd-induced ER stress, Cit-Vim membrane localization, secretion, and subsequent lung fibrosis.

320: Two-Dimensional Carbon Sorbents for the Treatment of Legacy and Emerging Perfluoroalkyl Substances
Wei Gao, NC State University
Per- and polyfluoroalkyl substances (PFASs) are contaminants of emerging concern because of their toxicological properties, widespread presence, and persistence in the environment. Water treatment methods including activated carbon adsorption and advanced oxidation are generally ineffective for PFAS control. Here we develop a group of functionalized two-dimensional (2D) carbon sorbents for the remediation of short-chain PFASs and emerging perfluoroalkyl ether carboxylic acids (PFECAs), such as hexafluoropropylene oxide dimer acid (GenX), based on the well established graphene oxide (GO) chemistry by the PI. Our GO derivatives have been tailored for capturing emerging PFASs, where different types of chemical moieties including small organic structures or short/long-chain polymers have been linked to the GO basal plane in a manner that ensures ready accessibility of active sites for PFAS adsorption. We have shown that with the presence of PolyDADMAC moities, our 2D sorbents readily encapsulates some PFAS species, in few cases better than powdered activated carbon. We are in the process of clarifying the complex interactions existing between the 2D sorbents and small PFAS molecules, elucidating the effects from both the chain length and chain rigidity. MD simulations from our collaborators have provided some initial insights on this matter.

321: Benzene exposure leads to pregnancy loss and sexually dimorphic placental response in a mouse model
Gil Mor, Wayne State University
Background: Benzene is a flammable liquid with a gasoline-like odor, which is a major source of environmental pollution and is associated with several adverse outcomes and long-term implications on the offspring. Little is known about benzene exposure during pregnancy and its impact on fetal development. We hypothesize that exposure to benzene induces maternal immune activation and its impact on placental function. We report the presence of immunological sexual dimorphism in the

placental response with implications on placental function, and pregnancy outcomes.
Methods of Study: Female C57BL/6 pregnant mice were exposed to benzene (50 ppm) for 5h/day from E0.5 to E17.5. On E17.5, mice were sacrificed and tissues were collected. Cytokines were determined by Luminex. Data were analyzed by iPathwayGuide.
Results: Benzene exposure during pregnancy leads to maternal inflammation characterized by circulating IL-1α, IL-1β, IL-10, IL-12 (p70), Eotaxin, TNFα, IL-17 and IFN-gamma. Fetal resorption, impaired placental vascularity, and IUGR were all observed in our model. RNA sequencing and proteomics data displayed an acute inflammatory response in both female and male placentas. Interestingly, we observed immunological sexual dimorphism in placental samples leading to differential responses to benzene exposure in male and female placentas.
Impact Statement: We report for the first time an immunological sexual dimorphism in the placenta and a differential response to benzene. Benzene-induced maternal and placental inflammation may underlie the reported pregnancy complications. The sexually dimorphic placental response to benzene may shape fetal development and the postpartum responses to the environment between male and female offspring.

322: Parallel studies concerning the persisting neurobehavioral impacts of developmental exposure to mixtures of benzo[a]pyrene and cadmium in zebrafish and rats
Edward D. Levin, Duke University
Toxicant exposures are often modeled using individual compounds, yet co-exposures are more common. Considerable research has characterized the neurotoxic effects of polycyclic aromatic hydrocarbons (PAHs) and heavy metals, but their potential interactions remain largely unknown. In parallel studies, zebrafish and rats were developmentally exposed to the PAH benzo[a]pyrene (BaP) and/or the heavy metal cadmium (Cd). Zebrafish were exposed to BaP (0-3 μM), Cd (0-0.3 μM) or both from 5-120 hours post-fertilization. BaP alone impaired dark-induced motility at 6dpf and hyperactivity when the fish became adolescents. BaP with Cd blocked both of these effects. However, othCd caused a mixture-specific BaP-effect, inhibiting motility in the light at 6dpf. For comparison, we exposed female rats to BaP (0.03 mg/kg/day), Cd (0.3 mg/kg/day) or both via osmotic minipumps throughout gestation. Male and female offspring were assessed for bodily and reflex development, and locomotor, emotional and cognitive function. Ano-genital distance was significantly decreased in males with BaP exposure. CD-exposed rats showed faster negative geotaxis than controls on the initial day of testing (PND7), but co-exposure with BAP reversed this effect. BAP-treated offspring also showed greater novelty-induced suppression of eating compared to controls, indicative of great fear-like responding. Persisting neurobehavioral effects are seen in both zebrafish and rats after chronic developmental exposure to BaP and Cd. However, these effects can differ between single-exposures and mixtures, indicating a need for greater clarity on interactions within mixtures.

333: Reducing Exposure Risk: Development and Evaluation of an Educational Seafood Consumption Program for Pregnant Women
Sharon A. Croisant, The University of Texas Medical Branch
Background: The Houston Ship Channel serves America's fourth-largest city and one of the world's busiest ports, bordered by industry, refineries, and petrochemical facilities established over the past 100+ years. Legacy pollutants, lack of zoning, and more than a dozen federal Superfund sites have contributed to significant levels of polycyclic aromatic hydrocarbons (PAHs), mercury, dioxins, furans, PCBs, etc., that pose risk for surrounding communities. The Baylor-Rice Superfund Research Program's (B-R SRP) focus on PAHs as a persistent human health concern addresses the need for identifying at-risk populations and developing technologies for identifying and ameliorating risk, particularly for pregnant women and children. Methods: Many communities surrounding the Channel and Superfund sites are

impacted by population density, Environmental Justice issues, poverty, and pollution. The B-R SRP Community Engagement Core works with residents and local leaders to facilitate strategies to reduce community-level exposures to PAHs. One strategy is nutritional education for pregnant women to reduce potential exposures through consuming contaminated seafood. Results: We have developed and adapted lessons and materials, including slides and a teacher's script that will ultimately be translated into multiple languages and used in prenatal education programs offered through our partner, the Hope Clinic. We are testing and validating all program materials and outcomes through pre- and post-tests, an end-of-course evaluation, and a brief follow-up telephone survey at two time points following the training. Impact: With a better understanding of risk, pregnant women are empowered to make informed food and nutrition choices during pregnancy and after the birth of their babies.

334: Academic Tracker: Software for Tracking and Reporting Publications Associated with Authors and Grants

Hunter Moseley, University of Kentucky

In recent years, United States federal funding agencies, including the National Institutes of Health (NIH) and the National Science Foundation (NSF), have implemented public access policies to make research supported by funding from these federal agencies freely available to the public. Enforcement is primarily through annual and final reports submitted to these funding agencies, where all peer-reviewed publications must be registered through the appropriate mechanism as required by the specific federal funding agency. Unreported and/or incorrectly reported papers can result in delayed acceptance of annual and final reports and even funding delays for current and new research grants. So, it's important to make sure every peer-reviewed publication is reported properly and in a timely manner. For large collaborative research efforts, the tracking and proper registration of peer-reviewed publications along with generation of accurate annual and final reports can create a large administrative burden. In order to help with this reporting burden, we have developed the Academic Tracker software package, implemented in the Python 3 programming language and supporting Linux, Windows, and Mac operating systems. Academic Tracker helps with publication tracking and reporting by comprehensively searching major peer-reviewed publication tracking web portals, including PubMed, Crossref, ORCID, and Google Scholar, given a list of authors. Academic Tracker provides highly customizable reporting templates so information about the resulting publications is easily transformed into appropriate formats for tracking and reporting purposes. The source code and documentation is hosted on GitHub (https://moseleybioinformaticslab.github.io/academic_tracker/) and is available via the Python Package Index for easy installation.

335: A Draft Minimum Information about Geospatial Information System (MIAGIS) Standard

Hunter Moseley, University of Kentucky

FAIR (Findable, Accessible, Interoperable and Reusable) is a set of guiding principles for managing publicly accessible data that emphasizes making data findable with unique identifiers and search mechanisms, easily accessible, i.e. downloadable, interoperable between computer systems and programs, and reusable for future use-cases. The ArcGIS (Aeronautical Reconnaissance Coverage Geographic Information System) Online mapping and analytics software is a popular online tool for geospatial analysis and generating maps. However, ArcGIS maps can be deleted by the user and the platform is thus not a true data repository providing dataset permanence, which is a requirement for FAIR. To improve FAIRness of GIS maps, we have developed a draft Minimum Information About Geospatial Information System (MIAGIS) with associated deposition directory structure for maximizing the FAIRness of ArcGIS analyzed datasets and associated GIS maps. We have also developed an associated miagis Python package that facilitates the generation and validation of a MIAGIS-compliant

JSON metadata file. Source code is freely available on GitHub and PyPI under the Clear Berkeley Software Distribution (BSD) 3 license.

336: Impaired PPARɣ activation exacerbates infection-induced lung injury
Jennifer Larson-Casey, University of Alabama-Birmingham
Background: Emerging data supports an association between environmental heavy metal exposure and lung disease, including pneumonia.
Methods: Mice were intratracheally administered of CdCl2, and 5 days later mice were infected with Streptococcus pneumoniae. Bronchoalveolar lavage was performed on day 15 and scRNA-seq and FACS-sorted macrophages for use in subsequent analyses. The FDA approved drug, BVD-523, was given by oral gavage starting on day 6 to inhibit ERK activation. In vitro experiments were performed to evaluate cadmium-mediated post-transcriptional regulation of PPARɣ.
Results: We show by scRNA-seq an increase in Pparg gene expression in lung macrophages from mice exposed to cadmium and/or infected with S. pneumoniae. However, cadmium or infection regulated an inhibitory post-translational modification of peroxisome proliferator-activated receptor ɣ (PPARɣ) to exacerbate lung injury. Cadmium and infection mediated ERK activation to regulate PPARɣ degradation in monocyte-derived macrophages. Mice harboring a conditional deletion of Pparg in monocyte-derived macrophages had more severe lung injury and increased mortality. Moreover, subjects residing in areas of high air cadmium levels showed PPARɣ inhibition that was mediated, at least in part, by ERK activation in isolated BAL cells. Demonstrating the importance of ERK activation, cadmium exposed and infected mice treated with the ERK inhibitor, BVD-523, had decreased lung injury and enhanced survival.
Impact: These observations suggest that impaired activation of PPARɣ in monocyte-derived macrophages exacerbates lung injury and the severity of lung infections.Targeting ERK activation may provide a novel therapeutic target to protect against cadmium and infection-induced lung injury.

337: Michigan-Ohio Occupational Research Education Program (MOORE)
Stuart Batterman, University of Michigan
This new R25 training program responds to the need to develop practical skills and research expertise among students and practitioners in the areas of emerging technologies/contaminants, and more broadly, to advance skills in the field of occupational health and safety (OHS). Our objectives are to develop and deliver training and research experiences for graduate students and professionals. The MOORE program represents a new collaboration among the University of Michigan, University of Cincinnati, and Michigan State University. We seek to develop and implement educational programs on occupational health and safety management practices for emerging technologies and practices; to provide intensive interdisciplinary and interprofessional research experiences and training for graduate students and professionals on OHS practices for emerging technologies/chemicals and practices; and to develop and promote innovative, cross-cutting, and evidence-based educational infrastructure for the participating universities. We have developed a best-practices guide for web-based instruction, initiated other course instructional materials, and plan for a research experience in early 2023. Our impact is to broaden the scope of training opportunities among the participating universities, improve the quality of instruction, and make high quality OHS-relevant materials more broadly available.

338: Occupational and Environmental Exposures and Work Practices for Nanomaterials and Electronic Products
Candace Tsai, University of California-Los Angeles
The UCLA training program aims to provide professional training through academic curricula, research experiences, and continuing education courses in industrial hygiene and environmental health sciences to graduate students and industrial hygienists in the Southern California region, and to recruit diverse

undergraduate and graduate students to join the graduate school pursuing master and doctoral studies in occupational and environmental health sciences related fields. Our mission is to prepare next-generation professionals for effective management of stressors caused by emerging technologies. Our multidisciplinary team includes the highly diverse faculty members and student population at UCLA, UC Irvine (UCI) and California State University Fullerton (CSUF) and Long Beach (CSULB).
Our training focus on occupational exposures and effects, digital learning techniques, practices and protection guidance regarding engineered nanomaterials, emerging infectious agents, and nanotechnology-enabled products including consumer electronic products and their related waste to be managed at the generation and disposal stages.
The research training in the first summer has provided trainees research experience. The industrial hygiene (IH) graduate student trainees have studied nanoparticle emissions contributing to potential human exposure from laser cutting operations and 3D printing. We found that significant numbers of airborne particles within the sizes of nanometer and sub-micrometer were released from laser-cutting acrylic and wood materials. Summarized results will be presented in the poster. We have successfully trained students during the first summer program, meeting our proposed number of students in the first year. Our novel research projects have involved multiple graduate students including student from our collaborating university.

339: Biological Health and Safety Training in Emerging Technologies (BioSTET)
Darrah K. Sleeth, University of Utah
Biological hazards present an ongoing threat to occupational health, especially in site cleanup. Research on emerging technologies has offered promising inroads to safer resolution of these hazards. However, new/supplemental training, as well as further advances in research, are needed. BioSTET represents a collaborative effort between the University of Utah, Cal Poly San Luis Obispo, and Montana Tech, with evaluation activities through UCLA and Texas A&M. The goal was to create continuing education (CE) and academic courses in emerging technologies specific to site biological health and safety. This collaborative, multidimensional educational experience will facilitate skills development and field application, while creating opportunities for innovative, cross-disciplinary research experiences and curriculum development on emerging technologies. The first aim was to develop CE modules and a certificate program for site biological health and safety; this was successfully launched in 2022 as free online training. The next phase will involve (1) a collaborative 4+1/graduate research topics course in site biological health and safety and (2) a collaborative graduate applied topics course utilizing products resulting from the research course. These courses will focus on emerging technologies (e.g., devices, systems, controls) in the biological health and safety aspects of environmental characterization and remediation. The proposed coursework will include the necessary rubrics from the 40-hour HAZWOPER certification in addition to the biological health and safety supplemental material developed here. Together, these efforts will help ensure that high-quality biological hazard training, especially as it relates to emerging technologies at site cleanup, is readily available to working professionals and students

340: 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.

341: 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).

342: 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.

343: Program on Occupational health and safety education on Emerging Technologies – Mid Atlantic Partnership (POccETMAP)
Ana Rule, Johns Hopkins University
Many emerging technologies are becoming increasing ubiquitous in workplaces as well as non-occupational settings such as commercial and residential environments. Johns Hopkins University, the University of Maryland, George Mason University, and Old Dominion University propose to work collaboratively on the Program on Occupational health and safety education on Emerging Technologies – Mid Atlantic Partnership (POccETMAP) to develop a comprehensive set of web-based educational and training modules, courses, and programs to foster the safe development and use of emerging technologies and mitigate their risks, emerging contaminants, and disaster preparedness. We are developing five online cores for professional training of OHS specialists, engineers, scientists, and instructors in the areas of (a) Detection Technologies for emerging contaminants; (b) Exposure assessment strategies; (c) Disaster preparedness and risk management; (d) Vulnerable occupational populations, and (e) Sustainable production and product stewardship. We demonstrate concepts with examples and illustrations drawn from the following emerging technologies: additive manufacturing, novel technologies for disinfection, electronic nicotine delivery, and nanobiotechnology. Each core contains 10 innovative, web-based modules that include short, narrated screencasts, animations, exercises, and activities. Instructors will use the modules to create lessons, courses, and programs in academic and continuing education settings. All materials will be freely available on the web, ensuring that the POccETMAP Program has a national and global reach. This innovative program and its educational products will target industrial hygiene students; students in other science, engineering, and technology disciplines; and professionals who require continuing education on the health and safety of emerging technologies.

344:

345: Ancestral Benzo[a]pyrene Exposure Alters the Sperm DNA Methylome of Zebrafish
Preethi Thunga, NC State University
Benzo[a]pyrene (BaP) is a prototypical polycyclic aromatic hydrocarbon (PAH) ubiquitously found in the environment and well-studied for its carcinogenicity, though its non-carcinogenic modes of action warrant further study. Previously, using zebrafish, we showed that developmental exposure to BaP resulted in behavioral deficits, global DNA hypomethylation, and altered expression of DNA methyltransferases. Behavioral and physiological malformations were observed into adulthood and persisted transgenerationally, suggesting an epigenetic mechanism. Activation of the aryl hydrocarbon receptor (AHR) pathway plays a key role in biotransformation of many PAHs to more toxic intermediates and may modulate cellular processes like DNA methylation, an important epigenetic marker. In this study, we interrogated an epigenetic mode of action for BaP transgenerational toxicity, specifically DNA methylation. Using whole-genome bisulfite sequencing (WGBS), we assessed base-specific methylation differences in the F2 generation germline resulting from ancestral BaP exposure, AHR2 knockdown, and a combination of both. WGBS analysis identified unique differential methylation patterns in response to each of these treatments, with differentially methylated sites (DMSs) and regions (DMRs) spanning the genome. Across all treatments, regions of chromosomes 10, 17, and 20 were particularly enriched with DMSs. Interestingly, ancestral exposure to BaP with non-functional AHR2 led to the highest number of

DMRs, with little overlap with either treatment individually. This study highlights the importance AHR in modulating DNA methylation upon exposure to AHR activators and presents compelling evidence of transgenerational effects of BaP exposure via the germline. This research was supported by NIEHS Award Numbers P42 ES016465, P30 ES030287, and T32 ES007060.

346: Metal Mixtures and DNA Methylation Measures of Biological Aging

Kaila Boyer, NC State University

Introduction: Metal exposures can lead to aging-related diseases. Native American communities suffer disproportionately from both elevated metals exposure and increased risk for cardiovascular diseases. DNA methylation-based “clocks” can be used to estimate accelerated biological aging that may underlie increased risk for aging-related diseases. Metals alter DNA methylation, yet little is known about their impact on epigenetic age acceleration. Our objective was to investigate the associations of metals on different DNA methylation-based aging measures in the Strong Heart Study (SHS) cohort.
Methods: Blood DNA methylation data from 2,307 SHS participants was used to calculate age acceleration for epigenetic clocks (Hannum, Horvath, PhenoAge, GrimAge, DunedinPACE). Urinary metals (As, Cd, W, Zn, Se, Mo) were creatinine-adjusted and categorized into quartiles. We examined associations of individual metals with linear regression models and used Bayesian Kernel Machine Regression (BKMR) for the impact of the total metal mixture and interactions between metals on aging.
Results: Increasing quartiles of Cd were associated with higher levels of epigenetic age across all aging measures, while Zn was associated with higher levels of GrimAge acceleration and DunedinPACE. BKMR analysis suggested increased age acceleration with higher levels of nonessential metals for DunedinPACE and GrimAge. A potential interaction between Cd and Zn was observed on Horvath age acceleration.
Impact Statement: Little is known about the relationship between metals exposure and epigenetic agingin American Indian populations. Examining how urinary metals and metal mixtures can influence age acceleration can provide a better understanding between metals and age-related diseases.