NIEHS Superfund Research Program

Annual Meeting

December 6-8, 2017 - Philadelphia, Pennsylvania

30th ANNIVERSARY
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<td>Administrators’ Program</td>
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<td>The Mystery of Mesoamerican Nephropathy: Transdisciplinary research in response to a public health crisis</td>
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<td>Mapping the Chemosphere: Understanding our chemical world to improve human health and the environment</td>
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</table>
**Day One: Wednesday, December 6, 2017**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>7:30 am – 8:45 am</td>
<td>Registration: Trainee, and RTC/CEC Programs</td>
<td>Pre-function Hallway (2nd Floor)</td>
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<tr>
<td>9:00 am – 3:15 pm</td>
<td>Trainee Program</td>
<td>Commonwealth Hall C</td>
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<tr>
<td>9:00 am – 3:15 pm</td>
<td>Research Translation and Community Engagement Cores (RTC - CEC) Program</td>
<td>Commonwealth Hall D</td>
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<tr>
<td>3:30 pm – 9:10 pm</td>
<td>Main Meeting Program</td>
<td>Millennium Hall</td>
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<tr>
<td>4:35 pm – 5:50 pm</td>
<td>Center Administrators’ Program</td>
<td>Commonwealth Hall D</td>
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Look to following pages for more details for the Main, Trainee, RTC & CEC, and Center Administrators’ Programs

### Trainee Program

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>7:30 – 8:45 am</td>
<td>Registration</td>
<td>Pre-function Hallway (2nd Fl)</td>
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<tr>
<td>9:00 am – 3:00 pm</td>
<td>Trainee Program</td>
<td>Commonwealth Hall C</td>
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<tr>
<td>9:00 – 9:15 am</td>
<td>Welcome/Introduction</td>
<td>Commonwealth Hall C</td>
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<tr>
<td></td>
<td>William Suk, PhD, MPH, Director, NIEHS Superfund Research Program</td>
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<td></td>
<td>Danielle Carlin, PhD, Program Administrator, NIEHS Superfund Research Program</td>
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<tr>
<td>9:15 – 10:45 am</td>
<td>Public Speaking (1hr &amp; 30 min)</td>
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<tr>
<td></td>
<td>Intro: Liwei Weng, PhD, University of Pennsylvania Superfund Research Program, Project 6</td>
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<tr>
<td></td>
<td>Moderator: Ali Seiphoori, PhD, Penn SRP, Project 2</td>
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<tr>
<td></td>
<td>• Speaker: Lisa Marshall, MA, Communication professional</td>
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<tr>
<td></td>
<td>Title: “Effective Science Presentations”</td>
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<tr>
<td>10:45 – 11:00 am</td>
<td>Break</td>
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<td>11:00 am – 12:00 pm</td>
<td>Scientific Writing</td>
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<tr>
<td></td>
<td>Intro: Kevin Gillespie, Doctoral Candidate, University of Pennsylvania Superfund Research Program, Project 6</td>
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<td></td>
<td>Moderator: Mitchell Cheung, PhD, Penn SRP, Project 4 (Fox Chase Cancer Ctr)</td>
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<tr>
<td></td>
<td>• Speaker: Dr. Judith Swan, Associate Director, Writing in Science and Engineering, Princeton Writing Program, Princeton University</td>
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<tr>
<td></td>
<td>Title: “Effective Scientific Communication” — Writing from the Readers’ Perspective</td>
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<tr>
<td>12:00 – 1:15 pm</td>
<td>Working Lunch / SRP Alumni Career Panel</td>
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<tr>
<td></td>
<td>Intro: Sam Hofbauer, University of Pennsylvania Superfund Research Program, Project 6</td>
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<td></td>
<td>Moderator: Craig Menges, PhD, University of Pennsylvania Superfund Research Program, Project 4 (Fox Chase Cancer Center)</td>
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<tr>
<td></td>
<td>• Courtney Horvath-Kozul, Ph.D., DABT, Genzyme/Sanofi/Novartis, Preclinical Safety Global Coordinator</td>
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<tr>
<td></td>
<td>• Brad Newsome, Ph.D., Health Scientist, AAAS S&amp;T Policy Fellow, NIH Office of the Director</td>
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<td></td>
<td>• Monica Ramirez-Andreottta, PhD, Assistant. Professor, University of Arizona, Soil, Water &amp; Environmental Science</td>
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<td></td>
<td>• Jim Rice, Ph.D., Environmental Scientist, Gradient, Inc.</td>
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<td></td>
<td>• Britt Dahlberg, Ph.D. Director, Center for Applied History, Chemical Heritage Foundation</td>
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### Day One: Wednesday, December 6, 2017

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<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>1:30 – 2:15 pm</td>
<td><strong>Professional Introduction and Networking</strong></td>
<td>Millennium Hall</td>
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<tr>
<td></td>
<td><strong>Moderators:</strong> Bruce Stanton (P42 Center Director; Dartmouth College) and Thomas Sheahan (Training Core Leader; Northeastern)</td>
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<td></td>
<td><strong>Academia:</strong></td>
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<tr>
<td></td>
<td>- Nishad Jayasundara, PhD, Assistant Professor, University of Maine</td>
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<tr>
<td></td>
<td>- Monica Ramirez-Andreotta, PhD, Assistant Professor, University of Arizona</td>
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<td></td>
<td>- Alicia R Timme-Laragy, PhD, Assistant Professor, University Massachusetts, Amherst</td>
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<td></td>
<td>- Roxanne Karimi, PhD, Research Scientist, Stony Brook</td>
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<td></td>
<td>- Vivien Taylor, PhD, Research Scientist, Dartmouth College</td>
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<td></td>
<td>- Kate Buckman, PhD, Research Scientist, Dartmouth College</td>
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<td></td>
<td><strong>Government:</strong></td>
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<tr>
<td></td>
<td>- Bradley Newsome, PhD, Program Administrator - NIH/NHLBI</td>
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<td></td>
<td>- Danielle Carlin, PhD, Program Administrator – NIH/NIEHS</td>
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<tr>
<td></td>
<td><strong>Industry:</strong></td>
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<tr>
<td></td>
<td>- Courtney Kozul-Horvath, PhD, Preclinical Researcher, Novartis</td>
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<td></td>
<td>- Kathleen “Karrie” Radloff, PhD, Environmental Engineer, Gradient Inc.</td>
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<td></td>
<td>- James W. Rice, PhD, Environmental Scientist, Gradient Inc.</td>
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<td></td>
<td><strong>Other:</strong></td>
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<td></td>
<td>- Elena Craft, PhD, Environmental Defense Fund</td>
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<td></td>
<td>- Andres Cardenas, PhD, Postdoc, Harvard University</td>
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<td></td>
<td>- Vanessa De La Rosa, PhD, Postdoc, Silent Spring Institute</td>
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<tr>
<td>2:15 – 3:15 pm</td>
<td><strong>Research Translation / Community Engagement / Training Collaborative Session</strong></td>
<td>Commonwealth Halls C &amp; D</td>
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<tr>
<td></td>
<td><strong>Title:</strong> Advancing Risk Communication Panel</td>
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<tr>
<td></td>
<td><strong>Moderator:</strong> Richard Pepino, MSS, MS, Director, Research Translation Core, Penn SRP Research and Training Center, University of Pennsylvania</td>
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<td></td>
<td><strong>Panelists:</strong></td>
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<td></td>
<td>- Jonathan Essoka, 3rd, PhD, Superfund &amp; Technology Liaison, Office of Science Policy, Office of Research and Development, US-EPA</td>
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<td></td>
<td>- Sara Flanagan, KC Donnelly Externship 2016 Award Trainee, Columbia University Superfund Research Program (SRP) Community Engagement Core (CEC)</td>
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<td></td>
<td>- Dan Romer, PhD, Research Director, Annenberg Public Policy Center; Director, Adolescent Communication Institute (ACI), University of Pennsylvania</td>
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<td></td>
<td>- Tracy Carluccio, Deputy Director, Delaware River Keeper Network</td>
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<tr>
<td>3:30 pm</td>
<td><strong>Reconvene to Main Program</strong></td>
<td>Millennium Hall</td>
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<td><strong>Welcome/Introduction</strong></td>
<td>Pre-function Hallway</td>
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<tr>
<td>9:00 am – 3:00 pm</td>
<td><strong>Registration</strong></td>
<td>Commonwealth Hall D</td>
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<tr>
<td>9:00 – 9:05 am</td>
<td>Michelle Heacock, PhD, Program Administrator, NIEHS Superfund Research Program</td>
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<td></td>
<td>Brittany Trottier, MPH, Health Specialist, NIEHS Superfund Research Program</td>
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### Day One: Wednesday, December 6, 2017

#### RTC - CEC Program

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<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td>9:05 - 9:15 am</td>
<td>Kristi Pettibone, Ph.D., Health Scientist Administrator, NIEHS</td>
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<tr>
<td></td>
<td><strong>Title:</strong> &quot;Introduction to Translational Framework&quot;</td>
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<tr>
<td>9:15 – 10:45 am</td>
<td><strong>Session 1: BoRit Superfund Site Comes to Philadelphia</strong></td>
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<tr>
<td></td>
<td>A snapshot of what it has been like to live and work with the Ambler</td>
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<tr>
<td></td>
<td>BoRit Superfund site</td>
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<td></td>
<td><strong>Moderator:</strong> Edward A. Emmett, MD, Director, Penn SRP Community</td>
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<td></td>
<td>Engagement Core, University of Pennsylvania</td>
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<td></td>
<td><strong>Presenters:</strong></td>
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<tr>
<td></td>
<td>• Bob Adams, Co-Chair BoRit Community Advisory Group (CAG)</td>
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<td></td>
<td>• Sharon Vargas, Former Business Owner and Resident of West Ambler,</td>
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<td></td>
<td>Co-Chair BoRit CAG</td>
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<td>• Fred Conner, Township Commissioner, Whitpain Township</td>
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<td></td>
<td>• Lora Werner, MPH, Regional Director Agency for Toxic Substances and</td>
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<td></td>
<td>Disease Registry (ATSDR), Centers for Disease Control and Prevention</td>
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<td>(CDC)</td>
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<tr>
<td>10:45 – 11:00 am</td>
<td>Break</td>
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<td>11:00 am – 12:00 pm</td>
<td><strong>Session 2: Disaster Preparedness and Public Health Challenges</strong></td>
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<td><strong>Moderator:</strong> Phil Brown, PhD, RTC and CEC co-director, PROTECT/Puerto</td>
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<td></td>
<td>Rico Test Site to Explore Contamination Threats</td>
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<td></td>
<td><strong>Presenters</strong></td>
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<tr>
<td></td>
<td>• Carmen Milagros Velez Vega, PhD, MSW, Chair, Social Sciences</td>
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<tr>
<td></td>
<td>Department, University of Puerto Rico, Medical Sciences Campus, School</td>
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<tr>
<td></td>
<td>of Public Health</td>
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<td></td>
<td>• Jennifer Horney, PhD, MPH, CPH, Associate Professor, Texas A&amp;M</td>
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<td></td>
<td>University</td>
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<td></td>
<td>• Aubrey K. Miller, M.D., MPH, Senior Medical Advisor, National</td>
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<td></td>
<td>Institute of Environmental Sciences (NIEHS)</td>
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<td>• Joseph “Chip” Hughes Jr. MPH, Director, Worker Education and Training</td>
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<td></td>
<td>Program, National Institutes of Environmental Health Sciences (NIEHS)</td>
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<tr>
<td>12:00 – 1:00 pm</td>
<td>Lunch</td>
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<td>1:00 – 2:00 pm</td>
<td><strong>RT/CE Poster Session</strong></td>
<td>Commonwealth Hall A/B</td>
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<td>2:15 – 3:15 pm</td>
<td><strong>Research Translation / Community Engagement / Training Collaborative</strong></td>
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<td></td>
<td><strong>Moderator:</strong> Richard Pepino, MSS, MS, Director, Research Translation</td>
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<td>Core, Penn SRP University of Pennsylvania</td>
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<td><strong>Panelists:</strong></td>
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<td></td>
<td>• Jonathan Essoka, Superfund &amp; Technology Liaison, Office of Science</td>
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<td>Policy, Office of Research and Development, US-EPA</td>
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<td></td>
<td>• Sara Flanagan, KC Donnelly Externship 2016 Award Trainee, Columbia</td>
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<td></td>
<td>University Superfund Research Program (SRP) Community Engagement</td>
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<td>Core (CEC)</td>
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<td></td>
<td>• Dan Romer, PhD, Research Director, Annenberg Public Policy Center;</td>
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<td>Director, Adolescent Communication Institute (ACI), University of</td>
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<td>Pennsylvania</td>
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<td></td>
<td>• Tracy Carluccio, Deputy Director, Delaware River Keeper Network</td>
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<tr>
<td>3:30 pm</td>
<td>Reconvene to Main Program</td>
<td>Millennium Hall</td>
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<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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<tbody>
<tr>
<td><strong>8:00 am – 6:00 pm</strong></td>
<td>Registration Open</td>
<td>Pre-Function Hallway</td>
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<tr>
<td><strong>3:30 pm – 9:00 pm</strong></td>
<td>Main Program</td>
<td>Millennium Hall</td>
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<tr>
<td>3:30 – 3:55 pm</td>
<td><strong>Welcome</strong></td>
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<tr>
<td><strong>Moderator:</strong></td>
<td>Ian Blair, Ph.D., Director, Penn SRP Research &amp; Training Center,</td>
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<td></td>
<td>University of Pennsylvania</td>
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<td><strong>Speaker:</strong></td>
<td>J. Larry Jameson, M.D., Ph.D., EVP, University of Pennsylvania Health</td>
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<tr>
<td></td>
<td>System and Dean, Perelman School of Medicine, University of</td>
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<td>Pennsylvania</td>
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<td><strong>Speaker:</strong></td>
<td>Steven J. Fluharty, Ph.D., Dean, University of Pennsylvania, School</td>
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<td>of Arts &amp; Science (SAS)</td>
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<tr>
<td><strong>Speaker (video):</strong></td>
<td>Linda S. Birnbaum, Ph.D., D.A.B.T., A.T.S., Director, National</td>
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<td></td>
<td>Institute of Environmental Health Sciences (NIEHS) &amp; National</td>
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<td></td>
<td>Toxicology Program (NTP)</td>
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<td><strong>Speaker:</strong></td>
<td>William Suk, Ph.D., M.P.H., Director, NIEHS, Superfund Research</td>
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<td></td>
<td>Program, and Center for Risk and Integrated Sciences</td>
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<tr>
<td>3:55 – 4:35 pm</td>
<td><strong>Invited Plenary Speaker:</strong> Joe Shaw, Ph.D., Associate Professor,</td>
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<td>Public and Environmental Affairs, Indiana University</td>
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<tr>
<td><strong>Moderator:</strong></td>
<td>Richard Woychik, Ph.D., Deputy Director, NIEHS</td>
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<tr>
<td><strong>Title:</strong></td>
<td>“Mapping the chemosphere: Understanding our chemical world to improve</td>
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<td></td>
<td>human health and the environment”</td>
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<tr>
<td>4:35 – 5:50 pm</td>
<td>**Scientific Session 1: Understanding Environmental Exposures Using</td>
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<td>Big Data Approaches</td>
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<tr>
<td><strong>Moderator(s):</strong></td>
<td>Stefano Monti (Research Support Core Leader; Boston University</td>
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<td>and Melis Onel, (PhD Trainee; Texas A &amp; M University)</td>
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<td><strong>Presenters:</strong></td>
<td>Daniel Nomura (Project Leader; University of California-Berkeley)</td>
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<td>o Chemoproteomic Platforms for Mapping Proteome-Wide Reactivity of</td>
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<td>Environmental Chemicals</td>
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<td>Andrew Morris (Director, Research Support Core and co-PI Project 1;</td>
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<td>University of Kentucky Superfund Research Program)</td>
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<td>o Lipidomic analysis of PCB induced hepatic steatosis</td>
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<td></td>
<td>Gabrielle Black (PhD Trainee; University of California-Davis)</td>
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<td>o Identifying compounds originating from consumer products in sewage</td>
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<td>sludge utilizing effects-directed, non-targeted LC-qTOF-MS/MS</td>
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<td>Jennifer Guelfo (Postdoc; Brown University)</td>
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<td>o A Risk-based Geospatial Framework to Evaluate Sources of Per- and</td>
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<td>Polyfluoroalkyl Substance (PFAS) Groundwater Impacts</td>
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<td>Kathryn Demanelis (Postdoc; University of Chicago)</td>
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<td>o The impact of arsenic exposure on whole blood DNA methylation: an</td>
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<td>epigenome-wide study of Bangladeshi adults</td>
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<td>5:50 – 6:00 pm</td>
<td><strong>Break</strong></td>
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<td>6:00 – 7:30 pm</td>
<td><strong>Poster Session 1</strong></td>
<td>Commonwealth Halls A &amp; B and Pre-function Hallway</td>
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<tr>
<td>7:30 – 9:00 pm</td>
<td><strong>Dinner</strong></td>
<td>Millennium Hall</td>
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### Day Two: Thursday, December 7, 2017

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<th>Time</th>
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<tr>
<td>8:00 am – 3:00 pm</td>
<td>Main Meeting Registration</td>
<td>Pre-function Hallway</td>
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<tr>
<td>9:00 am – 5:15 pm</td>
<td><strong>Main Program</strong></td>
<td>Millennium Hall</td>
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<td>9:00 am – 9:40 am</td>
<td><strong>Invited Plenary Speaker:</strong> Sarah Tishkoff, Ph.D., David and Lyn Silfen University Professor, Genetics and Biology, University of Pennsylvania</td>
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<td><strong>Moderator:</strong> Ian Blair, Ph.D., Director, Penn SRP Research &amp; Training Center, University of Pennsylvania</td>
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<td></td>
<td><strong>Title:</strong> “Genomic Adaptation to Diverse Environments in Africa”</td>
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<td>9:40 am – 10:55 am</td>
<td><strong>Scientific Session 2:</strong> Fundamental Research for Innovation and Environmental Health</td>
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<td><strong>Moderators:</strong> Courtney Kozul-Horvath (Karen Wetterhahn Alumni, Novartis) and Kelly Fader (PhD Trainee; Michigan State University)</td>
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<td><strong>Presenters:</strong></td>
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<td></td>
<td>• Eric Uwimana (PhD Trainee; University of Iowa)</td>
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<td></td>
<td>o Chiral Polychlorinated Biphenyls (PCBs) Are Metabolized to Hydroxylated Metabolites by Human CYP2A6, CYP2B6 and CYP2E1</td>
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<td>• Ralph Pietrofesa, MSSP,MPH, MBE (KC Donnelly Award Winner 2016; MS Trainee, University of Pennsylvania)</td>
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<td></td>
<td>o The Synthetic Lignan Secoisolariciresinol Diglucoside (LGM2605) Prevents Copper Oxide Nanoparticle-Induced Damage in Murine Macrophages</td>
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<td>• Tess Leuthner (PhD Trainee; Duke University)</td>
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<td>o Adaptation to cadmium reveals variation in germline mitochondrial genome mutation rates</td>
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<td>• Reginald McNulty (Postdoc; University of California-San Diego)</td>
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<td>o Elucidating the Structure and Mechanism of Toxicant-induced Inflammasome Activation</td>
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<td>• Anne Nigra (PhD Trainee; Columbia University)</td>
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<td>o Decline in arsenic exposure in the United States from 2003 to 2014: the impact of the Environmental Protection Agency maximum contaminant level</td>
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<tr>
<td>10:55 am – 11:15 am</td>
<td><strong>Break</strong></td>
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<td>11:15 am – 12:30 pm</td>
<td><strong>Scientific Session 3:</strong> Environmental impacts in ecosystems</td>
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<td><strong>Moderators:</strong> Stephania Cormier (Center Director; Louisiana State University) and Ray Yeager (Postdoc; University of Louisville)</td>
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<td><strong>Presenters:</strong></td>
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<td>• Mark Hahn (Project Leader; Boston University)</td>
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<td></td>
<td>o Molecular Ecology at Superfund Sites: Application of Population Genomics and Genome Editing to Understand Genetic Mechanisms of Adaptation Following Multi-Generational Exposure to Chemical Mixtures</td>
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<td></td>
<td>• Jordan Kozal (PhD Trainee; Duke University)</td>
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<td>o Cross-Generational Exposure to Benzo(A)Pyrene Affects Metabolic Plasticity and Thermal Stress Response Capacity</td>
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<td>• James Minick (PhD Trainee; Oregon State University)</td>
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<td>o A Passive Sampling Model to Predict PAH Levels in Butter Clams, a Traditional Food Source for Native American Tribes of the Salish Sea Region</td>
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<td>• James Sanders (PhD Trainee; R01; University of Maryland-Baltimore)</td>
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<td></td>
<td>o Development of a Novel Equilibrium Passive Sampling Strategy for Methylmercury in Sediment and Soil Pore waters</td>
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<tr>
<td>12:30 pm – 1:30 pm</td>
<td>Lunch</td>
<td>Commonwealth Hall</td>
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| 1:30 pm – 2:45 pm (1hr 15min) | **Scientific Session 4:** Contaminant Fate and Transport  
**Moderators:** Raina Maier (Center Director; University of Arizona) and Kristen Prossner (MS Trainee; Virginia Institute of Marine Sciences)  
**Presenters:**  
- Livia Capaldi (MS Trainee; Dartmouth College)  
  - Understanding the Fate of Legacy Mercury Contamination in the Floodplain in Berlin, New Hampshire  
- Athena Nghiem (PhD Trainee; Columbia University)  
  - Scaling from Lab to Field: Exploring environmental variability on in-situ formation of biogenic magnetite for arsenic sequestration  
- Ali Seiphoori (Postdoc; University of Pennsylvania)  
  - Direct Observation and Determination of the Mechanisms Governing Mobility of Asbestos in Porous Media  
- Steven Chow (PhD Trainee; R01; Johns Hopkins University)  
  - Characterization of a Model Reactive Barrier for in Situ Bioremediation of Chlorobenzenes at Anaerobic-Aerobic Groundwater Interfaces  
- Renee Wurth (KC Donnelly Award Winner 2016; Postdoc; Northeastern University)  
  - Research and Translation of Water Quality and Equity in California | Commonwealth Halls A/B Pre-function Hallway |
| 2:45 pm – 3:15 pm | **Wetterhahn Award Presentation**  
**Moderator:** Dr. Gwen Collman (Director, Division of Extramural Research and Training, NIEHS) | Commonwealth Hall C   |
| 3:15 pm – 4:45 pm | **Poster Session 2**  
**Commonwealth Halls A/B Pre-function Hallway** | Commonwealth Halls A/B Pre-function Hallway |
| 5:00 pm – 6:00 pm | **Directors/PI Meeting** (Current P42, R01 and R25 Directors)  
**Speaker:** Jed R. Bullock, Legislative Liaison, NIEHS | Commonwealth Hall C   |
| 7:00 pm | **Dinner on your own** or as part of the following groups:  
- **Directors’ Dinner** (P42 Center Directors, R01 and R25 Principal Investigators)  
- **RTC-CEC Dinner**  
- **Trainees’ Dinners**  
- **Administrators’ Dinner** | Commonwealth Halls A/B Pre-function Hallway |

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**Day Three: Friday, December 8, 2017**

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<th>Time</th>
<th>Event</th>
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<tr>
<td>7:45 am – 8:30 am</td>
<td>Training Core Leaders sub-meeting</td>
<td>Commonwealth Hall D</td>
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</table>
| 8:30 am – 12:30 pm | **Main Program**  
**Invited Plenary Speaker:** Madeleine L. Scammell, D.Sc., Assistant Professor, Environmental Health, Boston University, School of Public Health  
**Moderator:** Joseph “Chip” Hughes Jr, M.P.H., Director, Worker Education and Training Program, (WETP), National Institutes of Environmental Health Sciences (NIEHS)  
**Title:** “The Mystery of Mesoamerican Nephropathy: Transdisciplinary research in response to a public health crisis” | Millennium Hall         |
| 8:30 am – 9:10 am | **Scientific Session 5:** Emerging and re-emerging Superfund Issues  
**Moderator(s):** Bruce Stanton (Center Director; Dartmouth College) and Elena | Millennium Hall         |
| 9:10 am – 10:25 am (1hr 15min) | **Scientific Session 5:** Emerging and re-emerging Superfund Issues  
**Moderator(s):** Bruce Stanton (Center Director; Dartmouth College) and Elena | Millennium Hall         |
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<th>Time</th>
<th>Session/Activity</th>
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<tr>
<td>10:25 am – 10:45 am</td>
<td><strong>Break</strong></td>
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<td>10:45 am – 12:00 pm</td>
<td><strong>Scientific Session 6: Advances in determining susceptibility to Superfund contaminants</strong>&lt;br&gt;Moderators: Peter Raynor (R25, University of Minnesota) and Nishad Jayasundara (Karen Wetterhahn Award Alumni; University of Maine)&lt;br&gt;Presenters:&lt;br&gt;  - Michael Petriello (Postdoc; University of Kentucky)&lt;br&gt;    o Serum levels of dioxin-like pollutants are positively associated with the cardiometabolic disease risk biomarker Trimethylamine-N-oxide in leaner women residing in Anniston, Alabama&lt;br&gt;  - Peter Dornbos (PhD Trainee; Michigan State University)&lt;br&gt;    o Identification of Genetic Modulators of TCDD-induced B-cell Dysfunction using a Population-Based Approach&lt;br&gt;  - Jessica Laine (KC Donnelly Award Winner 2016; Postdoc; University of North Carolina-Chapel Hill)&lt;br&gt;    o Investigation of Nutritional Biomarkers Associated with Metabolism of Inorganic Arsenic and Infant Birthweight&lt;br&gt;  - Kevin Hsu (PhD Trainee; Dartmouth College)&lt;br&gt;    o Adult mice exposed in utero to arsenic via maternal drinking water exhibit enhanced inflammatory and immunopathologic responses to acute influenza A infection&lt;br&gt;  - Juliette Aka (Postdoc; University of Pennsylvania)&lt;br&gt;    o Biosynthesis of Estrogens in Mesothelioma Cancer Cells and Effect on Cell Growth</td>
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<td>12:00 pm – 12:30 pm</td>
<td><strong>Awards and Closing Comments</strong></td>
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**Day One: Wednesday, December 6, 2017**

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<th>Time</th>
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<tr>
<td>2:30 – 3:30 pm</td>
<td>Registration</td>
<td>Pre-Function Hallway</td>
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<tr>
<td>4:35 pm – 5:50 pm</td>
<td>Administrator Session 1</td>
<td>Commonwealth Hall D</td>
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| 4:35 – 5:50 pm| Moderator: Shawn Tucker, Research Program Coordinator, Oregon State University SRP Program  
Introductions and Welcome  
New Administrator Introductions  
Sign-up for one-on-one sessions with Grants Management Staff (GMS) | Commonwealth Hall D       |

**Day Two: Thursday, December 7, 2017**

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<td>9:00 am – 2:45 pm</td>
<td>Administrators’ Program</td>
<td>Commonwealth Hall C</td>
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| 9:00 – 9:40 am| 15 min one-on-one sessions with NIEHS Grants Management Staff (GMS)  
Lisa Archer Edwards and Bryann Benton | Commonwealth Hall C       |
| 9:40 – 11:00 am| Administrator Session 2                                               | Commonwealth Hall C       |
|                | Led by: NIEHS Program Staff : Danielle Carlin, PhD, Michelle Heacock, PhD,  
Heather Henry, PhD, Brittany Trottier; MDB Inc Staff: Maureen Avakian, Sara Amolegbe  
Program Highlights from November 30th Administrators Call **(RPPR, Annual Updates, iEdison, Human Subjects  
MDB Inc. and Data Collection Tool  
Grant Review Process: Janice Allen, PhD, and Laura Thomas, PhD, Scientific Review Branch (SRB) | Commonwealth Hall C       |
| 11:00 – 11:15 am| Break                                                                |                           |
| 11:15 am – 12:30 pm| Administrator Session 3                                              |                           |
|                | Led by Lisa Archer Edwards and Bryann Benton, NIEHS GMS Staff       |                           |
|                | NIH/NIEHS Updates  
Carryover Policy & Requests  
Electronic Carryover guidelines/process  
Questions/Comments from Administrators’ Group |                           |
| 12:30 – 1:30 pm| Lunch                                                                 |                           |
| 1:30 – 2:45 pm| Administrator Session 4                                              |                           |
|                | Brittany Trottier, M.P.H., Health Specialist, NIEHS  
Updates in the NIEHS CareerTrac System |                           |
| 2:45 | Reconvene to Main Program                                           | Millennium Hall           |

**Day Three: Friday, December 8, 2017**

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<td>8:30 am – 12:00 noon</td>
<td>Administrators’ Program</td>
<td>Commonwealth Hall C</td>
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| 8:30 am – 9:10 am| 15 min one-on-one sessions with NIEHS GMS staff  
Lisa Archer Edwards and Bryann Benton | Commonwealth Hall C       |
| 9:10 am – 10:10 am| Administrator Session 5                                               | Commonwealth Hall C       |
|                | Led by Mindy Sickels Sterbenz, Research Support Manager, Iowa Superfund Research Program  
Discussion on cost principles and selected item costs  
Case Studies  
Sub-award tracking | Commonwealth Hall C       |
<p>| 10:25 am – 10:45 am| Break                                                                | Commonwealth Hall C       |</p>
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| 10:45–11:15 am | **Administrator Session 6 (Part I)**<br>  Led by Shawn Tucker, Research Program Coordinator, Oregon State University SRP Program  
|              | ▪ Annual SRP Meeting 2018 – Preliminary Planning and Brainstorming  
|              | ▪ Election of 2018 Administrator Chair & Co-Chair                                  |
| 11:15 am – 12:00 pm | **Administrator Session 6 (Part II)**<br>  Led by Shawn Tucker  
|              | ▪ Best Practices Group Discussions (15 min each)  
|              | ▪ **Topic 1**: New Human Subjects/Clinical Trials application forms – Mindy Sickels Sterbenz, Research Support Manager, Iowa Superfund Research Program  
|              | ▪ **Topic 2**: iEdison - Jennifer Moore, Program Coordinator, University of Kentucky SRP Program  
|              | ▪ **Topic 3**: eRA Commons and Trainees                                           |
| 12:00 noon   | Reconvene to Main Program                                                        |
|              | Millennium Hall                                                                  |
Trainee Program Invited Speakers Workshops

Lisa B. Marshall, M.S. Communication Professional

“Effective Science Presentations”

Bio: Communication expert Lisa B. Marshall (www.lisabmarshall.com) delivers consulting and workshops, is author of Smart Talk and Ace Your Interview and host of the Public Speaker and Smart Talk podcasts. She has a long history of helping organizations and elite performers develop strong communication and leadership by emphasizing scientifically based insights and practical techniques. Her company develops solutions to facilitate organizational effectiveness and leadership development through consulting, training, keynotes, and one-on-one coaching.

Clients include Johns Hopkins Medicine, Pepsico, Roche, Kellogg’s, AARP, AstraZeneca, Harvard University, Leidos, and others and her work has been featured in The New York Times, The Chicago Tribune, Forbes, and more., Lisa holds a Masters of Communication with a dual concentration in Interpersonal/Intercultural Communication and Organizational Communication from the State University at New York at Albany. She received her Bachelor of Science degree from Drexel University in Computer and Information Systems.

Judith Swan, Ph.D. Associate Director, Writing in Science and Engineering, Princeton University

“Effective Scientific Communication — Writing from the Readers' Perspective”

Bio: Judith Swan is Associate Director for Writing in Science and Engineering at Princeton University, where she developed and oversees a writing program for graduate students and postdocs.

Her research focuses on writing development during scientific training and on the ways language shapes the interpretation of emerging science. For over 25 years, she has taught writing to scientists and engineers at all levels of academia, industry and government; her workshops have been offered at institutions such as Rockefeller University, Columbia University, University of Michigan, Icahn School of Medicine at Mt. Sinai, Bristol Myers Squibb Corporation, Merck Pharmaceuticals, the Centers for Disease Control and Prevention, the Environmental Protection Agency, and the National Institutes of Health.

Dr. Swan was trained in Biochemistry and Molecular Biology at Harvard and received her Ph.D. in Biology from MIT; she has taught composition at Princeton University, Duke University, and the University of Pennsylvania. “In Praise of Technique” talk at TEDx Carnegie Mellon 2013, https://www.youtube.com/watch?v=1pzjxYCwb08,
Invited Talks

The Mystery of Mesoamerican Nephropathy: Transdisciplinary research in response to a public health crisis

Madelaine L. Scammell, DSc, Associate Professor, Environmental Health, Boston University School of Public Health

Abstract: In 2017 Dr. Madeleine Scammell was one of five early career scientists who received the NIEHS Outstanding New Environmental Scientist (ONES) award. She will discuss her research, a Longitudinal Study of Mesoamerican Nephropathy among Agricultural Workers in Central America, examining exposure to pesticides, metals and heat stress, and biomarkers of kidney injury and kidney function in El Salvador and Nicaragua. Dr. Scammell will discuss this work specifically as an outgrowth of her experience in the non-profit world, and her training over sixteen years as a Superfund graduate student, and then leader of the Community Engagement and Research Translation Cores of the Boston University Superfund Research Program.

Bio: Dr. Scammell is an Associate Professor of Environmental Health at Boston University School of Public Health and a JPB Environmental Health Fellow at Harvard School of Public Health. She is Principal Investigator a recently funded longitudinal study of agricultural workers in El Salvador (an NIEHS/NIH Outstanding New Environmental Scientist award), and a co-investigator on a study of occupational risk factors of kidney disease in both El Salvador and Nicaragua. These efforts are focused on identifying and preventing exposures that may contribute to the epidemic of chronic kidney disease in Central America known as Mesoamerican Nephropathy (MeN). Dr. Scammell also leads the Community Engagement Cores of two research centers:

The Boston University Superfund Research Center (funded by NIEHS/NIH), and the Center for Research on Social and Environmental Stressors in Housing across the Life course (joint center between Boston University and Harvard-Chan School of Public Health funded by NIMHD/NIH and EPA). At BUSPH Dr. Scammell teaches Community-Engaged Research: Theory, Application and Methods, she also serves of the Board of Health in the City of Chelsea, MA where she lives.
Mapping the Chemosphere: Understanding our chemical world to improve human health and the environment

Joseph R. Shaw PhD, Associate Professor, Indiana University School of Public & Environmental Affairs

Abstract: Worldwide, our indoor and outdoor environments are increasingly saturated with chemicals, producing a “chemosphere” in which we live. Many of these chemicals can be harmful to human health. Chemical pollution is one of the largest environmental causes of disease and death in the world today. It is estimated to account for one in every six deaths, killing 1.7 million children per year. Fortunately, diseases caused by chemicals are the most preventable. It is estimated that eliminating or reducing exposure to hazardous chemicals is estimated to prevent 35% of ischemic heart disease and 42% of stroke, the largest and second largest contributors to global mortality, respectively. However, protecting the environment and human health from harmful chemicals using current approaches often leave us guessing whether they are safe or not. This uncertainty exists because few of the chemicals we use have ever been evaluated for safety due to the costs and time it takes for testing. It can cost as much as five million dollars and take as long as five years to complete tests for a single compound with our current methods. In addition, once chemicals enter the environment we lack effective, non-targeted monitoring techniques that do not require the selection of chemicals to be measured before measurements are made.

Our initiative, Mapping the Chemosphere, seeks to proactively reveal, which chemicals are prevalent in our environments, how we are exposed to them, and how they affect our health. We build on important discoveries and technical advances of the past decade, particularly the: (1) ability to rapidly identify genes, metabolites and bio-molecular interactions that are involved in pathways altered by chemical exposures, (2) availability of genomes for many animals, (3) improved analytical methods that allow for detection of chemicals in exceedingly small quantities, (4) exponential increases in computational power to identify predictive patterns in massive data sets, and (5) many studies underscoring the similarity across animals of biological processes that are highly relevant to human toxicology. We apply these key discoveries to identify the evolutionary origins of the molecular response to chemicals, and to discover the chemicals and their doses that influence biology. Our aim is to create a systems approach to chemical testing and monitoring that will enable industries to innovate toward safer and more sustainable products, help people engage in healthier interactions with the chemosphere, and allow governments better tools to foster both of these outcomes.

Bio: Joseph R. Shaw is an Associate Professor in the School of Public and Environmental Affairs at Indiana University, and holds an adjunct appointment in their School of Public Health. Shaw earned his doctoral degree in environmental toxicology from the Graduate Center for Toxicology at the University of Kentucky in 2001. He then moved to Dartmouth College where he received an NIEHS-SRP post-doctoral fellowship to apply emerging Omics technologies to characterize mechanisms of toxicant actions. He joined the faculty of the School of Public and Environmental Affairs at Indiana University, Bloomington in 2007. Shaw was named an Outstanding New Environmental Scientist (ONES) by the NIEHS in 2010 and recognized as an exceptional talent in the environmental sciences by the Royal Society, UK in 2013 for his work investigating toxicant exposure, genome structure and toxic effects on individuals and populations. He is a founding member of both the Daphnia and Fundulus Genomics Consortia where he helps lead over 600 scientists around the world working to develop new models for environmental genomics. He also helped establish the Consortium for Environmental Omics and Toxicology (now called the Environment Care Consortium) that seeks to apply twenty first century technologies to predictive toxicology. His work embraces new high-throughput molecular techniques and couples these with evolutionary theory, statistical analysis and bioinformatics in order to integrate toxic-response across levels of biological organization, and discover critical, specific and causative molecular toxicological and disease pathways resulting from complex environmental exposures.
Genomic Adaptation to Diverse Environments in Africa

Sarah Tishkoff, PhD, Departments of Genetics and Biology, University of Pennsylvania

Abstract: Africa is thought to be the ancestral homeland of all modern human populations. It is also a region of tremendous cultural, genetic and environmental diversity. Africa has a high burden of communicable disease and an increasing prevalence of non-communicable diseases such as hypertension and diabetes. Yet, African populations remain one of the most underrepresented groups in human genomics studies. A comprehensive knowledge of patterns of variation in African genomes is critical for a deeper understanding of human genomic diversity, the identification of functionally important genetic variation, the genetic basis of adaptation to diverse environments and diets, and the origins of modern humans. Here we characterize genetic and phenotypic diversity for anthropometric, cardiovascular, and metabolic traits in ethnically and geographically diverse Africans. These include populations with diverse diets that practice hunting and gathering, pastoralism, and agriculture. We discuss how natural selection, acting on traits related to adaptation to diverse environments, has shaped genomic diversity in Africa.

Bio: Sarah Tishkoff is the David and Lyn Silfen University Professor in Genetics and Biology at the University of Pennsylvania, holding appointments in the School of Medicine and the School of Arts and Sciences. Dr. Tishkoff studies genomic and phenotypic variation in ethnically diverse Africans. Her research combines field work, laboratory research, and computational methods to examine African population history and how genetic variation can affect a wide range of practical issues – for example, why humans have different susceptibility to disease, how they metabolize drugs, and how they adapt through evolution. Dr. Tishkoff is a member of the National Academy of Sciences and a recipient of an NIH Pioneer Award, a David and Lucile Packard Career Award, a Burroughs/Wellcome Fund Career Award, and a Penn Integrates Knowledge (PIK) endowed chair. She is a member of the board of directors of the American Society of Human Genetics and is on the editorial boards at PLOS Genetics, Genome Research; Evolution, Medicine, and Public Health; G3 (Genes, Genomes, and Genetics).
SESSION 1: Understanding Environmental Exposures Using Big Data Approaches

Chemoproteomic Platforms for Mapping Proteome-Wide Reactivity of Environmental Chemicals

Daniel K. Nomura

1University of California, Berkeley, Departments of Chemistry, Molecular and Cell Biology, and Nutritional Sciences and Toxicology

Abstract and Research Translation Component.

We are exposed to countless chemicals, many of which have been linked to adverse health effects, and most of which have not been characterized in terms of their toxicological potential or mechanisms. A major challenge in identifying these potentially disease-causing chemicals has been our inability to rapidly assess direct mechanisms in terms of direct molecular interactions of chemicals with biological systems. Our lab has pioneered chemoproteomic technologies to map the proteome-wide targets of widely used environmental chemicals. We have used these strategies to identify off-target profiles of many widely used environmental chemicals, including organophosphorus insecticides and herbicides such as glyphosate and acetanilides. Recently, we have used chemoproteomic approaches to discover that the widely used herbicide glyphosate is metabolized to the reactive metabolite glyoxylate in mice to react with >50 different protein targets. Among these targets, we found that the catalytic cysteines of several thiolases involved in fatty acid oxidation were inhibited by glyphosate conversion to glyoxylate in vivo in mouse liver, leading to impaired fatty acid oxidation and accumulation of fat in the liver. Overall, we demonstrate that our technologies can be used to map proteome-wide targets of widely used environmental chemicals, towards identifying unique mechanisms of toxicity. Our work is being used to help inform future regulatory decisions for pesticide usage. We are also working with chemical and pharmaceutical companies to implement our technologies into the development pipelines.

Lipidomic analysis of PCB induced hepatic steatosis

Suchismita Halder, Michael Petriello, Banrida Wahlang, Bernhard Hennig and Andrew J. Morris

Hepatic steatosis results from abnormal retention of neutral lipids in the liver. Although the pathology and progression of the disease is stereotypical, hepatic steatosis can be caused by multiple factors including excessive alcohol consumption and nutritional and metabolic dysfunction. Exposure to some drugs and toxins is also associated with hepatic steatosis and several environmental pollutants, in particular dioxins and dioxin like chemicals induce hepatic steatosis in experimental models. The mechanisms involved appear complex with changes in expression of genes involved in lipid synthesis and catabolism reported that may impact on the balance between hepatic lipid synthesis from fatty acids and carbohydrates and secretion of liver-derived low density lipoproteins. We used untargeted and targeted measurements of multiple lipid species within common classes to compare the effect of dioxin-like PCB126 or dietary restriction of choline and methionine (an established experimental model of murine steatohepatitis) on the hepatic lipidome.

Dietary methionine and choline restriction resulted in expected pronounced decreases in choline containing lipids with increases in triglycerides as a consequence of a decrease in choline lipid dependent production of hepatic low density lipoproteins. By contrast, PCB126 treatment resulted in marked increases in global levels of many phospholipids and neutral lipids. Gene expression profiling suggests that increases in expression of several key enzymes involved in de novo synthesis of fatty acids, phospholipids and neutral lipids from carbohydrates and fatty acids likely accounts for or contributes to this phenotype. These results support the concept that increases in hepatic lipid synthesis could contribute to an increased risk of hepatic steatosis, hyperlipidemia and associated co-morbidities including cardiovascular diseases in PCB exposed individuals.
Identifying compounds originating from consumer products in sewage sludge utilizing effects-directed, non-targeted LC-qTOF-MS/MS

Gabrielle Black, University of California, Davis; Thomas Young, University of California Davis; Tarun Anumol, Agilent Technologies

Endocrine disrupting compounds in the environment have been a topic of national and regional concern. The EPA Endocrine Disrupting Screening Program (EDSP) has identified hundreds of compounds that exhibit endocrine disrupting characteristics. To date however, there has been little research investigating endocrine activity of products formed during degradation of consumer product ingredients, such as occurs within wastewater treatment plants (WWTP) that are designed to achieve substantial reductions in concentrations of diverse organic compounds. Utilizing effects-directed analysis (EDA) of endocrine active compounds in sewage sludge allows us to conduct a "bottom up" search for compounds that are not currently on the EDSP radar; or are transformation products originating from active ingredients found in consumer products. Twelve WWTPs throughout California have provided sewage sludge samples for this research, which couples suspect and non-target High Resolution LC-MS/MS with cell-based CALUX (Chemically Activated Luciferase gene expression) bioassays capable of identifying estrogenic, aryl hydrocarbon and, glucocorticoid receptor interactions. This presentation will outline the method and workflow of this technique in addition to reporting a subset of universally present compounds in sewage sludge using target, suspect and, non-target analytical approaches.

A Risk-based Geospatial Framework to Evaluate Sources of Per- and Polyfluoroalkyl Substance (PFAS) Groundwater Impacts

Jennifer Guelfo, Thomas Marlow, Scott Frickel, and Eric Suuberg; Brown University, Providence, RI,

Numerous communities in the U.S recently identified per- and polyfluoroalkyl substances (PFASs) in drinking water at levels exceeding federal advisories. During stakeholder engagement by the Brown Research Translation Core, source zone identification was noted to be a key challenge arising during assessment and management of PFAS impacts. Our objectives were to compile a database of facilities that are potential sources of PFAS groundwater impacts and develop and ground truth a risk-based, geospatial framework that evaluates potential for PFAS impacts to drinking water aquifers. The source database is comprised of publicly available information on thousands of sites in Rhode Island that may be associated with PFASs, such as airports, fire training areas, and select manufacturing facilities. A scoring system was developed that defines likelihood of release for each source type and compares those scores to the vulnerability (i.e. susceptibility to impacts) of aquifers in the vicinity. Risks of impacts are greatest where regions with a high likelihood of release are proximal to highly vulnerable aquifers. Results were used to generate state-wide maps of PFAS risks to drinking water aquifers that were shared with regulatory stakeholders to assist in design of a sampling program in Rhode Island that resulted in collection of samples at 61 wells. During sampling, multiple public wells were identified with PFAS detections that corresponded with mapped areas of medium to high risk. A sampling location ranked by the resulting framework as one of the top ten most at-risk wells in the state, was the only sample found to exceed federal PFAS advisory levels. Results collectively suggest the framework is effective for PFAS source zone identification, and illustrate how research translation partnerships can be leveraged to more effectively assess, manage, and reduce risks to human health.

The impact of arsenic exposure on whole blood DNA methylation: an epigenome-wide study of Bangladeshi adults

Kathryn Demanelis¹, Maria Argos², Lin Tong¹, Justin Shinkle¹, Mekala Sabarinathan¹, Farzana Jasmine¹, Muhammad G. Kibriya¹, Habib Ahsan¹, Brandon L. Pierce¹
Arsenic exposure affects >100 million people worldwide, including ~56 million in Bangladesh. Arsenic is a metal carcinogen, and one potential mechanism of arsenic carcinogenicity is alteration of DNA methylation. DNA methylation is an epigenetic mechanism that helps regulate gene expression and maintain genomic stability and can change in response to environmental exposures, like arsenic. We assessed associations between arsenic exposure and genome-wide DNA methylation among 396 Bangladeshi adults participating in the Health Effects of Arsenic Longitudinal Study (HEALS), who were exposed by drinking naturally-contaminated well water. Methylation in whole blood DNA was measured at ~850,000 CpG sites using the Illumina EPIC array. Association analyses were conducted using reference-free and other approaches to account for cell composition. We attempted replication in an independent set of 400 arsenical skin lesion cases with 450K array data. The median arsenic exposure measured in urine was 201.5 ug/g creatinine (IQR: 113.5-350 ug/g), and 76% consumed water with concentrations above the WHO guideline of 10 ug/L. From the reference-free analysis results, urine arsenic was associated with methylation at 182 CpGs (FDR<0.05). Of these CpGs 83% were also associated with arsenic measured in individuals' primary drinking well (p<0.05). Replication was tested for 84 arsenic-associated CpGs present on the 450K array, and 36% were associated with urine arsenic (p<0.05). Methylation at 74% of these 182 CpGs decreased with increasing arsenic. Compared to all CpGs, associated CpGs were enriched in non-CpG islands (p=0.0049) and depleted in gene promoters (p=0.0301). The robust associations between arsenic exposure and DNA methylation observed in this work suggest that epigenetic alterations may be important mediators in arsenic carcinogenicity and could be investigated as potential biomarkers of exposure in susceptible populations.

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**SESSION 2: Fundamental Research for Innovation and Environmental Health**

Chiral Polychlorinated Biphenyls (PCBs) Are Metabolized to Hydroxylated Metabolites by Human CYP2A6, CYP2B6 and CYP2E1

Eric Uwimana,¹,² Xueshu Li,² Patricia Ruiz,³ and Hans-Joachim Lehmler¹,²

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Exposure to chiral polychlorinated biphenyls (PCBs) has been associated with neurodevelopmental disorders. Their hydroxylated metabolites (OH-PCBs) are also chiral and potentially toxic to the developing brain; however, the formation of OH-PCBs by human cytochrome P450 isoforms is poorly investigated. To address this knowledge gap, we tested the hypothesis that the biotransformation of 2,2',3,4',6-pentachlorobiphenyl (PCB 91), 2,2',3,5',6-pentachlorobiphenyl (PCB 95), 2,2',3,3',4,6'-hexachlorobiphenyl (PCB 132), and 2,2',3,3',6,6'-hexachlorobiphenyl (PCB 136) is mediated by different human cytochrome P450 isoforms. ADMET Predictor and MetaDrug software were initially used to predict cytochrome P450 isoforms involved in the metabolism of chiral PCBs in silico. These predictions suggested a role of CYP1A2, CYP2A6, CYP2B6, CYP2E1 and CYP3A4 in the metabolism of chiral PCBs. Subsequent metabolism studies with recombinant human enzymes demonstrated that CYP2A6 and CYP2B6 oxidized PCB 91 and PCB 132 in meta position and that CYP2A6 oxidized PCB 95 and PCB 136 in para position. CYP2B6 played only a minor role in the metabolism of neurotoxic, chiral PCB to chiral OH-PCBs in humans. Further studies are needed to characterize the enantioselectivity of the oxidation of PCBs by both cytochrome P450 isoforms and assess the toxicity of the resulting OH-PCBs.
The Synthetic Lignan Secoisolariciresinol Diglucoside (LGM2605) Prevents Copper Oxide Nanoparticle-Induced Damage in Murine Macrophages

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Background: Copper-based nanoparticles (CuO-NPs) are an important class of materials with applications as catalysts, conductive inks, and antimicrobial agents. Environmental and safety issues are particularly important for copper-based nanomaterials because of their potential large-scale use and their high redox activity and toxicity reported from in vitro studies, especially in airway epithelial cells. There is a general consensus that the cytotoxicity and genotoxicity associated with copper-based nanoparticles is due to reactive oxygen species (ROS) generation and activation of oxidative pathways. We are currently investigating the cancer chemopreventive properties of a small molecule (LGM2605), the synthetic counterpart of the naturally occurring secoisolariciresinol diglucoside (SDG) and the most abundant lignan found in flaxseed, in diverse models of carcinogenesis. LGM2605 is an ideal candidate for testing in the established CuO-NP toxicity model as it has proven efficacy in scavenging free radicals and detoxifying harmful environmental toxicological exposures, such as benzo[α]pyrene, asbestos, and ionizing radiation. Methods: In the current study we evaluated the ability of LGM2605 to prevent CuO-NP-induced cytotoxicity, ROS generation, and proinflammatory cytokine release (IL-1β and TNFα) in murine macrophages. Results: 20 ppm CuO-NP given to J774A.1 murine macrophages induced a significant increase in cell death at 6-hours post CuO-NP exposure, which was significantly ameliorated by LGM2605 pretreatment (p<0.0001). ROS generation, determined by ROS positive cells (CellROX) and H2O2 production, was increased following CuO-NP exposure and significantly blunted by 100 µM LGM2605. Additionally, levels of proinflammatory cytokines, IL-1β and TNFα, released following CuO-NP exposure were significantly (p<0.01) reduced by LGM2605 treatment. Conclusion: LGM2605 reduced CuO-NP-induced oxidative stress and activation of murine macrophages supporting its possible use in preventing CuO-NP-induced toxicity in airways.

Adaptation to cadmium reveals variation in germline mitochondrial genome mutation rates

Tess Leuthner (Duke University, R. Nathan Keith (Indiana University); Joel N. Meyer (Duke University); Joseph R. Shaw (Indiana University)

Cadmium (Cd) is a heavy metal pollutant detected at essentially all Superfund sites and elsewhere, and ranked 7th on the ATSDR substance priority list. Though a human carcinogen, the mechanism of cadmium genotoxicity and mutagenicity is unclear. Additionally, mechanisms for differential susceptibility to environmental mutagens are of special interest to the Superfund Research Program and vulnerable communities. We take advantage of a population of the ubiquitous freshwater crustacean Daphnia pulex that is tolerant to cadmium after more than a century of exposure to iron ore smelting runoff to investigate potential mechanisms of cadmium-induced germline mutagenesis. Twelve genetically identical individuals of the tolerant (TOL) population and a Cd-sensitive reference population (SENS) of D. pulex were each exposed to chronic, environmentally-relevant cadmium conditions for more than 50 generations of mutation accumulation (MA). Because cadmium preferentially accumulates in mitochondria, mitochondrial DNA (mtDNA) and nuclear DNA repair mechanisms differ, and mtDNA germline mutations may contribute to cancer susceptibility, developmental and metabolic disorders, and aging, we specifically tested the effects of Cd on mtDNA germline mutagenesis. Overall, there was no effect of population history or Cd on mitochondrial genome mutation rates. However, there was a trend towards suppression of C:G > A:T transversion mutations and both A:T > G:C and C:G > A:T transition mutations in the TOL MA experimental lines.
Strikingly, there are specific context-dependent mutations that occur at C/G sites in the SENS MA experimental lines, which are absent in the TOL MA experimental lines. Overall, this innovative, “big data” approach may contribute to understanding of potential mechanisms that confer susceptibility to Cd and other Superfund toxicants.

Elucidating the Structure and Mechanism of Toxicant-induced Inflammasome Activation

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This project aims at advancing our knowledge, from a molecular basis, of how environmental toxic agents cause unwanted inflammation and cancer. The NLRP3 inflammasome has been identified as a key immune sensor for tissue damage. Although NLRP3 inflammasome assembly/activation leads to the production of inflammatory messengers (called cytokines) that alert the host immune system to initiate inflammatory responses, its dysregulation often results in overt diseases due to uncontrolled inflammation. Unfortunately, exposure to a number of Superfund toxicants has been shown to induce NLRP3 inflammasome activation that in turn initiates an undesirable inflammatory response, thereby causing pathologies. Interestingly, although these toxicants do not directly bind NLRP3, they are able to trigger mitochondrial damage and subsequent release of mitochondrial contents that somehow signal the activation of NLRP3 inflammasome. In this project, we seek to (1) identify the mitochondrial ligand responsible for direct NLRP3 activation; (2) characterize the structure of NLRP3 in native and assembled states using biochemical and biophysical approaches. Although there are crystal and NMR structures of NLRP’s pyrin domain, a complete molecular picture of the molecular structure – necessary for specific drug design – is currently lacking. Since NLRP3 inflammasome is subject to substantial post-translational modifications that consequentially influence its structure and function, we reason that isolation and characterization of NLRP3 inflammasome directly from human cells will elucidate functional mechanisms of Superfund toxicant-induced inflammation and cancer and thereby promote rational pharmacological drug design to prevent inflammation and cancer

Decline in arsenic exposure in the United States from 2003 to 2014: the impact of the Environmental Protection Agency maximum contaminant level

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Background: The current US EPA maximum contaminant level (MCL) for arsenic in public water systems (10 µg/L) took effect in 2006. Arsenic is not federally regulated in private wells. The impact of the 2006 MCL on arsenic exposure in the US, as confirmed through biomarkers, is unknown. We evaluated national trends in water arsenic exposure in the US, hypothesizing that urinary arsenic levels would decrease over time among participants using public water systems but not among those using well water. We further estimated the expected number of avoided lung, bladder, and skin cancer cases. Methods: We evaluated 14,127 participants in NHANES 2003-2014 with urinary dimethylarsiniate (DMA) and total arsenic available. To isolate water exposure, we expanded a residual-based method to remove tobacco and dietary contributions of arsenic. We applied EPA risk
assessment approaches to estimate the expected annual number of avoided cancer cases comparing arsenic exposure in 2013-2014 vs. 2003-2004. Results: Among public water users, fully adjusted geometric means of DMA decreased from 3.01 µg/L (2003-2004) to 2.49 µg/L (2013-2014) (17% reduction; p-trend<0.001); no change was observed among well water users (p-trend=0.35). Assuming these estimated exposure reductions persist across a lifetime, we estimate a reduction of 200 to 900 lung and bladder cancer cases per year. Conclusions and Research Translation: The decline in urinary arsenic among public water but not private well users in NHANES 2003-2014 indicates that the implementation of the current MCL has reduced arsenic exposure in the US population. Our study supports that well water users are inadequately protected against drinking water arsenic, and confirms the critical role of federal drinking water regulations in reducing toxic exposures and protecting human health.

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**SESSION 3: Environmental impacts in ecosystems**

**Molecular Ecology at Superfund Sites: Application of population genomics and genome editing to understand genetic mechanisms of adaptation following multi-generational exposure to chemical mixtures**

Mark E. Hahn,¹,² Sibel I. Karchner,¹,² Neelakanteswar Aluru,¹,² Diana G. Franks,¹,² Jared V. Goldstone,¹,² John J. Stegeman,¹,² Denise Champlin,³ Bryan W. Clark,⁴ Saro Jayaraman,³ Diane Nacci,³ Vinay Kartha,¹,⁵ Eric Reed,¹,⁵ and Stefano Monti¹,⁵

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Multi-generational exposure to mixtures of contaminants at Superfund sites can impose strong selective pressures that can alter the genetics of exposed populations, with both physiological and ecological consequences. For example, populations of the Atlantic killifish (Fundulus heteroclitus) inhabiting several Superfund sites contaminated with polychlorinated biphenyls (PCBs) and other chemicals have evolved heritable tolerance to the dioxin-like PCBs. Recent studies suggest that fish from the New Bedford Harbor (MA) Superfund site also have evolved tolerance to the effects of non-dioxin-like, ortho-substituted PCBs. Gene expression, population genetic, and population genomic studies have implicated the aryl hydrocarbon receptor (AHR) signaling pathway in the mechanism of resistance to dioxin-like compounds. Four killifish aryl hydrocarbon receptors (AHRs), AHR-interacting protein (AIP), and cytochrome P450-1A (CYP1A) were identified as shared targets of selection. Genome editing of AHRs and AIP using CRISPR-Cas9 technology in both killifish and zebrafish is being used to better understand the specific roles of these genes and their variants in the mechanism of differential susceptibility to both dioxin-like and ortho-PCBs. Studies include generation of null alleles as well as introduction of candidate single-nucleotide variants to test hypotheses about their role in the resistant phenotype. Elucidating the mechanisms of adaptation to long-term chemical exposure contributes to a fundamental understanding of mechanisms underlying differential sensitivity to chemicals, informs ecological risk assessment, and complements efforts to engage and inform communities living near the New Bedford Harbor Superfund site.

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**Cross-generational exposure to benzo(a)pyrene affects metabolic plasticity & thermal stress response capacity**

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In the face of global change, anthropogenic impacts have become pervasive in marine environments,
and organisms are increasingly being subjected to the concurrent or serial impacts of multiple stressors. Metabolic plasticity (i.e. adaptability of metabolism to changes in the environment) is crucial for an organism to effectively respond to a variety of stressors. Thermal stress response requires increased ATP production but reduces mitochondrial efficiency, necessitating modulation of energy flow among competing processes. Our current studies show that exposure of F0 generation Danio rerio to benzo(a)pyrene (BaP), a model polycyclic aromatic hydrocarbon, affects mitochondrial function, metabolic partitioning and plasticity in two subsequent generations removed from the exposure (F1 & F2). This suggests that history of cross-generational exposure to BaP (CE-BaP) may reduce an organism’s thermal stress response capacity. Herein, we explore the effects of CE-BaP on an F2 organism’s thermal tolerance under temperature stress, focusing on aerobic metabolism and metabolic plasticity. CE-BaP zebrafish embryos under thermal stress exhibit reduced developmental viability and altered metabolic response to thermal stress, with differential mitochondrial metabolic partitioning at 28 and 32°C. The interactive effects of CE-BaP and temperature persist later in life with adult F2 zebrafish exhibiting reduced critical thermal maxima as well as altered aerobic metabolism at 32°C (e.g. aerobic scope and Q10 effects) and heart-specific mitochondrial function (e.g. mitochondrial reserve capacity) at 32°C. Overall, this study suggests that CE-BaP affects metabolic thermal stress response and that legacy pollution (e.g. Superfund sites) may potentiate the effects of climate change. Broader implications of this study are being communicated to the community surrounding Atlantic Wood Industries Superfund site (Virginia) in collaboration with the Duke Superfund Research Translation and Community Engagement Cores.

A passive sampling model to predict PAH levels in butter clams, a traditional food source for Native American tribes of the Salish Sea Region

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Food security is a primary human health indicator for indigenous populations and is adversely affected by the accumulation of contaminants in traditional food sources, including shellfish. As filter feeders, shellfish may accumulate contaminants found in the sediment. The freely dissolved fraction (Cfree) of contaminants in sediment pore water is a better predictor of contaminant bioavailability than bulk sediment concentrations. Passive sampling provides a simplified and accurate approach to directly measure Cfree in pore water. In this work, the collection of butter clams (Saxidomus gigantea) was spatially and temporally paired with deployment of passive sediment pore water samplers at four locations at traditional harvesting grounds of Native American tribal communities in the Puget Sound region of the Salish Sea in Washington, USA. Passive sampling techniques were used to measure Cfree in pore water for 62 individual PAHs. A linear regression model was constructed to predict PAH levels in the edible fraction of butter clams from Cfree in porewater. This model presents a simplified and cost effective approach to assess the quality of this important, traditional food source avoiding the need to take clams from the ecosystem. Results from this work have been communicated to tribal communities through advisory meetings and local media. Recommendations were made to avoid clam harvesting in certain areas and to limit harvesting in others. Authors of this paper from Oregon State University have made several trips to interact with tribal members to better understand their culture and to get input from tribal members during research design. Tribal communities have expressed interest in utilizing the predictive capabilities of passive sampling to assess the safety of the clams and other traditional food sources.

Development of a novel equilibrium passive sampling strategy for methylmercury in sediment and soil porewaters

James P. Sanders and Upal Ghosh (University of Maryland, Baltimore County), Alyssa McBurney and Cynthia C. Gilmour (Smithsonian Environmental Research Center), Steven S. Brown (The Dow...
Chemical Company)
At many Superfund sites, mercury is an important driver of risk to ecological and human receptors, particularly when inorganic mercury is converted to the more toxic and bioaccumulative methylmercury (MeHg) by microorganisms. The bioavailability of MeHg to benthic invertebrates near the base of aquatic food webs is a critical consideration for contaminated site risk assessment and management. For many other persistent contaminants, passive sampling of porewaters represents an increasingly viable method of measuring bioavailability, but for MeHg, no passive sampling method has been widely accepted. To address this gap, we are developing a novel approach designed to generate equilibrium measurements of dissolved MeHg. Custom polymers containing activated carbon were prepared and evaluated in increasingly environmentally realistic experiments. In aqueous isotherm tests, polymers accumulated MeHg complexes in a proportional manner over a relevant range of water concentrations. In slurries of marsh soils from Berrys Creek, New Jersey, polymer-measured porewater concentrations were within a factor of two of direct instrumental measurements. In stagnant soil microcosms, polymers were similarly accurate, and time course data indicated that they equilibrated with porewater within 8 d. Polymer-water partitioning coefficients were remarkably consistent across experiments. Mechanistic studies showed that MeHg accumulation by sampling materials is relatively rapid, partially reversible, and characterized by internal diffusion rather than surface adsorption. These findings indicate the potential for dynamic equilibrium sampling. Ongoing work is aimed at correlating sampler measurements with accumulation by a benthic test organism in marsh soil microcosms. Sampling data will be used to support a bioaccumulation model to validate the device’s predictive capability. Ultimately, the sampler will enable more accurate monitoring and prediction of bioavailability under different site management scenarios.

Microbial assembly processes in marginal soils
James C. Stegen (Pacific Northwest National Laboratory); Julia W. Neilson (University of Arizona); Eoin Brodie (Lawrence Berkeley National Laboratory); Peter A. Troch (University of Arizona); Jon Chorover (University of Arizona); Raina M. Maier (University of Arizona)

In sub-surface environments, the biotic components are critically linked to abiotic processes. However, there is limited understanding of community establishment, functional associations, and community assembly processes of microbes in these environments. This study presents an analysis of microbial signatures in a marginal soil system. Starting with an incipient terrestrial basalt soil, sub-meter scale sampling revealed the contrasting distribution patterns of simple soil parameters such as bulk density and electrical conductivity. Phylogenetic analysis of 16S rRNA gene indicated the presence of a total 40 bacterial and archaeal phyla, with high relative abundance of Actinobacteria on the surface and highest abundance of Proteobacteria throughout the system. Community diversity patterns were inferred to be dependent on the depth profile and average water content in the system. Predicted functional gene analysis suggested mixotrophic lifestyles with both autotrophic and heterotrophic metabolisms, the likelihood of a unique salt tolerant methanogenic pathway with, signatures of an incomplete nitrogen cycle, and predicted enzymes of extracellular iron (II) to iron (III) conversion followed by intracellular uptake, transport and regulation. Microbial community assembly was predominantly governed by variable selection. The presence of significant heterogeneity in predicted functions in a homogeneous incipient basalt highlights the complexity exhibited by microorganisms even in the simplest of environmental systems. Similar research approaches can be translated to evaluate community assembly patterns in contaminated soils. This approach may be used to develop predictive estimates of how microbial communities establish, evolve, impact, and respond to contaminants over spatiotemporal scales. The outcome of this work has the potential to provide informed decision about Superfund site restorations and future site management strategies with respect to predictive microbial community structure, function, and assembly processes.
SESSION 4: Contaminant Fate and Transport

Understanding the fate of legacy mercury contamination in the floodplain in Berlin, New Hampshire

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The Androscoggin River near Berlin, NH flows past a Superfund site that, prior to 1962, was a chlor-alkali facility. Leakage of elemental Hg from the site directly into the river was reported during site characterization in the late 1990s and had likely been occurring for decades. Despite remediation efforts that concluded in 1999, elevated levels of Hg were observed in surface sediments and in the water directly adjacent to the site as recently as 2010. The objectives of this study were to: 1) evaluate the extent/concentration of Hg in the downstream floodplain, and 2) evaluate the fate of legacy floodplain Hg after deposition. Downstream floodplain sediments contain significantly elevated levels of Hg relative to upland soils and this is most likely due to fluvial input of particle-bound Hg from the site. Mercury concentrations are highest in bankfull floodplain sediments, reaching up to 10 µg/g as far as 5 km downstream of the site and remain elevated relative to background levels up to ~15 km downstream. Sequential extractions indicate that Hg in near channel sediments consists of organically-bound Hg(II) as well as a significant fraction comprised of inorganically-bound Hg. Soil pore water sampling also indicates a strong temporal variation in the floodplain; pore water Hg concentrations spike during snowmelt runoff and then decay through the summer. Our results suggest that the potential for contaminated floodplains to be a source of Hg to downstream ecosystems will strongly depend on hydrological and biogeochemical processes occurring in the floodplain. This diversity in potential may also indicate similar diversity in future risk of Hg mobilization due to climate change.

Scaling from Lab to Field: Exploring environmental variability on in-situ formation of biogenic magnetite for arsenic sequestration

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Arsenic remediation remains a difficult problem to address in contaminated aquifers. Recently, we have shown in the lab that in-situ formation of biogenic iron minerals including magnetite can be an effective remediation strategy. The magnetite produced in groundwater systems incorporates arsenic and other metals into its mixed valence iron mineral structure or retains the metals through adsorption. Magnetite is advantageous over other iron minerals because it is thermodynamically stable under a wide range of redox conditions. However, it can be difficult to scale up to field conditions where groundwater composition, sediments, and microbial communities have considerable variability. For example, the Lot 86 Superfund Site, in North Carolina, is a heterogeneous site with a saprolitic aquifer and high manganese concentrations where anthropogenic buried wastes resulted in groundwater contamination. Column experiments examined the effect of varying microbial and groundwater composition on trace metal incorporation into magnetite, in both arsenic-sorbed ferrihydrite and relevant saprolitic cuttings from North Carolina. We expect that high dissolved
manganese concentrations will change magnetite formation as manganese doping of magnetite has been shown to convert magnetite’s structure. With the arsenic-sorbed ferrihydrite, X-ray absorption spectroscopy analyses indicate that dissolved Mn concentrations may be inhibiting the system’s formation of magnetite, but that As is still strongly retained by the minerals that are produced. For North Carolina sediments, the sediment darkened visually during reaction, consistent with the formation of Fe minerals, and As was also retained. Generally, microbial co-cultures involved in Fe (III)-Fe (II) cycling and natural microbial communities showed more promising magnetite formation than single culture columns. Incorporating these data into a preliminary hydrological model can inform scale up from lab to field.

Direct observation and determination of the mechanisms governing mobility of asbestos in porous media

Ali Seiphoori (Department of Earth & Environmental Science, University of Pennsylvania), Douglas J. Jerolmack (Department of Earth & Environmental Science, University of Pennsylvania)

Transport of asbestos through soil by groundwater is typically considered to be negligible. There are indications, however, that under some conditions of pore-water/soil chemistry asbestos may become mobile, implying that buried contaminants could migrate from a disposal site and surface elsewhere. Shape, size and surface charge may influence the physical and chemical interactions of colloids with the soil matrix, and asbestos consists of elongated particles with different size and unique surface charge properties. Although chemical factors such as pH and ionic strength of pore water may affect the transport properties, the presence of dissolved organic carbon (DOC) has been identified to remarkably enhance the mobility of colloids including asbestos. To date, there is no explanation for how the presence of DOC may facilitate the mobilization of asbestos in soil - mainly because the soil medium has been treated as a black box without the possibility of observing particles within the matrix. Here, we investigated the mobility of chrysotile asbestos particles in porous media by developing a flow cell with an optically-transparent porous medium composed of granules of a refractive-index matched material. This enabled us to observe and track the particles within the water-saturated porous medium using in situ microscopy. The aqueous suspension of asbestos fibers was passed through this artificial soil, while the physical and chemical interaction of asbestos particles with the medium and their pore-scale distribution were analyzed. We studied the effects of changing solution chemistry (e.g., ionic strength, pH, and DOC content) on transport, attachment and aggregation of chrysotile particles. Experiments revealed a novel colloid-facilitated mobility mechanism where the DOC-associated nanoparticles attach to chrysotile fibers by an electrostatic attraction, which facilitates their mobilization through the porous medium while modulating aggregation among fibers. Although pH and ionic strength also influenced aggregation and the attachment rate of particles to the substrate, the effect of DOC was more pronounced. This work may lead to enhanced predictions for the fate and transport of asbestos (as well as other contaminants) in the environment, and has implications for the mobility of asbestos particles in the human body.

Characterization of a model reactive barrier for in situ bioremediation of chlorobenzenes at anaerobic-aerobic groundwater interfaces

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Bioremediation of persistent organic contaminants, such as chlorobenzenes (CBs), to innocuous end-products often requires both anaerobic and aerobic biodegradation processes for complete mineralization. CBs have accumulated in groundwater and wetland sediments at the Standard Chlorine of Delaware (SCD) Superfund Site and pose significant ecological and human health risks. Reductive dechlorination of higher chlorinated CBs under anaerobic conditions can lead to the
accumulation of daughter products such as monochlorobenzene and benzene, which are more toxic and bioavailable than their parent compounds. Aerobic biodegradation can readily mineralize less chlorinated daughter compounds to harmless end-products, however, oxygen availability often limits this degradation pathway in groundwater. In wetland sediments, natural anaerobic-aerobic gradients may potentially be leveraged to support both biodegradation pathways.

This research demonstrates an innovative in situ remediation technology using anaerobic and aerobic-degrading bacterial biofilms in a single permeable biobarrier to passively intercept and degrade CBs. Utilizing upflow column experiments to simulate biobarriers deployed at anaerobic-aerobic interfaces, we evaluate long-term column performance under various electron donor regimes to mimic site conditions. Preliminary results demonstrated substantial remediation of 1,2,4-trichlorobenzene; up to 3.5 mg/L were mineralized under O2-limiting conditions at a calculated ratio of 0.11 mol CB / mol O2. Ongoing experiments will assess the performance of this dual-biofilm barrier compared to more simple treatments using either single anaerobic or aerobic degradation pathways to assess added value for field-scale application. Results from these studies will help EPA and other stakeholders’ remediation decision-making at SCD, as well as provide a potential technological platform for future remediation projects at other contaminated sites.

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Research and translation of water quality and equity in California

Renee Wurth (Northeastern University); Rachel Morello-Frosch (University of California Berkeley); Carolina Balazs (University of California Berkeley)

Background: California is commonly in a drought, leaving water shortages that have greater impacts on vulnerable communities. Among these vulnerable groups are children and minorities, who primarily live and go to school in socioeconomically disadvantaged communities that are reliant on rural water systems that lack resources to improve quality.

Methods: Utilized spatial water system and school data to accurately link water quality data to all public schools in California. Used the spatial data to create heat maps that display the level of water quality for differently contaminant types by senate and assembly regions in California. Results: By using spatial analysis we (1) initiated analysis that will quantitatively show the differential impact on schools according to their water system type and sociodemographic factors of the area and children. We also (2) employed water quality data to show which senate and assembly regions have the highest levels of water contamination and compliance issues and created personalized fliers for each senator and assembly man or woman in those areas. Further (3) we took these results to the Capitol to lobby with representatives, while also giving a platform for community members to share their narratives with water inequality. Discussion: Through quantitative research designed towards community needs we created visual reports on water quality in California and shared findings with relevant politicians as well as providing a platform for community stake holders.

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SESSION 5: Emerging and re-emerging Superfund Issues

Volatile PCB Health Risk: Living next to the largest marine Superfund site in the USA

Wendy Heiger-Bernays¹, Kathryn Tomsho¹, Zoe Petropoulos¹, Komal Basra¹, Kathryn Crawford¹, Keri Hornbuckle², Andres Martinez², and Madeleine K. Scammell¹

¹Boston University Superfund Research Program; ²Iowa Superfund Research Program

New Bedford Harbor (NBH) is an 18,000-acre Superfund site in Massachusetts, surrounded by four towns. The US Environmental Protection Agency placed NBH on the National Priorities List in 1982 because of high concentrations of PCBs measured in the water and sediment. In response to health concerns raised by residents living near NBH, we designed a monitoring program to measure congener-specific PCB concentrations in the ambient air around NBH. We collected four rounds of
monitoring data at 18 locations for six weeks each. No significant difference was observed between the concentrations measured before and during active dredging, however, total PCB concentrations correlated with distance to the harbor. A systematic review of the literature on inhaled PCB toxicity indicates the thyroid as a target organ for PCB toxicity. Several other outcomes, including immune system effects and cancers are also observed in animals and people. Neurobehavioral outcomes, diabetes and decreases in testosterone may be explained by physiological changes that result from thyroid hormone level modulation. Estimates of the Margin of Exposure suggest that at the highest concentrations measured in the ambient air around NBH, changes in thyroid hormone levels are possible among people living nearby. Using EPA-type risk assessment methodologies, we found cancer risk estimates due to inhalation of air from the harbor are below one additional cancer case in a population of a million people. This work was conducted in response to, and in collaboration with, community members and Toxics Action Center, New England. All of our data, analyses and manuscripts will be made freely available. We shared all materials and results with residents, MassDEP and EPA Region 1 prior to public release or presentation.

Embryonic exposures to perfluorobutanesulfonic acid (PFBS) impair growth and pancreatic organogenesis in the zebrafish, Danio rerio
Karilyn E. Sant, Olivia L. Venezia, Paul P. Sinno, and Alicia Timme-Laragy

Department of Environmental Health Sciences, University of Massachusetts Amherst

Since phase-out of highly persistent perfluorosulfonates from American non-stick and stain-resistant products in the early 2000s, perfluorobutanesulfonic acid (PFBS) has replaced these compounds as a primary surfactant. Compared to other longer chain perfluorosulfonates which have human half-lives of 5-10 years, PFBS has a half-life in the human body of just over 1 month. Environmental, ecological, and human concentrations of PFBS have been steadily rising in recent years, raising concerns about potential negative health effects. We have previously found that embryonic exposures to a related and more persistent compound, perfluorooctanesulfonic acid (PFOS), decreased pancreas length and insulin-producing islet area in zebrafish embryos (Danio rerio). The objective of this study was to identify the extent to which embryonic PFBS exposures disrupt pancreatic organogenesis and to compare these findings with historical PFOS toxicity data. Zebrafish embryos were exposed to 0 (0.01% DMSO), 16, or 32 µM PFBS daily beginning at 1 day post fertilization (dpf) until microscopic examination at 4 and 7 dpf. Embryos from two different transgenic fish lines (Tg(insulin:GFP) and Tg(ptf1a:GFP) were examined using fluorescent microscopy for islet area and total exocrine pancreas length, respectively. Embryos exposed to PFBS had increased incidence of tail and spinal deformities, and delayed inflation of the swim bladder. PFBS embryos were shorter than control embryos, and had 5-13% shorter pancreata. Islet areas decreased by 12-13% due to PFBS treatment, but to a lesser degree than historical PFOS data. Overall, this work suggests that developmental exposures to PFBS can perturb embryonic development and pancreatic organogenesis, and that further risk assessment is warranted.

Preliminary Assessment of Surface Metal Contamination at an Electronics Recycling Facility that only Performed Sorting and Refurbishing
Diana Ceballos, Ariane Dumas*, Robert Herrick

Harvard T.H. Chan School of Public Health; *Masters student

Electronic waste includes a wide variety of electronic and electrical equipment such as discarded computers, batteries, and television sets. High exposures to metals such as lead, cadmium, nickel, have been documented in electronics recycling facilities that shred or process electronics. These facilities often employ vulnerable workers such as non-English speaking immigrants and prisoners. However, little has been documented about the potential exposures in facilities where only sorting and refurbishing occurs.
The number of enterprises doing only sorting and refurbishing has not been accurately documented. Expert industry sources report large numbers of these small facilities with limited health and safety capability.

We performed surface sampling at a facility using NIOSH 9102 method for assessing migration of 29 metals from production (7 samples in sorting and refurbishing) to non-production areas (3 samples in office and dining areas). We also made observations and talked to management. The facility employed 6 permanent staff workers and had up 12 volunteers including elderly and special needs high school student.

We found that many surfaces had metals at levels below laboratory reporting limits or lower than other U.S. facilities that recycle electronics. However, some surfaces were positive (23µg lead/sample, 88µg copper/sample, 11µg barium/sample) in the dining area, suggesting potential migration from the production areas (≤40µg lead/sample, 190µg copper/sample, ≤36µg barium/sample).

We recommended the facility should implement regular and effective cleaning of surfaces, ideally with a lead-removing product, in areas such as offices and dining areas to ensure they are as free as practicable from contaminants. Workers should also frequently clean their hands with lead-removing products, especially before eating. There is a need for greater hazards awareness in electronics sorting and refurbishing facilities.

Challenges in Assessing Risk from Exposure to Water and Soil Contaminated by Hurricane Harvey Flooding

Jennifer A. Horney, PhD, MPH; Galen Newman, PhD; Weihsueh Chu, PhD; Thomas McDonald, PhD (Texas A&M University)

Introduction: The Superfund Research Center (SRC) at Texas A&M (TAMU) is focused on tools and models that address exposure to complex mixtures during emergency contamination events. With 52 inches or rain falling on Houston - a metropolitan area larger than New Jersey with 6 million residents and >20 Superfund sites – flooding from Hurricane Harvey exposed residents to a variety of chemicals and toxins. Methods: Researchers, media, and local agencies conducted sampling in Houston following Hurricane Harvey. The CEC of the TAMU SRC, in coordination with Projects 1, 3, and community partners, collected samples of surface water and soil one week after Hurricane Harvey. Samples were analyzed by gas chromatography-mass spectrometry to assess for the presence of metals, polycyclic aromatic hydrocarbons, and by-products of wastewater treatment. Results: Analysis of samples for which we had baseline, pre-disaster data was prioritized. All samples had evidence of sterols, metals, and PAHs. Research Translation Component: While analysis of samples collected immediately following Hurricane Harvey provide basic toxicological understanding of potential exposure among residents of Houston environmental justice neighborhoods, results of laboratory analyses are easily misunderstood by residents, policy makers, and the media. For example, media outlets focused on “high levels of the carcinogen benzene” leading residents to worry about elevated risks for childhood leukemia. While measured levels greatly exceeded EPA reference concentrations, existing guidelines provide little information about the magnitude of risk. CEC and RTC worked together to develop visual risk communication materials for residents to better communicate risk, given potential exposures prior to Hurricane Harvey or afterwards as part of the cleanup.

KC Donnelly Project: Targeted outreach to promote private well testing and identify unsafe arsenic wells

Sara Flanagan,1,2 Steve Spayd,3 Nick Procopio,3 Jessie Gleason,4 and Yan Zheng,1,5

1Lamont-Doherty Earth Observatory, Columbia University, 2City University of New York Graduate
Naturally occurring arsenic is a public health threat for those relying on unregulated private well water. Presently, the greatest barrier to exposure reduction is a lack of well testing; most households in affected areas have never tested, in part due to low awareness and optimistic risk biases. Precautionary action research suggests interventions to raise awareness with personally-relevant risk information may help overcome such biases and provoke testing. New Jersey’s Private Well Testing Act has since 2002 required arsenic testing during home sales; the resulting database of over 35,000 geocoded well tests is an opportunity to test personally-relevant targeted outreach in arsenic-affected areas. Residents of properties (n=1743) located within 1000 feet of a well found to have arsenic above 5 µg/L were mailed a notice of the high arsenic result in their neighborhood and offered a free test. Overall 16% requested a test kit and 13% submitted a water sample, with significantly higher participation among those told that the neighborhood well had an arsenic concentration over 5 times higher than the drinking water standard, compared to those told the concentration was above it. Most testing participants (70%) had never tested their well for arsenic before; 80% of them didn’t know arsenic was a problem in their area. Overall 25% of wells tested (n=230) exceeded 5 µg/L; both the arsenic level of and distance to the neighboring well were significant predictors of exceedance. Given the high proportion of untested wells, this intervention succeeded in motivating testing among many households unreached by previous awareness-raising activities and identified arsenic problems among a significant portion, demonstrating the effectiveness of geographically and personally-relevant risk targeted messaging and outreach.

Session 6: Advances in determining susceptibility to Superfund contaminants

Dioxin-like PCB 126 increases systemic inflammation and accelerates atherosclerosis in lean LDL receptor deficient mice

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Exposure to dioxins and related persistent organic pollutants likely contribute to cardiovascular disease (CVD) risk through multiple mechanisms including the induction of chronic inflammation. Multiple epidemiological studies have shown that leaner individuals may be more susceptible to the detrimental effects of lipophilic environmental toxins because they lack large adipose tissue depots that can accumulate and sequester these pollutants in more obese individuals. This phenomenon complicates efforts to study mechanisms of pollutant toxicity in animal models. We investigated whether a model dioxin-like pollutant, PCB 126, could increase inflammation and accelerate atherosclerosis in Ldlr -/- mice fed a low-fat atherogenic diet. We fed Ldlr -/- mice the Clinton/Cybulsky proatherogenic diet (10% kcal fat, 0.15% cholesterol) and sacrificed mice at 8, 10, or 12 weeks post PCB (2 doses of 1 µmol/kg) or vehicle gavage. To characterize this novel model, we examined the effects of PCB 126 on markers of systemic inflammation, hematological indices, fatty livers, and atherosclerotic lesion size. Mice exposed to PCB 126 exhibited significantly increased plasma cytokine levels, increased circulating biomarkers of CVD, altered platelet and red blood cell counts, increased accumulation of hepatic fatty acids, and accelerated atherosclerotic lesion
formation in the aortic root. PCBs also increased circulating neutrophils, monocytes, and macrophages as determined by flow cytometry analysis. Exposure to dioxin-like PCB 126 increases inflammation and accelerates atherosclerosis in mice. Translational component: This low-fat atherogenic diet provides a useful tool to study the mechanisms linking exposure to lipophilic pollutants to increased risk of CVD.

Identification of Genetic Modulators of TCDD-induced B-cell Dysfunction using a Population-Based Approach

Melanie Warren, Bob Crawford, Norbert Kaminski, David Threadgill, John J. LaPres

Department of Biochemistry and Molecular Biology, Michigan State University; Institute for Integrative Toxicology, Michigan State University; Interdisciplinary Program in Toxicology, Texas A&M University; Department of Pharmacology and Toxicology, Michigan State University

Traditionally, toxicological studies have not accounted for the remarkable diversity in responses to xenobiotic exposures seen across large groups of individuals. As common laboratory models used to assess risk do not incorporate genetic diversity, sub-populations that may be more susceptible to toxicant-mediated injury may not be included within exposure-guidelines. Previous reports from our lab have established a large degree of interindividual variability in 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)-induced suppression of human B cells. Here, we used primary B cells from 12 inbred mouse strains to scan for genetic modulators that impact TCDD-induced suppression of human B cell function. Comparison between the human and mouse data showed a correlation between the interindividual differences in response to TCDD. Using quantitative trait loci (QTL) analysis, a region of chromosome 1 was found to be significantly associated with the TCDD-induced inhibition in the number of antibody secreting cells (p=0.031). A gene within this region called Serpinb2, which encodes for plasminogen activator inhibitor 2 (PAI-2), is dysregulated by TCDD in mouse and human B cells. Further analysis indicated 4 putative dioxin response elements within 25 kb of the Serpinb2 promoter. Time-course exposure of a susceptible mouse strain (C57BL6/J) with a less-susceptible strain (DBA/1J) to TCDD identified significant differences between strains for Serpinb2 gene (n=3, p=0.009) and protein (n=4, p<0.001) expression. Finally, B cells isolated from Serpinb2-/- mice were found to be more sensitive to TCDD-induced suppression as compared to wildtype mice (n=3; p=0.037). As such, our results not only indicate that this gene plays a protective role against TCDD-mediated immunosuppression, but also suggests a novel function of Serpinb2/PAI-2 within humoral immunity.

Investigation of Nutritional Biomarkers Associated with Metabolism of Inorganic Arsenic and Infant Birthweight

Jessica E. Laine, Vesna Ilievski, David Richardson, Amy H. Herring, Miroslav Styblo, Marisela Rubio-Andrade, Gonzalo Garcia-Vargas, Mary V. Gamble, and Rebecca C. Fry

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The prenatal period represents a critical window of susceptibility to arsenic (As) exposure. Differences in pregnant women’s metabolism of As, as indicated by increases in monomethyl- arsenicals (%MMAs) and decreases in di-methyl arsenicals (%DMAs) in urine, are risk factors for adverse birth
outcomes. One carbon metabolism (OCM), a nutritionally-regulated pathway essential for supplying methyl groups, plays a role in As metabolism. In this study from the Biomarkers of Exposure to ARSenic (BEAR) pregnancy cohort in Gómez Palacio, Mexico, we assessed the relationships between OCM indicators (e.g. maternal serum B12, folate, and homocysteine (Hcys)), and levels of As and its metabolites in maternal urine and in neonatal cord serum. We evaluated the relationship between OCM indicators, As metabolism, and infant birthweight using mediation analyses. Infants born to mothers in the lowest tertile of serum folate had significantly higher mean levels of %MMAs in cord serum relative to folate replete women. In addition, elevated maternal Hcys (Hcys levels >10.4 μmol/L) was positively associated with As in maternal urine and cord serum as well as cord serum %MMAs. The average birthweight z-score was lower among infants born to mothers with both lower folate (< median) and deficient in B12 (< 148 pmol/L) as compared to infants born to higher folate (median) and B12 sufficient mothers (p = 0.0015). Furthermore, inefficient maternal metabolism of As in combination with lower folate status had a greater impact on the association of B12 deficiency on infant birthweights than when As metabolism was efficient. The results from this study illustrate the public health significance for pregnant women as it pertains to interactions between nutrition and toxicants for the health of their infants.

Adult mice exposed in utero to arsenic via maternal drinking water exhibit enhanced inflammatory and immunopathologic responses to acute influenza A infection

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1Dartmouth School of Graduate and Advanced Studies, Dartmouth College, 2Program in Experimental and Molecular Medicine, and 3Dartmouth Toxic Metals Superfund Research Program, Geisel School of Medicine at Dartmouth College, 4Departments of Medicine, and 5Microbiology and Immunology, Geisel School of Medicine, Lebanon NH

Arsenic (As) exposure via drinking water is an important environmental health concern that affects millions of individuals in the United States. A population that is uniquely at risk are those exposed to As in utero. Epidemiological studies suggest a strong association between in utero As exposure and incidence of enhanced morbidity associated with subsequent childhood respiratory infections. Studies of murine exposure to in utero As suggest that this may result in an altered immune responses to respiratory virus infection in newborn mice. However it is unclear whether these effects persist after maturation into adulthood. We employed a murine model of influenza A (IAV) to determine whether in utero arsenic exposure leads to enhanced adult animal inflammatory and immunopathology responses to infection, as well as to characterize the immunological alterations responsible for the inflammatory phenotype. Our results suggest that adult animals subjected to in utero As exposure exhibit enhanced inflammatory responses to IAV infection. Furthermore, our preliminary data suggest that early hyper inflammatory activation by IAV-infected alveolar macrophages drive and amplify the observed immunopathology responses in developmentally exposed mature animals. These data suggest that in utero As exposure may affect immune responses and health outcomes long after drinking water remediation. Additionally, our results support the importance of raising public awareness of the long-term risks of in utero As exposure well into adulthood.

Biosynthesis of Estrogens in Mesothelioma Cancer Cells and Effect on Cell Growth

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1Department of Systems Pharmacology and Experimental Therapeutics, University of Pennsylvania; 2Center of Excellence in Environmental Toxicology, University of Pennsylvania; 3Center for Cancer Pharmacology, University of Pennsylvania; 4Center for Research on Reproduction and Women’s Health, University of Pennsylvania

Malignant mesothelioma (MM) is a highly aggressive cancer with only about 10% patients surviving
The disease is associated with occupational and environmental exposure to asbestos, however, a higher prevalence of MM is seen in women due to environmental exposure. Inverse correlations between the levels of estradiol (E2), the most potent estrogenic hormone in women, and mesothelioma cancer patient survival post diagnosis suggests that decreased E2 levels inhibits mesothelioma cancer growth. Here we investigated whether MM cells could conduct denovo synthesis of the estrogenic metabolites estrone (E1) and E2 via the aromatase pathway using 4-androstene-3,17-dione (4-Adione) and testosterone (T) as precursors or via the sulfatase and 17beta-hydroxysteroid dehydrogenase pathway using E2 sulfate as substrate. We also determined whether the estrogenic metabolite 5-androstene-3b,17b-diol (5-Adiol) could be formed from DHEA. All steroid measurements were made using stable isotope dilution liquid chromatography tandem mass spectrometry (LC-MS/MS). These metabolites were also tested to see if they affect MM cell growth. Our results showed that in MSTO-211H MM cells, E1 and E2S are converted to E2; by contrast the aromatase substrates 4-Adione and T were not converted to E1 or E2. In REN cells, only the conversion of E2S to E2 was observed. These data support the dominance of the sulfatase pathway over the aromatase pathway for estrogen synthesis in MM. We also showed that 5-Adiol is formed from the precursor DHEA in MSTO-211H cells. Our preliminary data showed that T and E2 modulated MM cell growth. This is the first documentation that MM can form estrogenic metabolites from precursors. This study will not only improve our understanding of the roles of estrogens and androgens in mesothelioma, but will also determine whether inhibiting steroid synthesis or using adjuvant hormonal therapy has a role in the treatment of mesothelioma. [Supported by a Pilot-Project from P30-E013508 funded by the National Institute of Environmental Health Sciences].

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SUPERFUND RESEARCH PROGRAM CENTERS’ ABSTRACTS


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The BU Superfund Research Program (BUSRP) is populated by investigators and trainees from Boston University, the Wood Hole Oceanographic Institution and the Harvard School of Public Health and focuses primarily on contaminants found in and around the New Bedford Harbor Superfund site and in drinking water of communities in the Buzzard’s Bay and Cape Cod area. NBH, an 18,000 acre estuarine Superfund site, has extremely high levels of PCBs (historically up to 100 mg/g in sediment; 0.1-1 mg/g dry weight in killifish) and other industrial wastes of significant concern to the surrounding communities and to federal and state agencies who are attempting remediation. The theme that links all components, Long-term impacts of early life exposure to Superfund chemicals in humans and wildlife, is an emerging area of special interest to the NIEHS, USEPA, and other regulatory agencies in part because of the implications for newly appreciated Superfund chemical exposure outcomes, including transgenerational effects and aberrant adolescent behavior. The BUSRP’s overarching objective is to address the Program theme while meeting specific goals articulated by the national SRP. The Program has four specific aims: 1) Carry out multidisciplinary human and wildlife population-based research integrated with mechanistic studies in animal models. This aim addresses the SRP mandate to perform mechanistic and/or mode of action research that includes laborator- and population-based studies. Two complementing epidemiological studies, three laboratory/field-based projects, and a supporting service core address the effects of early life exposure on adolescent and adult behavior, the integrity of developing biologic systems (bone, adipose tissue, brain), and alterations in gene programming or gene pool selection across generations, all emerging environmental health issues. 2) Transmit scientific results to affected communities through bidirectional partnerships. The CEC will expand and enhance its trust-based, bidirectional relationships with partners and stakeholders through targeted communication strategies, encouraging open access, and sharing scientific information and resources. 3) Respond to and alert scientists and government stakeholders to environmental issues of most concern to affected communities. The RTC, with the CEC, investigators, and trainees, will provide scientific expertise in response to concerns in the NBH/Buzzard’s Bay/Cape Cod area, expanding educational initiatives, developing prevention and intervention strategies, and coordinating multidirectional public and government sponsored interactions. 4) Train and mentor young investigators in inter- and transdisciplinary approaches to resolving complex human and ecological health issues resulting from exposure to hazardous substances. The Training Core will implement a program leveraging resources within BU and WHOI to provide interdisciplinary training and mentoring and to teach trainees how to communicate findings to SRP partners and stakeholders.
2. Massachusetts Institute of Technology Superfund Research Program

Bevin Engelward\textsuperscript{1,2} (Program Director), John Essigmann\textsuperscript{1,2,3} (Co-Program Director), Sophea Chan\textsuperscript{2}, Robert Croy\textsuperscript{2}, Harold Hemon\textsuperscript{2,4}, Jesse Kroll\textsuperscript{2,4,8}, Douglas Lauffenburger\textsuperscript{1,2}, Leona Samson\textsuperscript{1,2,5}, Noelle Selin\textsuperscript{2,6,7}, Timothy Swager\textsuperscript{2,3}, Amanda Tat\textsuperscript{2}, Kathleen Vandiver\textsuperscript{2}, Forest White\textsuperscript{1,2}.

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The Massachusetts Institute of Technology Superfund Research Program (MIT SRP) brings engineering and scientific innovation to bear on critical problems relevant to stakeholders in Maine and Massachusetts. Their problem-oriented program centers around two pervasive contaminants, N-nitrosamines (potently carcinogenic to animals) and PAHs (carcinogenic to people). Both these contaminants are present in multiple Superfund Sites and they continue to be produced by ongoing industrial activities today. Native Americans in Maine and people living in the Mystic River Watershed in Massachusetts have expressed serious concerns about contaminants in their environments. In both locations, people are negatively impacted by legacy contaminants, and in both cases, there are Environmental Justice communities of concern. To address their concerns, the MIT SRP aims to develop novel sensors and engineering tools to predict the distribution and composition of pollutants. This work will guide decision making regarding safety and remediation. By also studying cellular and physiological responses (in terms of cell signaling, mutations, and cancer), the team will help to reveal what makes some people more susceptible to cancer than others, and will develop tools to predict and mitigate disease. The bi-directional program is based on established relationships with stakeholders. The team continues to grow relationships with the Massachusetts Department of Public Health, the Agency for Toxic Substances and Disease Registry, the U.S. Environmental Protection Agency, the NIEHS, and Tribal Leaders. Embedded in all of the MIT SRP activities are training opportunities for undergraduates, graduate students and postdocs, thus supporting the next generation. Taken together, the MIT SRP enables risk reduction, guidance for remediation, and support for policy decisions, thus having a direct and measurable impact on public health.

3. University of Washington Superfund Research Program

Evan Gallagher, Zhengui Xia, Clement Furlong, Lucio Costa, Rebecca Neumann, James Gawel, Theo Bammler, Thomas Burbacher

The University of Washington Superfund Research Program investigates the mechanisms and ramifications of metal neurotoxicity in humans and aquatic species. Our Center supports four Research Projects and five Cores (Functional Genomics and Bioinformatics, Research Translation, Community Engagement, Training and Administration Core). The four research projects are: (1) mechanisms and biomarkers of metal olfactory injury to Pacific salmon, with a primary focus on cadmium; (2) cellular and molecular mechanisms of cadmium-mediated neurotoxicity in rodents, including effects on olfaction and cognition; (3) the role of paraoxonases as modifiers of cadmium and manganese neurotoxicity; and (4) biogeochemistry and bioavailability of arsenic in an urbanized shallow lake system in Washington State. The research projects focus on metals that commonly occur at Superfund hazardous waste sites for which there are critical data gaps impeding the full understanding of their neurotoxic effects on human health and viability of aquatic species. The Functional Genomics Core supports the research projects by providing expertise in molecular based technologies and bioinformatics analysis. The Research Translation Core assists investigators in disseminating their research results and interacts with agencies such as the Region 10 EPA to apply current research outcomes to improve public health. The Community Engagement Core provides support for local nonprofit organizations such as the Northwest Toxics Community Coalition to help them reduce environmental pollution in their communities. The Training Core provides opportunities
for graduate students to be involved in all aspects of the program and the Administration Core provides the overall management of resources for the program. Our four pre-doctoral Trainees will share their research at the meeting poster session. We encourage you to learn more about the UW SRP through their work.

4. Health Effects and Geochemistry of Arsenic: The Columbia University NIEHS Superfund Research Program

Joseph H. Graziano1, Habibul Ahsan2, Mary V. Gamble1, Benjamin Bostick3, Steven Chillrud3, Sandra Baptista4, Stuart Braman3, Yan Zheng3,5,6, Sara Flanagan3,5,6, Brian Mailloux7, Nancy Lolacono1, Ana Navas-Acien1, Alexander van Geen3

1Department of Environmental Health Sciences, Columbia University Mailman School of Public Health, New York, NY; 2Departments of Public Health Sciences, Medicine and Human Genetics and Comprehensive Cancer Center, The University of Chicago, Chicago, IL; 3Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY; 4Center for International Earth Science Information Network, The Earth Institute, Columbia University, Palisades, NY; 5School of Earth and Environmental Sciences, Queens College, City University of New York, Flushing, NY; 6Graduate School of Public Health and Health Policy, City University of New York, New York, NY; 7Department of Environmental Sciences, Barnard College, New York, NY

The contamination of water with arsenic (As) is associated with major public health and mitigation issues in the U.S. This proposal includes two biomedical and two geoscience projects designed to reduce As exposure and toxicity in human populations in the U.S. and in Bangladesh.

We build on our existing cohort of 35,000 adults in Bangladesh examining dose-response relationships between As from food and water with incident cases of cardiovascular disease (CVD), non-malignant lung disease, and diabetes mellitus. We will combine and meta-analyze data from Bangladesh, Taiwan, China (Inner Mongolia) and the U.S. to refine the dose-response relationships between As exposure and CVD. Building off previous findings in adults, we propose a randomized clinical trial in 8-10 year old children in Bangladesh to test the hypothesis that folate+B12 supplementation lowers blood As.

Building on our previous geoscience research, which indicates that in situ magnetite formation forms a diffuse barrier capable of long-term As retention, we propose laboratory and field research to optimize and implement this approach at a U.S. Geological Survey research site and a Superfund site. In Bangladesh, we will quantify geographic and socio-political barriers to reducing As exposure and will examine the vulnerability of shallow and deep aquifers that are low in As.

We partner with state and local governments to reduce As exposure in communities that rely on As-contaminated household wells and facilitate effective communication among our SRP scientists, stakeholders and government partners. Finally, we will continue to training the next generation of scientists, to enable them to improve the health of those who reside in environments that might expose them to As and other contaminants in soil, water and food.

5. UC Davis Superfund Research Center: Biomarkers of Exposure to Hazardous Substances.

Bruce Hammock1, Tom Young2

1Department of Entomology and Nematology and Comprehensive Cancer Center, University of California, Davis, CA 95616; 2Department of Civil and Environmental Engineering, University of California, Davis, CA 95616

The University of California Davis Superfund Research Center broadly focuses on (a) gaining an understanding of the biological and toxicological mechanisms by which hazardous chemicals produce adverse health effects, (b) developing, validating and integrating novel mechanism-based biomarkers,
bioassays and instrumental methods for evaluating exposure, levels of contamination, and health risks from exposure to these chemicals, and (c) developing novel remediation strategies to reduce the toxicity of hazardous substances. To achieve these goals the SRC consists of 5 integrated projects, 2 research support cores, a training core, a community engagement core, a research translation core and an administrative core. The UCD-SRC will use integrated chromatographic, biosensor and cell based technologies to detect and identify contaminants and develop innovative approaches for bioremediation. Rapid immunochemical and cell based analysis will supplement classical technologies for the evaluation of sites, as well as determining human susceptibility, exposure and effect. Fundamental mechanisms of toxic action of selected chemicals will be explored to predict risk and develop new biomarkers. This mechanistic knowledge will be extended in vivo with an emphasis on mechanism of toxicity. We are expanding the use of transcriptomics, proteomics, metabolomics and integrated bioinformatics technologies to discover new mechanisms of action of hazardous materials and biomarkers for their action and to connect hazardous substance exposures to organism level effects. The biomarkers developed in this project will serve as biological dosimeters in exposure studies. All aspects of the program will be connected to our Community Engagement Core, and subject to community approval will be demonstrated on Yurok Tribal Lands. Technologies developed by the SRC will be tested at field sites and transferred to end users through a research translation core.

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6. University of New Mexico Metal Exposure and Toxicity Assessment on Tribal Lands in the Southwest (UNM METALS): Reducing Risks to Tribal Populations with Exposure to Abandoned Uranium Mine Waste

Johnnye Lewis, PhD

The UNM Metal Exposure and Toxicity Assessment on Tribal Lands in the Southwest (METALS) Superfund Research Program (SRP) will focus on risk reduction for Native Americans exposed to hazardous metals mixtures from abandoned uranium mine waste. Specifically, the Environmental projects will improve understanding of biogeochemical, mineralogic, and physical properties in waste samples and airborne dusts at the respirable scale using electron microscopy and spectroscopy. The Biomedical projects focus on how metals mixtures promote DNA damage, immune dysregulation, inflammation, and autoimmunity. Our previous work has demonstrated that uranium mine waste exposures significantly contribute to these health outcomes in tribal populations. Recognizing that complete remediation of these sites remains decades away, the UNM center will also develop and implement trans-generational approaches to risk communication and risk avoidance. The Center will expand ongoing, developed partnerships with three Native American communities living in close proximity to unique waste sites. Each of these sites has unique mineralogical and geochemical properties leading to distinct exposure pathways by which vulnerable communities may be impacted. As a new center funded in August, we have had introductory meetings with our community partners to discuss the background research on which the center will build multidirectional communication and start to identify new strategic initiatives. A composite of those presentations will be presented at this meeting. In summary, we will work closely with communities and tribal and federal agencies to develop informed Superfund prioritization based on site-specific factors identified through our research, and develop solutions that build on site properties to immobilize and remove metals, reduce risk in ways that are holistic, predictable and sustainable, and test biological interventions to reduce toxicity.

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7. Introducing URI-led STEEP (Sources, Transport, Exposure and Effects of PFASs) SRP

Rainer Lohmann, Graduate School of Oceanography at University of Rhode Island, Philippe Grandjean, Harvard T.H. Chan School of Public Health, Geoff Bothun, College of Engineering at University of Rhode Island, Bongsup Cho, College of Pharmacy at University of Rhode Island, Alyson
McCann, College of Environment and Life Sciences at University of Rhode Island, Amber Neville, Coastal Institute at University of Rhode Island, *Nicole E. Rohr, Coastal Institute at University of Rhode Island, Laurel Schaider, Silent Spring Institute, Angela Slitt, College of Pharmacy at University of Rhode Island, Elsie Sunderland, Harvard T.H. Chan School of Public Health, Judith Swift, Coastal Institute at University of Rhode Island (*Presenting Author)

The newly initiated URI STEEP SRP is co-led by Rainer Lohmann (URI) and Philippe Grandjean (HU) with collaboration from the Silent Spring Institute. STEEP will address the emerging and expanding problem of per- and polyfluorinated alkyl substance (PFAS) contamination, which have gained national prominence in recent years following the discovery of drinking water contamination across the US (e.g., Hoosick Falls, NY) and increasing research needs of ATSDR and EPA to effectively regulate PFASs to protect environmental and human health.

STEEP aims to better understand the pathways of PFASs contamination from entry into the environment through groundwater contamination, dispersal through the food web, and distribution to vulnerable human populations during early development, in part through breast milk. Specifically, STEEP will:

- Characterize sources of PFASs through in situ groundwater measurements combined with geochemical modeling to assess transport and fate;
- Assess the relationship of PFASs to risk of immune dysfunction and metabolic abnormalities and derive benchmark doses levels;
- Focus on the impact of in utero and early postnatal PFAS exposures on sensitive indicators of organ dysfunctions through parallel human epidemiologic studies and rodent model studies; and
- Develop and deploy in situ passive sampling techniques for PFASs and their precursors in water.

To ensure a legacy of scientific awareness, STEEP Cores match the intensity and rigor of the research projects to:

- Prepare the next generation of interdisciplinary emerging contaminant researchers;
- Translate scientific findings for dissemination to various internal and external stakeholders; and
- Engage Cape Cod communities exposed to PFAS-contaminated drinking water.

The STEEP SRP will improve scientific understanding of PFASs and enhance public understanding to inform regulations to protect environmental and public health.”

8. Texas A&M University Superfund Research Center: Comprehensive tools and models for addressing exposure to mixtures during environmental emergency-related contamination events

Ivan Rusyn¹ and Anthony H. Knap²

¹Department of Veterinary Integrative Biosciences, College of Veterinary Medicine and Biomedical Sciences, and ²Geochemical and Environmental Research Group, College of Geosciences, Texas A&M University, College Station, TX

Climate change and shifts in domestic economic activity markedly increase risks from catastrophic chemical contamination events resulting from weather-related or anthropogenic emergencies. The complexities of hazardous chemical exposures, potential adverse health impacts, and the need to rapidly and comprehensively evaluate the potential hazards of exposures to complex mixtures call for novel approaches in the Superfund Research Program. This Center brings together a team of scientists from biomedical, geosciences, data science and engineering disciplines to design comprehensive solutions for complex exposure- and hazard-related challenges. Our overall theme is to characterize and manage both existing and environmental emergency-created hazardous waste sites through the development of the tools that can be used by first responders, the impacted
communities, and the government bodies involved in site management and cleanup. Our case study is a hurricane or flooding event that impacts Galveston Bay/Houston Ship Channel area and leads to exposure to contaminated sediments. In addition, in response to Hurricane Harvey our Center is studying exposure pathways that followed a different disaster scenario, one that involved a massive rain event and mobilization of contaminants on land and into the marine environment. Project 1 is studying fate and transport of complex environmental contaminants in sediments and incorporate this information into environmental models. Project 2 is developing novel low-cost broad-acting sorption materials suitable for mitigation of acute exposures to complex contaminant mixtures. Projects 3 and 4 take advantage of the discoveries in cell imaging and stem cell biology to establish predictive in vitro methods for quantitative evaluation of the complex mixture-perturbed adverse outcome pathways and intra- and inter-individual variability in toxicity. An Exposure Science Core is developing and applying novel sensitive analytical methods for targeted and un-targeted analysis of a broad array of contaminants in environmental and biological samples. A Data Science Core is developing computational and statistical tools for analysis and integration of BIG DATA in environmental health. A Decision Science Core is developing an integrated toxicokinetic, human health, and economic models to support environmental health decisions. The Center is actively engaged with community organizations and public health practitioners in Texas to address health concerns of the populations that have been and may be impacted by environmental emergency-related contamination events. We train students and postdoctoral fellows in inter-disciplinary approaches across our scientific areas, decision making and emergency response. The research translation to local, state, national and international stakeholders is conducted through technology transfer and comprehensive outreach for the solutions developed by the Center. Finally, the management of this program is conducted in close partnership with the administration at Texas A&M University and Health Science Center, the NIEHS-funded Center for Translational Environmental Health Research, and overseen by the advisors representing academia, federal and state agencies, industry and a non-governmental organization.

9. Louisville Superfund Center, Diabetes and Obesity Center, and Institute of Molecular Cardiology, University of Louisville, Louisville, Kentucky

The Louisville Superfund Center supports research on the cardiometabolic effects of volatile organic chemicals (VOCs) that are of high relevance to the Superfund Program. VOCs are abundant in combustion products, paints, wood preservatives, cleansers, and disinfectants. High levels of VOCs are present at several Superfund sites. The major objectives of the Center are to conduct state-of-the-art research on the cardiometabolic toxicity of VOCs and to determine how they affect cardiometabolic disease prevalence and severity in exposed populations. Center investigators will conduct mode-of-action research to unravel critical pathways of toxicity and to identify cardiometabolic changes of chemicals (VOCs) found at Superfund and related sites. Using animal experiments and human population studies, Center investigations will aid in the discovery and validation of novel biomarkers of both exposure and cardiometabolic injury. These studies will be complemented by mode-of-action mechanistic studies in animals to identify the molecular and cellular mechanisms that contribute to VOC toxicity. In addition, work supported by the Center will lead to the development of new methods and devices for quantifying atmospheric levels of VOCs that will employ advanced technologies and offer precise, but low-cost measurements of hazardous waste sites. Senior Center members will educate and train junior investigators, graduate students, and post-doctoral Fellows in the field of environmental science, and promote relevant community awareness and participation to enhance mutual bidirectional understanding of exposure risk and the health effects of exposure. The findings and discoveries of the Center will be transferred to affected communities, end users in public and private sectors, and other stakeholders. Collectively, Center activities will lead to rigorous evaluation and better understanding of the effects of VOCs on obesity, diabetes, and cardiovascular disease.
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**RESEARCH TRANSLATION AND COMMUNITY ENGAGEMENT CORES’ ABSTRACTS**

1. **NIEHS tools to evaluate economic impacts of environmental health research**

Sharon Beard, Christie Drew, Pat Mastin, Molly Puente, Barbara Gittleman, Michelle Heacock, Alfonso Latoni, Ruth Lunn, Sheila Newton, Kristi Pettibone, Kimberly Thigpen-Tart, Mary Wolfe, Demia Wright

In 2012 NIEHS released a set of strategic plan goals that will help us achieve our mission and vision for environmental health science. Goal 10 focuses on evaluating the economic impact of policies, practices, and behaviors that reduce exposure to environmental toxicants, through prevention of disease and disabilities, and investing in research programs to test how prevention improves public health and minimizes economic burden. We have growing portfolio of NIEHS supported research that uses health care data to understand the impact of environmental exposures on health outcomes. To encourage our grantees to incorporate environmental health economic analyses into their research proposals, we have prepared a poster to promote resources that are available to support and facilitate environmental health economic analysis. The poster highlights an annotated bibliography we have created that researchers can use to quickly find examples of environmental health research that has incorporated economic analyses. The poster provides ideas about sources of economic data and information about resources available from other agencies, such as BenMap from the EPA. The poster also highlights examples of environmental health economic analysis that NIEHS has funded.

2. **BerryCare: Community Partnerships to Increase Consumption of Phytonutrient-rich Blackberries among Older Adults**

Dawn Brewer, PhD, RDN, LD (University of Kentucky CE Core Leader); Annie Koempel, RDN, LD (University of Kentucky CE Core Program Manager); Kelci McHugh (University of Kentucky CE Core Trainee)

Background: The University of Kentucky’s Superfund Research Center’s (UK-SRC) Community Engagement Core (CEC) engages with Kentucky communities to provide nutrition and environmental health education. Recent activities targeted seniors because they are vulnerable to the detrimental health effects of environmental pollution accumulated over their lifetime. Additionally, the natural processes of ageing impair the ability of the body to effectively respond to environmental stressors. The inclusion of phytonutrients, naturally-occurring compounds in plant-based foods, in the diet is associated with the mitigation of the negative health effects of environmental pollutants. The purpose of the BerryCare pilot program is to provide rural Kentucky senior center attendees with a sustainable source of phytonutrient-rich blackberries through the establishment of partnership among UK-CEC, a senior center, a rehabilitation facility, and Cooperative Extension.

Study Design: Forty-five blackberry bushes were planted at a rural Kentucky senior center. Six nutrition lessons developed by UK-CEC were presented by Family and Consumer Science (FCS) Extension Agent and Horticulture Extension representatives. Knowledge change and physical measurements were assessed pre- and post-lessons and a focus group was conducted to evaluate initial program successes and challenges.

Results: Participants (n=20) were primarily white (76.9%) and female (70%), ages 55-83. There were no significant changes in knowledge or physical measurements following lessons. Focus group data revealed the establishment of a successful community partnership as well as identification of several program successes and lessons learned unique to a senior population and the growing of blackberries.

Conclusion: Year 1 of the two-year blackberry project has established a successful partnership between UK-CEC and several community organizations intended to provide senior center attendees a sustainable source of phytonutrient-rich blackberries.
3. Update on private well arsenic-testing outreach pilot through health care providers

Steven Chirrud, Stuart Braman, Sara Flanagan, Jessie Gleason, Steve Spayd, Nick Procopio, Ana Navas-Acien, and Joseph Graziano

Columbia University Lamont-Doherty Earth Observatory; New Jersey Department of Health; New Jersey Department of Environmental Protection; Columbia University Mailman School of Public Health

Arsenic in drinking water is colorless, odorless and tasteless; its presence can only be determined by testing. Exposure in utero and during early life increases risks of adverse health impacts from arsenic; a high priority is to target private well households with pregnancies and young children. Because health care providers are trusted communicators of health information, the Columbia SRP in collaboration with NJDEP and NJDOH this year began a pilot program to offer free drinking water tests for arsenic and lead to patients of three family practices and one OB/GYN practice in Hunterdon County. Over 16% of private wells in Hunterdon exceed the NJ standard for arsenic in drinking water, yet most private wells have still never been tested for arsenic. A Grand Rounds talk at the Hunterdon Medical Center followed by kickoff events at the practices presented on the high prevalence of arsenic in local private wells and risks to unborn babies and children based in part on Columbia SRP work in Bangladesh and New England. We have created key facts sheets for health care providers, informational brochures and posters for exam and waiting rooms, and test kits which are distributed through the practices. Periodic e-newsletters highlighting the health effects of arsenic are distributed among practice partners. To date, water samples have been submitted by 57 households, which combined include 5 pregnancies and 66 children, and arsenic has exceeded 5 μg/L in 12% of samples tested. We continue to work with our healthcare partners to develop and test strategies to improve uptake of test kits and return of water samples, as well as to better target our priority population of prenatal and pediatric patients.

4. University of Washington Superfund Community Engagement Core

Katie Frevert, Thomas Burbacher

The UW SRP Community Engagement Core (CEC) serves as a key integrating element in the University of Washington Superfund Research Program. The Core has the responsibility of assisting UW SRP investigators and trainees in building bi-directional relationships with community members and agencies involved in hazardous waste site cleanup. The primary role of the CEC within the UW SRP is to work with community stakeholders and associated local, state and federal agencies to improve public health through developing strategies that reduce community exposures to hazardous substances. The longest on-going partnership the Core has is with the Duwamish River Cleanup Coalition, Technical Advisory Group for Seattle’s Lower Duwamish Waterway (LDW) Superfund site. Working together as the cleanup proceeds through the remediation process, effective strategies have been implemented that address subsistence fishing in the waterway with the goal of protecting the health of the public by reducing exposure to known contaminants in the fish. In the last year our CEC staff has worked closely with Public Health Seattle King County and with the non-profit organization ‘Just Heal Action,’ in their partnership with the Washington State Department of Fish and Wildlife to inform fishers about fishing rules as well as identifying where fishing is safe.

Since 2007, the Core also has partnered with the Northwest Toxic Communities Coalition, a non-profit umbrella organization in EPA Region 10 that serves as a conduit of relevant information and resources for its member organizations. The core has provided assistance with organizing summits for members to interact in-person, coordinating webinars on topics of shared interest and developing workshops focused on environmental health hazards in their communities in response to requests from coalition members.
5. Capacity Building for Transdisciplinary Collaboration

Lauren Heberle ¹, PhD, Lindsay K. Tompkins ², MS, Kandi L. Walker ³, PhD, and Joy L. Hart ³, PhD

¹ Department of Sociology, ² School of Public Health and Information Sciences, ³ Department of Communication, University of Louisville and ULSRC (Note: Tompkins presenting author)

Toxicant exposure can initiate/exacerbate multiple health problems, especially cardiometabolic diseases that include many chronic conditions, ones that disproportionately affect Kentuckians. It is critical to understand why certain communities are more highly impacted than others. Therefore, an overarching goal of the newly formed University of Louisville Superfund Research Center (ULSRC) is to better understand the health impacts of exposure to volatile organic compounds (VOCs) in three “hot spot” areas of Louisville, Kentucky. It is our hypothesis that exposure to VOCs initiates/exacerbates cardiometabolic conditions. To more fully understand and better mitigate such effects, the ULSRC is collaborating with the communities most affected. These communities have high concentrations of people living in poverty and racial minorities, groups likely to experience disproportionate health effects.

Toward fostering close collaborative relationships, the ULSRC’s Community Engagement Core (CEC) is comprised of community members and investigators. Through this core, multiple participation strategies will be employed, listening valued, and agreements reached on how community members and researchers can collaborate in achieving joint goals. Frequent interaction and ongoing communication between community members and investigators contribute to relationship development and are expected to enhance collaborative agreements. Rather than employing more traditional models of community outreach, the CEC relies on a multidirectional collaborative investigatory model, where relationships across participants are equalized with all stakeholders contributing.

Additionally, the CEC is integrated into multiple ULSRC cores and, beyond cultivating community relationships, will also examine potential change in community member and investigator knowledge and attitudes. Given that few investigations have examined such influences on investigators, this research is positioned to make unique contributions. In this poster presentation, we describe the structure of ULSRC’s CEC, highlight opportunities, and examine potential challenges/obstacles.

6. Volatile PCB Health Risk: Living next to the largest marine Superfund site in the USA

Wendy Heiger-Bernays ¹, Kathryn Tomsho ¹, Zoe Petropoulos ¹, Komal Basra ¹, Kathryn Crawford ¹, Keri Hornbuckle ², Andres Martinez ², and Madeleine K. Scammell ¹

¹Boston University Superfund Research Program, ²Iowa Superfund Research Program

New Bedford Harbor (NBH) is an 18,000-acre Superfund site in Massachusetts, surrounded by four towns. The US Environmental Protection Agency placed NBH on the National Priorities List in 1982 because of high concentrations of PCBs measured in the water and sediment. In response to health concerns raised by residents living near NBH, we designed a monitoring program to measure congener-specific PCB concentrations in the ambient air around NBH. We collected four rounds of monitoring data at 18 locations for six weeks each. No significant difference was observed between the concentrations measured before and during active dredging, however, total PCB concentrations correlated with distance to the harbor. A systematic review of the literature on inhaled PCB toxicity indicates the thyroid as a target organ for PCB toxicity. Several other outcomes, including immune system effects and cancers are also observed in animals and people. Neurobehavioral outcomes, diabetes and decreases in testosterone may be explained by physiological changes that result from thyroid hormone level modulation. Estimates of the Margin of Exposure suggest that at the highest concentrations measured in the ambient air around NBH, changes in thyroid hormone levels are possible among people living nearby. Using EPA-type risk assessment methodologies, we found
cancer risk estimates due to inhalation of air from the harbor are below one additional cancer case in a population of a million people.

This work was conducted in response to, and in collaboration with, community members and Toxics Action Center, New England. All of our data, analyses and manuscripts will be made freely available. We shared all materials and results with residents, MassDEP and EPA Region 1 prior to public release or presentation.

7. Challenges in Assessing Risk from Exposure to Water and Soil Contaminated by Hurricane Harvey Flooding

Jennifer A. Horney, PHD, MPH; Galen Newman, PhD; Weihsueh Chu, PhD; Thomas McDonald, PhD

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Introduction: The Superfund Research Center (SRC) at Texas A&M (TAMU) is focused on tools and models that address exposure to complex mixtures during emergency contamination events. With 52 inches or rain falling on Houston – a metropolitan area larger than New Jersey with 6 million residents and >20 Superfund sites – flooding from Hurricane Harvey exposed residents to a variety of chemicals and toxins.

Methods: Researchers, media, and local agencies conducted sampling in Houston following Hurricane Harvey. The CEC of the TAMU SRC, in coordination with Projects 1, 3, and community partners, collected samples of surface water and soil one week after Hurricane Harvey. Samples were analyzed by gas chromatography–mass spectrometry to assess for the presence of metals, polycyclic aromatic hydrocarbons, and by-products of wastewater treatment.

Results: Analysis of samples for which we had baseline, pre-disaster data was prioritized. All samples had evidence of sterols, metals, and PAHs. Research Translation Component: While analysis of samples collected immediately following Hurricane Harvey provide basic toxicological understanding of potential exposure among residents of Houston environmental justice neighborhoods, results of laboratory analyses are easily misunderstood by residents, policy makers, and the media. For example, media outlets focused on “high levels of the carcinogen benzene” leading residents to worry about elevated risks for childhood leukemia. While measured levels greatly exceeded EPA reference concentrations, existing guidelines provide little information about the magnitude of risk. CEC and RTC worked together to develop visual risk communication materials for residents to better communicate risk, given potential exposures prior to Hurricane Harvey or afterwards as part of the cleanup.

8. Continuing to Combat Polychlorinated Biphenyls in Schools

Ashlee Johannes, Engagement Coordinator of Community Engagement Core, Iowa Superfund Research Program, The University of Iowa and Craig Just, Director of Community Engagement Core, Iowa Superfund Research Program, The University of Iowa

Fourteen million students are potentially exposed to polychlorinated biphenyls (PCBs) based on the number of schools built with PCB-containing materials during 1950 to 1979 (1). Due to this concerning exposure among the adolescent population, The ABCs of PCBs: A Toxic Threat to America’s Schools by the Office of Senator Edward J. Markey established six key findings (1):

1) PCB hazards in schools is likely widespread and surfacing from a variety of sources
2) Potential cases of PCB hazards in schools remains unknown due to the lack of requirements at the federal level, and often state, for school inspections
3) Inconsistent communication and lack of transparency between schools, EPA, states, and those affected by a PCB hazard remains unresolved
(4) Each EPA region has a different approach for tracking PCB hazards, enforcing reparative actions, and communicating with local educational agencies about PCBs.

(5) Response to and remediation of PCB hazards in schools have been improper and ineffective with further uncertainty of effectiveness due to no testing requirements of PCBs postremediation.

(6) Limited funding impedes state and local education agencies ability to perform testing, respond to, or remediate PCBs in schools.

Targeting these key findings, the Iowa Superfund Research Program (isrp) continues to partner with schools on establishing a PCB-free environment.

The isrp collaborated with America Unites for Kids to measure and remediate Malibu schools of PCBs. In this case against the Santa Monica-Malibu Unified School District, the ruling stated all PCBs must be removed from their schools. In result of this collaboration and several others, the isrp seeks to expand its role with PCBs in schools by increasing engagement with agencies involved with PCB mitigation efforts. References: 1Senator Edward J. Markey’s (D-Mass.) new report “The ABC’s of PCBs: A Toxic Threat to America’s Schools”. October 2016.

9. Cultural competency among university-based researchers for working with Native American Tribes

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Established in 2013, the Community Engagement Core (CEC) in Oregon State University’s Superfund Research Program works with Native American Tribes to investigate their concerns about environmental pollution. Integral to this mission is the development of cultural capacity among university-based environmental health researchers so that they can work more effectively with Native American Tribes. The activities developed by the CEC to cultural relativity of environmental health science research have included: 1) day long workshop highlighting best practices for acknowledging Tribal sovereignty and developing research projects with Tribes, 2) integrating university-based science projects in Tribal communities, 3) having university-based researchers attend cultural tours conducted by a Tribal Elder and staff member, 4) presenting research findings to Tribal partners at community meetings, and 5) interacting with Tribal Community Advisory Boards. To evaluate the effectiveness of these activities, we conducted an internal evaluation that comprised a structured questionnaire and in person qualitative interviews. The results of this evaluation showed that SRP-affiliated university-scientists had a high degree of understanding of data sharing agreements that acknowledge Tribal sovereignty with regards to scientific data and interpretation. We also found that participating in a cultural tour with the Tribal Elder and staff member increased knowledge of cultural context that is important to understanding Native American perspectives. However, knowledge of vocabulary and cultural context relevant to Native American experiences is still low among SRP-based researchers who have not attending a cultural tour.

10. Understanding the Catch: Fish Consumption Surveys and Fish Tissue Testing in the Elizabeth River Area of Virginia

Charlotte Clark, Director, Research Translation Core, Duke University Superfund Research Center; Bryan Luukinen, Sr. Program Coordinator, Research Translation and Community Engagement Cores, Duke University Superfund Research Center; Gretchen Kroeger Foley; Savannah Volkoff, PhD Student, Duke University Superfund Research Center; Joe Rieger, Deputy Director of Restoration, Elizabeth River Project; Richard Di Giulio, Director, Duke University Superfund Research Center
The Duke University SRP Center has a long history of research and engagement in the Elizabeth River area of Virginia, led by Center Co-Director Richard Di Giulio and his research on Atlantic killifish. PCBs are also a contaminant of concern and the fish consumption advisory for PCBs includes bluefish, croaker, spot, and striped bass, among others. Two NIEHS supplemental grants provided funding for us to better understand fishing in the area and to better characterize PCBs in fish species not on the advisory. In summer 2015, we surveyed 60 anglers in-person on the Elizabeth River and 231 registered anglers in the Hampton Roads area by email to learn more about their perceptions of the advisory and their fish consumption behaviors. We also caught and tested red drum and speckled trout for the presence of PCBs, because those fish had not previously been evaluated. We learned that both species contain PCBs at levels above the VA DEQ criteria of 20 ppb, but below the VDH criteria of 100 ppb that triggers the fish consumption advisory. Of individuals we surveyed, very few women of child-bearing age or children violate the fish advisory. Our survey results indicate that the majority of anglers surveyed are not aware of the advisory, consume fish on the advisory more often than recommended, and are not being reached with information through their preferred channels. We shared our preliminary findings in a presentation for VA DEQ with Elizabeth River Project in the Spring of 2016. We will share our findings and recommendations with a larger group of stakeholders, including community groups, VA DEQ, VDH, and EPA Region 4, in November, 2017.

11. After more than 35,000 Samples of Homeowners wells in New Jersey, can we detect temporal trends in groundwater arsenic?

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Stuart Braman, Lamont Doherty Earth Observatory, Columbia University, Palisades, NY 10964; Steven Chillrud, Lamont Doherty Earth Observatory, Columbia University, Palisades, NY 10964; Mark Bakker, Water Management Department, Technical University Delft, Delft Netherlands; Brian Mailloux, Department of Environmental Science, Barnard College, New York NY 10027

Naturally-occurring arsenic in groundwater is a concern for homeowners with private wells in the United States. The New Jersey Private Well Testing Act (PWTA) requires arsenic testing whenever a house with a private well is sold. Through the PWTA, 35,500 wells have been sampled for arsenic between 2001 and 2014. Some wells have been sampled multiple times. The overall goal of this SRP-NJDEP partnership is to develop a method that can regularly evaluate the NJ PWTA data for temporal changes in arsenic in unique wells. Households with 2 or 3 samples were monitored for unidirectional trends and households with 4 to 6 samples were analyzed using statistical trend analyses. By 2014, the NJ PWTA data contained 5,438 households with 2 samples, 805 households with 3 samples and 127 households with 4 or more samples, with 6 being the largest. In wells tested twice, 85% had both samples either below the State’s 5 ug/L MCL or below the detection limit, and another 7% of the wells had one of the duplicate pair below 5 ug/L with the other above 5, with another 6% showing similar concentrations above 5 ug/L. The data show well-specific arsenic concentrations have changed in a low percentage of the wells, and the number with an increasing concentration trend are roughly matched by those that decrease. Overall these results indicate that multiple laboratories have produced consistent data and that the primary concern in NJ is intervention in areas with high arsenic concentrations and testing of additional private wells, not temporal changes in arsenic.

12. A tale of two Superfund sites: A comparison between the EPA’s remediation of a Superfund site then and now

Jessica Meeker, MPH, Michael Anderson, Richard Pepino, MSS, Edward Emmett, MD

The US-EPA uses the same Risk Assessment Guidance for Superfund (RAGS) that they have since the documents’ inception in 1989. The EPA has published a number of addendums to the RAGS over
the years. However, this model still provides the primary guidance to the preparation of the human health evaluation activities conducted during the baseline risk assessment. The EPA, in conjunction with ATSDR, is responsible for determining an acceptable risk level for each contaminant present at a Superfund site on the National Priority List (NPL). This risk level is the point at which ill health effects are unlikely and probability of disease is small. The EPA listed the Ambler Piles Superfund site, located in Ambler, PA, to the NPL list in 1986. In accordance with the RAGS guidelines it was cleaned up and taken off the NPL in 1996. The BoRit Superfund site, also located in Ambler, did not initially qualify for listing on the NPL. Its original ranking was based upon the threshold scoring using the EPA’s risk assessment model. In 2008 BoRit was listed on the NPL, and the EPA is currently finishing up the cleanup. The twenty-year gap in NPL listing offers a comparison between how the EPA operated then versus now. The potential variation between the EPA’s approach to the Record of Decision and community involvement, as well as the degree to which environmental safeguards were offered under each remediation, will be considered. Although the EPA still operates under the same guidelines that they did in the 1980s, this comparison will give insight into how the approach and priority of the EPA has changed over the years.

13. UC Davis Superfund Research Program & Yurok Tribe Environmental Program: Collaboration to address contamination in the Klamath Watershed

Elizabeth Middleton, Suzanne Fluharty, Assistant Director, Ecosystem and Community Health Division, Yurok Tribe Environmental Program;

Louisa McCovey, Program Director, Yurok Tribe Environmental Program; Kaitlin Reed, PhD student, Dept. of Native American Studies, UC Davis

Researchers from the Yurok Tribal Environmental Program (YTEP) and the UC Davis Superfund Research Program (UCD SRP) are beginning a collaboration to identify residues, degradation bi-products, and levels of previously unanalyzed contaminants in the Klamath watershed and their potential effects. Primary sources of contamination in the Lower Klamath include chemical applications from large-scale illegal marijuana cultivation, industrial timber management, and legacy pollution from historic milling and mining. YTEP and UCD SRP researchers will collaborate to develop and implement culturally appropriate field deployable bioassays for local tribal. These bioassays will serve as innovative chemical sensing tools to identify contaminants with completed exposure pathways in Tribal and community members. It is hoped that by sharing this technology and information that the decision-making making power over both individual health and the health of the Tribal environment will return to the Tribal community, generating an increased sense of empowerment and self-determination. This will, in turn, allow a lessening of the psycho-social factors that contribute to overall negative health impacts. This collaborative work will be accomplished through bi-directional training on (1) tribally specific pathways of exposure and key considerations for working in sovereign, indigenous contexts; (2) specific technologies for environmental health monitoring; and (3) remediation strategies for identified contaminants. Through this process, the UCD SRP, Community Engagement Core (CEC) will bridge the gap between university-based laboratory science, university and tribal fieldwork, and local community knowledge by partnering with the Yurok Tribe as a sovereign nation.

14. The Healthy Places Science Gateway Project: Creating a Resource for Healthy Community Design and PlaceMaking that is Sustainable, Resilient and Regenerative

Keith Pezzoli, Ilya Zaslavsky, Thomas Whitenack, Kelsey Lindner, Leslie Lewis (UC San Diego)

Science gateways provide a novel approach to creating research environments integrating online community tools and data collections with the purpose to facilitate and sustain access to resources for scientists, students, and allied partnerships. In collaboration with the NSF-funded Science Gateways
project, UC San Diego’s Superfund Research Center’s Research Translation and Community Engagement teams are key participants in the creation of a Healthy Places Science Gateway. The Gateway will provide ready access to online data visualization and analysis tools for what the CDC calls healthy community design. These include mapping applications that portray environmental and health data in the San Diego – Tijuana cross-border region and facilitate data collection and analysis effort of students, researchers, government and community partners. The Healthy Places Science Gateway aims to provide essential cyberinfrastructure needed for Citizen Science and Bioregional Knowledge Networking led by UC San Diego’s new Bioregional Center for Sustainability Science, Planning and Design; and the San Diego Supercomputer Center. Our goal is to develop an online toolkit for exploring potential impacts of various social, economic, environmental and genetic factors on public health at a small-area scale, in particular to improve capacity for detecting and remediating hepatotoxic Superfund chemicals with a focus on toxicant-induced liver disease, especially toxicant associated steatohepatitis (TASH). The Healthy Places Science Gateway focus area is southeastern San Diego, with several disadvantaged neighborhoods, where the population is subject to cumulative impacts of exposures to environmental toxicants, poor nutrition, and higher levels of obesity and poverty. We will demonstrate the initial collection of tools and results of students projects anchored on the emerging Gateway infrastructure. Project support from NIEHS under award P42ES010337 is gratefully acknowledged.

15. Building a Culture of Health in the Green: Gardens as Hubs for Citizen Science and Environmental Health Literacy Efforts in Underserved Communities.

Ramírez-Andreotta MD\(^1,2\), Bohlman M\(^1\), Sandhaus S,\(^1\) and Kaufmann D\(^3\)

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Gardens have been shown to help address social and economic constraints on health by increasing access to wholesome foods, improving community building efforts, enhancing well-being, and reducing the cost of food. Home and community gardening are on the rise and community revitalization efforts may be diminished if these gardens are located in environmentally compromised spaces. Co-created citizen science projects are designed by both the public and researchers and the public is involved in most steps of the research process. This process begins with an alignment of community concern and research expertise. Gardenroots: A Citizen Science Project is the product of a needs assessment, which revealed gardener’s concerns regarding environmental quality due to their proximity to resource extraction activities. Two-hundred and sixty-seven plant, 174 water, and 125 soil samples were collected by 54 participants and delivered for analysis. Trained Gardenroots participants collected and submitted garden samples for analysis in 2015 and later received their data (individual and aggregated) in 2016 via community gatherings or mail. To date, only a limited number of co-created citizen science projects have been initiated in medically underserved areas, and even less in conjunction with risk communication. Using an informal science learning approach, low-cost sampling kits, and a cultural model of risk and environmental communication, this project aims to: 1) co-produce environmental monitoring, exposure assessment, and risk data in a form that will be directly relevant to the participant’s lives, 2) increase the community’s involvement in environmental decision-making, and 3) improve environmental education and literacy (e.g. individual learning and socialecological outcomes) in rural and/or underserved communities.

Key Words: Citizen science, public participation in scientific research, environmental monitoring, environmental health literacy, Superfund sites, Plant uptake of metals, vegetables, mining waste, Home-gardens, exposure assessment, risk communication
16. Introducing URI-led STEEP (Sources, Transport, Exposure and Effects of PFASs) SRP

Rainer Lohmann, Graduate School of Oceanography at University of Rhode Island; Philippe Grandjean, Harvard T.H. Chan School of Public Health; Geoff Bothun, College of Engineering at University of Rhode Island; Bongsup Cho, College of Pharmacy at University of Rhode Island; Alyson McCann, College of Environment and Life Sciences at University of Rhode Island; Amber Neville, Coastal Institute at University of Rhode Island; *Nicole E. Rohr, Coastal Institute at University of Rhode Island; Laurel Schaider, Silent Spring Institute; Angela Slitt, College of Pharmacy at University of Rhode Island; Elsie Sunderland, Harvard T.H. Chan School of Public Health; Judith Swift, Coastal Institute at University of Rhode Island; *Presenting Author

The newly initiated URI STEEP SRP is co-led by Rainer Lohmann (URI) and Philippe Grandjean (HU) with collaboration from the Silent Spring Institute. STEEP will address the emerging and expanding problem of per- and polyfluorinated alkyl substance (PFAS) contamination, which have gained national prominence in recent years following the discovery of drinking water contamination across the US (e.g., Hoosick Falls, NY) and increasing research needs of ATSDR and EPA to effectively regulate PFASs to protect environmental and human health.

STEEP aims to better understand the pathways of PFASs contamination from entry into the environment through groundwater contamination, dispersal through the food web, and distribution to vulnerable human populations during early development, in part through breast milk. Specifically, STEEP will:

- Characterize sources of PFASs through in situ groundwater measurements combined with geochemical modeling to assess transport and fate;
- Assess the relationship of PFASs to risk of immune dysfunction and metabolic abnormalities and derive benchmark doses levels;
- Focus on the impact of in utero and early postnatal PFAS exposures on sensitive indicators of organ dysfunctions through parallel human epidemiologic studies and rodent model studies; and
- Develop and deploy in situ passive sampling techniques for PFASs and their precursors in water.
- To ensure a legacy of scientific awareness, STEEP Cores match the intensity and rigor of the research projects to:
  - Prepare the next generation of interdisciplinary emerging contaminant researchers;
  - Translate scientific findings for dissemination to various internal and external stakeholders; and
  - Engage Cape Cod communities exposed to PFAS-contaminated drinking water.

The STEEP SRP will improve scientific understanding of PFASs and enhance public understanding to inform regulations to protect environmental and public health.

17. Multi-directional Community Engagement in Native American Communities Partnering with the UNM M.E.T.A.L.S. Superfund Research Program

Chris Shuey, MPH (Southwest Research and Information Center); David Begay, Ph.D. (Indigenous Education Institute and University of New Mexico); Wm. Paul Robinson (Southwest Research and Information Center), University of New Mexico SRP Program

The University of New Mexico (UNM) M.E.T.A.L.S. Superfund Research Program will focus on risk reduction in Native American communities affected by abandoned uranium mines. The UNM METALS (Metal Exposure and Toxicity Assessment on Tribal Lands in the Southwest) Program expands on long-standing relationships with three native communities in New Mexico and Arizona, using multi-directional community engagement and research translation to develop and implement trans-
generational approaches to risk communication and risk avoidance. As a newly funded center, we have had introductory meetings with our community partners to discuss the background research on which the center will build and to identify new initiatives to reduce risk from chronic exposures to hazardous substances in uranium mine wastes. Recently, UNM METALS presented its work at an open house sponsored by the Pueblo of Laguna, one of our partners. The event, attended by more than 50 community members, highlighted the complimentary work of university researchers with that of regulatory agencies characterizing the Jackpile Uranium Mine NPL site. Our group presented seven posters highlighting ongoing research in uranium mobility, modeling of airborne sub-micron mine dusts, and collaborative approaches to engaging the communities in biomedical projects. This event allowed us to provide relevant health information, expand our communications network, and document community health concerns. Ongoing partnerships among UNM, tribal agencies, and the Southwest Research and Information Center (SRIC) give us a leg up on meeting the goals of the UNM METALS SRP. By effectively integrating advances in environmental health research with indigenous knowledge, we aim to engage tribal communities in developing risk reduction/intervention strategies while working with tribal agencies to inform remediation policy and practice and to define future research needs.

18. Michigan Safe Fish Mobile App
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Fish is an excellent food source that is high in nutrients, an excellent source of proteins, minerals and vitamin D and omega 3 fatty acids. Consumption of 1-2 weekly servings of fish have been linked to lower rates of cardiovascular diseases, depression, and age related cognitive decline. However, fish are often a sink for environmental contaminants, thus consumption of fish poses exposure risks to these contaminants. The state of Michigan has developed a fish advisory program that balances the health benefits vs. risks of eating fish from both supermarkets and the waterways of Michigan. The purpose of this Fish App is to connect the community to information about the risk of toxic chemicals when present in fish caught in local waters as well as fish consumed from the market. So it is important to educate the public on safe portion sizes and allowable frequency of consumption. In addition to providing information to the user, the bodyweight of the user can be selected and the app will provide a safe portion size (eg. if a person weighs between 46 and 90 lb, a maximum portion size of 4 oz. is recommended). A points system (called Eat 8!) is also used to help track the amount of portions consumed each month. This is particularly important because certain fish are higher risk for containing chemicals. Other information is provided about methods of reducing exposure risks when consuming fish, including choosing fish low in chemicals, cleaning catches properly, and cooking well. To enhance the user experience, other features of the app including a “Fish ID” in which the user can scroll through pictures of fish that are present in local waters to identify a catch. The catch and location can also be stored in the database. An important functionality is also to provide the user access to the “Eat Safe Fish Guidelines”, which is information provided by the MDHHS about fish caught in local waters by county and menu for “Frequently Asked Questions”.

19. Health Professionals’ Knowledge of Environmental Factors Affecting Health
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The Research Translation Core, in coordination with the Community Outreach and Translation Core of CRECE Center for Research on Early Childhood Exposure and Development in Puerto Rico (Children's Environmental Health Center), works on a multi-level approach to studying health professionals' awareness of environmental factors in disease, as well as ways to improve that awareness. We conducted surveys on practicing speech-language pathologists (SLPs) (N=26), SLP MA student trainees (N=22) and nursing students (N=23) to determine their level of knowledge with respect to environmental factors affecting health, especially on early childhood development. We conducted an online and in person survey of various categories of health providers (N=46) in Puerto Rico. Following the initial survey, we provided participants with an educational session. Pre-and post-session evaluations showed that while most participants understand that environmental factors are important, there is little or no training for in-take and evaluation of patient environmental health history; however, there was an increase in awareness and knowledge after the session. In order to support the health professional’s access to the facts about environmental factors in reproductive health we have already published a bulletin in both English and Spanish, geared to physicians and nurses. Survey instruments on environmental health knowledge have been prepared for administration at physician, nurses, and psychologists conferences, and nursing schools to be administered over the next year.

20. Investigating Knowledge of Healthcare Provider Education and Attitudes About Environmental Health Threats and Outcomes in Puerto Rico (PR)

Colleen Murphy¹, Carmen M. Vélez Vega¹, Phil Brown², Stephanie Clark², Xavier Lopez Leon¹, Zulmarie Diaz Reguero¹, Nancy Cardona¹, Lorena Cortes Torres¹, José F Cordero³, Akram Alshawabkeh⁴

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The Institute of Medicine recommends increased education regarding environmental determinants of health among healthcare providers (HCPs). However, studies reveal deficiencies in environmental health (EH) knowledge among them. HCPs may recognize that environmental hazards have potential negative impact on patient health, but many do not conduct EH exposure histories with their patient due to lack of education and time. Building off existing research that is currently taking place through the Superfund Research Program, PROTECT (PR Testsite for Exploring Contamination Threats) provides an ideal location for examining questions about perceptions of HCPs in Puerto Rico on EH. PROTECT is well-suited to investigate perceptions and practices pertaining to emerging understanding of EH contaminant exposures.

Methods: An anonymous questionnaire, administered in person and online via Survey Monkey was used to identify perceptions of EH knowledge across HCPs employed by community health centers in PR. Descriptive analysis of participant responses was conducted. Results: Respondents indicate low levels of knowledge and education relating to EH effects on patient health. Additionally, responses indicate lack of preparedness to address EH related interventions and an increased desire for education regarding EH knowledge.

Conclusion: HCPs who acknowledge the importance of environmental determinants of health incorporate this knowledge into their professional practice. However, the majority of respondents do not have knowledge of EH, providing an opportunity to develop programming for education. The passing of hurricanes Irma and Maria have left Puerto Rico devastated on innumerable levels; intensifying the already alarming EH risks. Study results and subsequent EH education will be provided to HCPs in Community Health Centers; future RTC/CEC activities will include EH education to HCPs at a broader level.
21. Responses to Aftermath of Hurricanes Irma and Maria in Puerto Rico

Carmen M. Velez Vega¹, Gredia Huerta-Montañez¹, Colleen Murphy¹, Héctor Torres¹, Zaira Rosario¹, Natacha Guilloty¹,  Lilliana González¹, Krizia Santos¹, Carlos Vergara¹, Abigail Figueroa¹, Phil Brown², John Meeker³, Rita Loch-Caruso³, Ingrid Padilla⁴, Dorothy Vesper⁵, Roger Giese², April Gu², David Kaeli², Ljiljana Rajic², Thomas Sheahan², Jose F. Cordero⁶, Akram N. Alshawabkeh²

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Since Hurricanes Irma and Maria hit Puerto Rico, the PROTECT and CRECE Center Teams have been collaborating with outside groups to ensure the safety and welfare of affected communities in terms of providing necessary supplies and medicine, water filtrations systems and developing educational materials related to safe food and water consumption during this emergency. The PROTECT and CRECE team have research partnerships with four Federally Qualified Community Health Centers (CHCs) in Puerto Rico, to identify the needs that are of highest priority in Puerto Rican communities (e.g., drinking water, mosquito repellent, mosquito nets, disposable diapers, baby food). Attention has been focused on the communities surrounding Superfund sites such as Dorado which is of greatest concern due to reports of contaminated drinking water in this area. To address the influences of hurricanes in these sensitive areas, a group of PROTECT and CRECE student volunteers works toward educating the community members on the potential health impacts of water use and ways to prevent them. Through collaborative work with companies (i.e., Vestergaard Frandsen, Jesuit Corporation of San Ignacio de Loyola) and researchers from the groups outside PROTECT and CRECE including Dr. Tim Dye at the University of Rochester Medical Center, the water filtration systems are set up in a Puerto Rican CHSs. Further, the responses to concerns and questions from the affected communities have been coordinated by PROTECT, CRECE and Boston University’s SRP CEC and RTC Cores by leveraging the expertise of scientists in Puerto Rico, on the mainland, and in Canada.
**Poster Presentations**

**Wednesday, December 6, 2017**

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**PLEASE NOTE:** Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
DAY 1 POSTER PRESENTATIONS’ ABSTRACTS

D1-1-HS. Benzene exposure is associated with cardiovascular disease risk in humans and mice


Louisville Superfund Center, Diabetes and Obesity Center, and Institute of Molecular Cardiology, University of Louisville, Louisville, Kentucky

Benzene is a volatile organic found in gasoline, paint, adhesives, and solvents, and generated in high amounts from industrial sources, vehicle exhausts, and the combustion of tobacco products. It is ranked number 6 on Agency for Toxic Substances and Disease Registry priority list. While exposure to benzene has been widely associated with hematotoxicity and some cancers, its cardiometabolic effects are unknown. To assess this in humans, we measured urinary levels of the benzene metabolite trans,trans-muconic acid (t,t-MA) in a cohort of 210 individuals with mild to high cardiovascular disease (CVD) risk. We found that levels of t,t-MA were higher in those individuals with dyslipidemia and were inversely associated with several populations of circulating angiogenic cells. To further identify benzene-induced effects, we chronically exposed mice to volatile benzene or HEPA-filtered air and measured angiogenic cells as well as indices of oxidative stress, inflammation and insulin signaling. Benzene exposure decreased levels of Flk-1+/Sca-1+ cells but increased plasma glucose, and insulin, establishing a state of insulin and glucose intolerance. Moreover, insulin-stimulated Akt phosphorylation was diminished in the liver and skeletal muscle of benzene-exposed mice, and these changes were accompanied by increases in oxidative stress, NF-κB phosphorylation, elevated levels of MIP1-α transcripts and SOCS1 protein, but lower levels of IRS-2 tyrosine phosphorylation. These effects of benzene on insulin signaling and glucose handling preceded the development of cytopenias. Treatment with the superoxide dismutase mimetic, TEMPO, reversed these benzene-induced effects on oxidative stress, inflammation, insulin signaling, and systemic glucose intolerance. Thus, persistent benzene exposure may be a heretofore unrecognized contributor to the global epidemic of diabetes. Means taken to reduce benzene production or exposure may reduce the global burden of cardiovascular disease.

D1-2 HS Investigating the placental mitochondrial genome as a mediator of cadmium-induced increased preeclampsia risk

Oluwadamilare A. Adebambo, Hannah E. Laue (Department of Environmental Sciences, Mailman School of Public Health, Columbia University, New York); Kasey Brennan (Department of Environmental Sciences, Mailman School of Public Health, Columbia University, New York); Gabriella Gallo (Department of Environmental Science & Engineering, Gillings School of Global Public Health, UNC-Chapel Hill); Kim Boggess (Department of Obstetrics & Gynecology, School of Medicine, UNC-Chapel Hill); Steven Offenbacher (Department of Periodontology, School of Dentistry, UNC-Chapel Hill); Damian Shea (Department of Biological Sciences, North Carolina State University); Andrea A. Baccarelli (Department of Environmental Sciences, Mailman School of Public Health, Columbia University)

PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
University, New York); Rebecca C. Fry* (Department of Environmental Science & Engineering, Gillings School of Global Public Health, UNC-Chapel Hill)

Studies have demonstrated the presence of mitochondrial dysfunction in placenta from preeclamptic women, while others, including from our laboratory, have shown positive associations between cadmium (Cd) levels in the placenta with preeclampsia (PE). The aim of this study was to investigate the relationship between Cd exposure and placental mitochondrial alteration involved in PE pathogenesis. Here, we use a translational study design to investigate genomic alterations in the mitochondria of placentas from preeclamptic and normotensive women and placental JEG-3 trophoblast cells. Placentas were collected from a pregnancy cohort representing women across the southeastern US the Maternal Oral Therapy to Reduce Obstetric Risk (MOTOR) cohort including preeclamptic and healthy, normotensive subjects. Relative mtDNA copy number was obtained as the ratio of a mitochondrial gene (mtDNA 12S ribosomal ribonucleic acid) to a nuclear gene (ribonuclease P gene), and normalized to reference DNA sample. To investigate if increased ROS production from exposure to Cd in trophoblast cells leads to placental mitochondrial dysfunction, we also measured mtDNA copy number using real-time PCR in JEG-3 cells treated with cadmium relative to vehicle controls. We then carried out a mediation analysis to test whether the association between cadmium exposure/treatment and increased preeclampsia risk is mediated through and/or modified by mtDNA copy number. We observed higher mtDNA copy number in both the PE placentae and Cd treated cells and a positive association between Cd exposure and PE. Our data suggest that the mitochondrial genome plays a role in the increased risk of PE associated with Cd exposure.

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D1-3 HS. Association between Phenols and Parabens & Reproductive and Thyroid Hormones and the Interaction Effect of Social Support

Amira Aker1, Lauren E Johns1, Kelly K Ferguson1, Rafael E Rios Mcconnell2, Offie P Soldin3, Akram N Alshawabkeh4, Jose F Cordero5 and John D Meeker1

1 Department of Environmental Health Sciences, University of Michigan School of Public Health, Ann Arbor, MI, USA; 2 University of Puerto Rico Graduate School of Public Health, UPR Medical Sciences Campus, San Juan, Puerto Rico; 3 Department of Medicine, Georgetown University, Washington, DC, USA; 4 College of Engineering, Northeastern University, Boston, MA, USA; 5 College of Public Health, Athens, University of Georgia, GA, USA

Prenatal exposure to phenols and parabens has been associated with adverse birth outcomes. We examined the associations of these exposures with maternal hormones in 525 mothers in the cohort, PROTECT, and the interaction of social support with the exposures. Urinary phenol/paraben biomarkers and serum hormones (estriol, progesterone, sex hormone-binding globulin (SHBG), total triiodothyronine (T3), total thyroxine (T4), free thyroxine (FT4) and thyroid stimulating hormone (TSH)) were measured at two visits during pregnancy (16-20 and 24-28 weeks). Linear mixed models with random intercept were constructed to examine the associations between hormones and exposures with and without exposure*social support. The results were additionally stratified by visit. Results were transformed to hormone percent changes for an inter-quartile-range difference in the exposure (%Δ). Bisphenol-S was associated with a 10% decrease in CRH (95% CI: -17.82, -1.45). Butyl-, methyl- and propyl-paraben were associated with decreases in SHBG [(%Δ: -4.77, 95% CI: -8.88, -0.65); (%Δ: -3.25, 95% CI: -7.01, 0.51); (%Δ: -3.61, 95% CI: -7.61, 0.40)]. Triclosan was associated with a decrease in T4 and T3 at 20-24 weeks [(%Δ: -5.77, 95% CI: -10.89, -0.65); (%Δ: -7.70, 95% CI: -13.19, -2.21)]. Triclocarban was positively associated with T3 (%Δ: 3.41; 95% CI: -0.00, 6.82), and positively associated with T4 at 20-24 weeks (%Δ: 4.74; 95% CI: -0.57, 10.06). While FT4 was marginally associated with 2,5-dichlorophenol, interactions between social support and
benzophenone-3, 2,5-dichlorophenol and 2,4-dichlorophenol showed a decrease in the effect of the exposure for every unit-increase in social support ($p = 0.025, 0.030, 0.041$). Results will be translated for use in community outreach brochures, and website development/blogs for use by other PROTECT/SRP teams as part of the ongoing research translation goal.

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D1-4. Groundwater Chemistry of Deep Wells in Araihazar, Bangladesh: Are there any Patterns?
Afsana Akter, Department of Environmental Science, Barnard College, Columbia University, New York, NY; Brian J. Mailloux, Department of Environmental Science, Barnard College, Columbia University, New York, NY; Tyler Ellis, Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY; Alexander van Geen, Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY; Benjamin Bostick, Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY; Imtiaz Choudhury, Department of Geology, University of Dhaka, Dhaka, Bangladesh; Rajib Mozumder, Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY; Kazi Matin Ahmed, Department of Geology, University of Dhaka, Dhaka, Bangladesh; Mahfuzur R. Khan, Department of Geology, University of Dhaka, Dhaka, Bangladesh.

In Bangladesh and West Bengal India, deeper tubewells are one the most successful methods of avoiding exposure to Arsenic commonly found in shallow Holocene aquifers. In Bangladesh, the government has installed as many as 200,000 deep wells. Though deep wells are commonly used as low-As water sources, hot-spots do occur and little research has been done to evaluate their groundwater chemistry. The goal of this project is to evaluate the groundwater chemistry by examining cations (Pb, U, Si, P, S, Ca, Fe, Ba, Na, Mg, K, Mn, As, and Sr), anions (Cl$^-$, Fl$^-$, SO4 2-, Br$^-$), water quality parameters (pH, EC, NH4), and water isotopes ($\delta^{18}$O and $\delta^{2}$H) from 741 deep (ranging from 300-999 feet with mean depth of 706 feet) wells of Araihazar, Bangladesh along with radiocarbon analysis of DOC and DIC from select wells. We found that 93% (n=741) deep wells are low in arsenic (<10 ppb); however, 704 wells had manganese levels higher than the US EPA secondary maximum contaminant level (SMCL) (50 ppb) and 599 had iron levels exceeding the US EPA SMCL (300 ppb). The low Cl:Br ratio (90% below 400) suggests most wells have not been contaminated by human waste. Maps indicate that some villages have clusters of saline deep wells. The location of cluster villages is being compared to deep aquifer usage. Interventions such as testing and installations of deeper wells can continue to help mitigate arsenic exposure and protect the drinking and irrigation waters of Bangladesh. Analyses are occurring to determine if it is possible to understand how measured water chemistry can reveal which deep wells are susceptible to arsenic contamination.

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D1-5 HS. Characterization of Asbestos Associated Mortality in Ambler PA
Arielle Marks-Anglin, Michelle Ross, Doug Wiebe, Edward A. Emmett, Michael Anderson, Shabnam Elahi, Atu Agawu, Frances K. Barg

Penn SRP, University of Pennsylvania.

Asbestos exposure elevates the risk of death through asbestos-related diseases (ARDs), including asbestosis, lung cancer and mesothelioma. While the effects of exposure have largely been studied in occupational settings, less is known about mortality among non-occupationally exposed individuals. We want to investigate the effects of occupational and residential asbestos exposure on subsequent mortality in a 1930 historical cohort of residents in Ambler, PA, once the largest asbestos product
manufacturing site in the US. 4,524 records in total were drawn from census data, Ancestry.com and the National Death Index, from which 474 individuals were found to be occupationally exposed, and 1,438 exposed through household contact or the community. To overcome the lack of death records for a large portion of the cohort, we aim to train and validate a survival prediction model on the complete records and perform multiple imputation of time of death for residents with missing death dates. We will compare results from a complete case analysis to results from the multiple-imputation procedure.

D 1-6. Exposure to tetrachloroethylene-contaminated drinking water and the risk of stillbirths: a case-control study from Massachusetts and Rhode Island.

Ann Aschengrau¹, Lisa G. Gallagher¹, Michael R. Winter¹, Lindsey J. Butler¹, M. Patricia Fabian¹, Veronica M. Vieira²

¹Boston University School of Public Health, ²University of California, Irvine

Background: Residents in Massachusetts and Rhode Island were exposed to tetrachloroethylene (PCE)-contaminated drinking water from 1968 through the early 1990s when the solvent was used to apply a vinyl liner to the interior of drinking water pipes to solve taste and odor problems. PCE’s effects on the developing fetus are not well-understood. The present case-control study was undertaken to determine if the risk of stillbirth is increased among pregnant women exposed to PCE-contaminated drinking water.

Methods: Cases were comprised of stillborn infants delivered between 1968 and 1995 to mothers who resided in 28 cities and towns with affected water pipes (N=296). Cases whose cause of death was placental abruption and/or placental insufficiency were included. Controls were randomly selected live-born infants who were delivered during the same time period to mothers living in the same geographic area as cases (N=783). Vital records and self-administered questionnaires were used to gather data on confounding variables. Prenatal PCE exposure was estimated using US EPA water distribution system modeling software that incorporated a leaching and transport algorithm for PCE.

Results: The risk of stillbirth was elevated among women with high prenatal exposure levels. Women whose average monthly PCE exposure was above the remediation level of 40 ppb (N=55) had a statistically significant 2.8-fold increase in crude risk (95% CI: 1.5-5.0). More modest increases in the risk of stillbirth were seen at lower exposure levels, suggesting a possible dose-response relationship. Adjusted analyses controlling for confounding variables are currently underway.

Research Translation: These results will be directly communicated to public health, environmental, and water supply agencies to highlight the importance of considering vulnerable populations when monitoring and regulating drinking water contaminants.

D1-7 HS. Repeated plasma measurements of maternal inflammatory markers during pregnancy in relation to urinary phenols and parabens

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Background: During gestation, regulation of the maternal immune system is critical for the progression of a healthy pregnancy and fetal development. Limited human and animal studies have provided evidence that exposure to phenols and parabens is related to the inflammatory process. Our main objective was to characterize the longitudinal relationships between plasma inflammatory markers and individual maternal urinary phenols and parabens across pregnancy.

Methods: The present study was conducted on data from a nested case-control study of preterm birth, including 130 cases and 352 controls. We measured 6 phenols and 4 parabens in urine samples, as well as 5 inflammatory markers in plasma at up to four study visits from each participant during pregnancy. We utilized linear mixed models to analyze repeated measurements to characterize associations between individual exposure analytes and inflammatory markers.

Results: We observed that a subset of phenols and parabens had significant positive relationships with the pro-inflammatory markers C-reactive protein, Interleukin-6, and tumor necrosis factor-α, and the anti-inflammatory molecule interleukin-10. The greatest magnitude among these associations indicated that an interquartile range increase in triclosan was associated with a 12.5% (95% CI: 3.67, 22.0) increase in C-reactive protein. We also observed significant inverse relationships between ethylparaben and IL-β, in addition to benzophenone-3 and tumor necrosis factor-α.

Conclusions: The results of our study provide evidence suggesting that exposure to phenols and parabens is associated with bidirectional shifts in circulating levels of inflammatory markers, which could potentially be an indicator of immune disruption. These relationships may have implications for fetal development and birth outcomes, and emphasizes the need to pursue further research to better characterize potential mechanisms of immune disruption during pregnancy.

D1-8. Evaluating mixture toxicity using two aquatic model organisms and a multi-tiered approach

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Wayne State University Center for Leadership in Environmental Awareness and Research (CLEAR)

We have developed a multi-tiered approach to evaluate complex mixtures of chemical contaminants that are commonly found in surface and groundwater. Contaminants of emerging concern (CECs) that are not routinely monitored or regulated often include chemicals that are known or suspected endocrine disrupting chemicals (EDCs). EDCs have the potential to cause adverse effects on environmental and human health at very low concentrations. Given the diversity of CECs that may affect endocrine function at very low concentrations, there is an urgent need to develop more efficient biologically-based methods of evaluation that can complement sophisticated analytical chemistry.

We have implemented a multi-tiered biological approach to evaluate the endocrine disrupting potential of water samples using two aquatic organisms, Danio rerio (zebrafish) and Daphnia pulex (waterflea). The first tier identifies how swimming behavior is affected by exposure to a range of sub-lethal chemical concentrations. The second tier employs morphological analysis to identify developmental effects (e.g. change in sex-ratio, feminized male fish) that represent EDC-like responses. The third tier examines the effects of single chemicals on gene expression, then utilizes information from the concentration-dependent biological responses observed in the first two tiers to determine specific concentrations of interest. Finally, a predictive mathematical model will be developed that combines the multi-tiered findings to evaluate the estrogenicity or anti-androgenic quality of water samples with known or unknown mixtures of chemical contaminants (e.g. wastewater effluent). The chemicals
evaluated include: estrone, metformin, triclosan, triclocarban, chlorpyrifos, 4-nonylphenol, bisphenol-A, dieldrin, and atrazine.

D1-9. Novel approaches to rapid and informative exposure analysis from environmental samples and mixtures


Surveillance of chemical exposure requires analytical platforms offering rapid measurements, high sensitivity, efficient separations, wide dynamic ranges, and applicability to a broad chemical space. We have developed a platform and pipeline that meets these needs by combining solid phase extractions with ion mobility spectrometry and mass spectrometry (SPE-IMS-MS). This platform is capable of performing both targeted and global measurements of endogenous and exogenous small molecules in human biofluids and environmental samples with high reproducibility, sensitivity and throughput. This exposomics approach overcomes many challenges for large scale exposure assessments and is a viable way of screening environmental conditions and patient cohorts for insight into human exposure and disease mechanisms.

D1-10 HS. Dioxin-like PCB increases peripheral vascular inflammation in mice with liver injury

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Xenobiotic and energy metabolism is dependent on a functional liver. Exposure to environmental pollutants like polychlorinated biphenyls (PCBs) is associated with inflammatory diseases, including non-alcoholic fatty liver disease and atherosclerosis. A compromised liver may play a critical role in modifying the induction of PCB toxicity and inflammation of the peripheral vasculature. Over a 14 week study, male C57Bl/6 mice (n=10) were fed an amino acid control diet or a methionine-choline deficient diet (MCD) with or without oral gavage of PCB 126 (0.5mg/kg). Post euthanasia, tissue and blood were collected for histological, toxicological, and inflammatory evaluation. Regardless of diet, PCB 126 induced hepatic steatosis. The MCD+PCB126 group exhibited fibrosis and increased liver to body weight ratio, suggesting liver injury and toxicity. Mice fed MCD-diet and exposed to PCB 126 demonstrated altered expression of hepatic genes involved in carbohydrate and lipid metabolism, indicating metabolic dysfunction. With regard to effects of PCB 126 on extra-hepatic organs, all mice fed MCD diet had decreased expression of plasma leptin and resistin, and PCB126 exposed groups appeared to have crown like structures in their epididymal adipose tissue, indicating the presence of inflammatory cells. In addition, MCD+PCB126 mice displayed increased plasma inflammatory markers including Icam-1, Mcp-1, and Tnf-α. Interestingly, in the MCD+PCB126 group, plasma ALT and AST levels were increased as well as pro-atherogenic trimethylamine-N-oxide (TMAO), implying simultaneous liver damage and increased peripheral vasculature disease risk. Together these results provide a novel linkage of a compromised liver to PCB-induced hepatic and vascular inflammation. These finding also have translational component, suggesting environmental pollutants can cause inflammatory disease pathologies by stimulating cross-talk between individual organ systems. (Supported in part by NIEHS/NIH grant P42ES007380).
D1-11. Genome-wide CRISPR-Cas9 Screens Reveal Novel Mechanistic Insight into Acetaldehyde and Arsenic Toxicity

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Mechanisms of toxicity remain unclear for many well studied chemicals including Arsenic and Acetaldehyde. Acetaldehyde, the primary oxidative product of alcohol metabolism has been linked to multiple health consequences. Acetaldehyde is suggested to underlie the hematologic complications of alcohol use such as leukemia and bone marrow failure but the mechanism(s) of acetaldehyde toxicity in hematopoiesis are poorly understood. Arsenic is a Superfund priority chemical and skin, bladder and lung carcinogen. Arsenic trioxide (ATO) is also used as an anti-leukemic agent used in the treatment of acute promyelocytic leukemia (APL). Comprehensive identification of cellular pathways involved in chemical toxicity response has recently become more feasible due to the emergence of the CRISPR (clustered regularly interspaced short palindromic repeats)-Cas9 (CRISPR associated protein 9) genome-editing tools that enable genome-wide functional toxicogenomics approaches. We employed genome-wide CRISPR-Cas9 loss of function screening in a human erythroleukemic cell line (K562) to identify cellular components whose disruption alters sensitivity to acetaldehyde and arsenic trioxide. Our primary screens identified multiple candidate genes that are potentially involved in the mechanism(s) of toxicity of each chemical. Using a novel secondary screening approach, we implemented simultaneous genetic validation of many candidate genes. Gene set enrichment analysis of validated candidates revealed cellular pathways that are mechanistically relevant to the toxicity of each of the studied chemicals. Consistent with the reported role of aldehydes in DNA damage, we demonstrated that disruption of genes encoding DNA repair enzymes increases the toxic effect of acetaldehyde. Our results revealed additional DNA repair components conferring protection against acetaldehyde-induced DNA damage. Our study on arsenic trioxide showed a predominant role of reactive oxygen species (ROS) in ATO toxicity and revealed a novel link between arsenic toxicity and selenocysteine incorporation into selenoproteins. Our work further demonstrates the strength of high throughput genetic screening using the CRISPR-Cas9 system in deciphering mechanisms of toxicity.

D1-12. Interferon Gamma-induced Stat3 Serine Phosphorylation Reverses TCDD-mediated Suppression of IgM Secretion in Primary Naïve Human B Cells

Lance K. Blevins, Institute for Integrative Toxicology; Robert Crawford, Institute for Integrative Toxicology; Norbert Kaminski, Institute for Integrative Toxicology, Dept. of Pharmacology & Toxicology, Michigan State University

2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) is a persistent environmental contaminant usually formed as a side product in organic synthesis and burning of organic materials. TCDD has potent immunotoxic effects in B lymphocytes resulting in decreased cellular activation and suppressed IgM secretion following activation with CD40 ligand. Previous work from our lab demonstrated that TCDD treatment of naïve human B cells resulted in significant increases in the levels of the tyrosine phosphatase SHP-1 which corresponded with suppression of IgM secretion. Stat3 is a critical B cell transcription factor for B cell activation and secretion of immunoglobulins (Ig). Stat3 dimerizes and translocates to the nucleus following phosphorylation as a result of cytokine receptor signaling. We
hypothesized that TCDD-mediated increases in SHP-1 could result in decreased Stat3 tyrosine phosphorylation. Interestingly, we found only modest changes in the levels of Stat3 tyrosine phosphorylation. However, there were significantly reduced levels of Stat3 serine phosphorylation as early as 12 hours following activation. These results corresponded to decreased phosphorylation of the serine specific phosphatase PP2a, which is known to be regulated by SHP-1. Further, studies have indicated that interferon gamma (IFNγ), which normally signals through the type II interferon receptor, can non-canonically drive Stat3 serine phosphorylation via Src kinase. Indeed, treatment of human B cells with IFNγ resulted in increased Stat3 serine phosphorylation and reversed TCDD-mediated suppression of the IgM response. Together, these data highlight a potential mechanism for TCDD suppression of Ig secretion and demonstrate the potential of interferon gamma as a means to reverse this effect in primary human B lymphocytes.

D1-13. Optimization and Field Testing of Magnetite-Based Arsenic Immobilization Strategies in Yinchuan, China

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It is often difficult to scale up laboratory research to the field, and to translate and implement that research into successful site remediation. In this research, we achieve both in demonstrating the successful immobilization of arsenic (As) from contaminated groundwater in the Yinchuan Plain of northwest China. Arsenic groundwater contamination is pervasive at Superfund and other sites, and is a major threat to public health. In situ magnetite precipitation may be an effective method of immobilizing groundwater As; this magnetite strongly retains As and is stable under a wide range of aquifer conditions, including those often associated with groundwater As contamination. Laboratory studies suggest that the formation of nanoparticulate magnetite is stimulated when aqueous Fe(II) and nitrate are added to contaminated aquifer sediments, and that mineral formation is facilitated by a consortium of Fe(II) oxidizing and Fe(III) reducing microorganisms. In this research, we optimize magnetite formation under field conditions, and then, through investigator-led research translation with the Chinese Geological Survey (CGS), we created and implemented a remediation plan for a contaminated groundwater well. These results were used to develop a reactive transport models using the numerical code PHT3D that integrates the proper biological processes, and used that model to refine a remediation approach at an As-impacted site in Yinchuan identified by CGS. In Fall, 2017, we performed a successful push-pull experiment within two contaminated wells containing 300-400 ppb As. These experiments are underway, but represent the effective field testing of this method, and provides evidence to support the application of this method at Superfund sites.
D1-14 HS. The Folic Acid and Creatine Trial: Treatment effects on arsenic methylation capacity and effect modification by baseline nutritional status

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1. Department of Environmental Health Sciences, Columbia University; 2. Department of Epidemiology, Columbia University; 3. Department of Biostatistics, Columbia University, 4. Columbia University Arsenic Project in Bangladesh, Dhaka, Bangladesh

Background: Arsenic is a human toxicant and carcinogen. Despite mitigation efforts, exposure through drinking water persists in many regions. Methylation of inorganic arsenic (InAs) to monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA) facilitates excretion. Folate and creatine, nutrients involved in one-carbon metabolism (OCM), may influence arsenic methylation.

Aim: To determine the effects of folic acid (FA) and/or creatine supplementation on urinary arsenic metabolites, and to assess effect modification by baseline nutritional status.

Methods: In a 24-week randomized controlled trial in Bangladesh, 622 participants were assigned to receive 400 μg FA, 800 μg FA, 3 g creatine, 400 μg FA + 3 g creatine, or placebo. At week 12, half of the participants receiving FA were switched to placebo.

Results: At weeks 6 and 12, the mean within-person decrease in ln(%InAs) and %MMA and increase in %DMA in the FA groups exceeded that of the placebo group (P≤0.05), and the mean decrease in %MMA in the creatine group exceeded that of the placebo group (P≤0.05). The effect of FA on the change in %DMA was modified by betaine status (P≤0.05), and the effect of creatine on the change in %MMA was modified by choline status (P≤0.05). A rebound was observed: at week 24, ln (%InAs) and %DMA did not differ from baseline among participants who discontinued supplementation.

Conclusions: FA supplementation increased arsenic methylation, and effects may be modified by OCM nutrients. Further research is needed to fully understand the relationship between creatine and arsenic methylation.

Research Translation: In collaboration with the Research Translation Core, findings from this work have been reported on the Columbia SRP website and have been used as SRP-Highlights, a press release, and Webinars.

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D1-15. Interprofessional Approach to Developing a Diverse Workforce Ready to Address Emerging Technologies in Occupational Health and Safety

K. Brisolara, ScD, S. Cormier, PhD (UTHSC); M Reams, PhD (LSU-BR)

With the establishment of a collaborative centered on emerging technologies in occupational health and safety, Louisiana State University Health Sciences Center, New Orleans (LSUHSC-NO), Louisiana State University at Baton Rouge (LSU-BR) and the University of Tennessee Health Sciences Center (UTHSC) along with Rhodes College has developed an innovative, interprofessional approach to workforce development. The goal is to prepare a diverse workforce to address health and ecological hazards arising from new and emerging technologies through didactic, experiential and field learning approaches. Specific topics of focus include: 1) potential hazards arising from e-waste and the electronics industry, 2) advances in the application of bioremediation and its relation to occupational health, 3) evaluation of regulatory policies and economic incentives; and 4) use of geographical information systems for site selection, management, and surveillance. With a focus on interprofessional education (IPE) methods, teams of students can learn about, from and with each
other to broaden students’ perspectives on occupational health and develop novel solutions to emerging technology issues. Utilizing a watershed approach, this initiative will augment workforce diversity through targeted recruitment for undergraduate programs at LSU-BR, graduate programs at UTHSC, LSUHSC-NO and LSU-BR, and occupational medicine at LSUHSC-NO. The participation of non-traditional field such as business and law will boost the dissemination of this training in emerging technologies. An advisory board comprised of industry, community-based training and professional organization representatives has been established to evaluate the program’s translational quality and sustain the applicability of emerging technology training to current industry and governmental concerns. This advisory board will also provide field knowledge of trends and concerns related to emerging technologies from a broad spectrum of industries to shape future workshop topics. Training structure will consist of several options to serve both traditional students and health and environmental professionals. Workshops will provide continuing education as required by Certified Safety Professionals (CSP) and Certified Industrial Hygienists (CIH) with initial curricula including geographic information system, economics, and law. Future workshop topics will be chosen by the program director in conjunction with the advisory board centered on emerging concerns related to new technologies and resulting hazardous substances.

D1-16. The Role of Nanoparticle Biodurability in Toxicity: A Case Study of High Aspect Ratio Molybdenum Nanoribbons

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The development of nanomaterials is rapidly expanding as their applications extend to electronics, energy storage, catalysts and biomedical technology. As the application of these novel nanomaterials increases, so does the risk of human exposure. Thus, it is imperative to consider the fate and toxicity of these emerging contaminants before their widespread adoption by industry. Nanomaterials with a high length to diameter ratio are categorized as high aspect ratio nanomaterials. Molybdenum trioxide (MoO₃) nanoribbons are a high aspect ratio nanomaterial currently under development for photochromic devices, such as color-changing glass. The needle-like shape of these nanoribbons is disturbingly similar to asbestos fibers, a human lung carcinogen. As high stability, or biodurability, is a key factor in asbestos toxicity, we first investigated the stability of MoO₃ nanoribbons. MoO₃ nanoribbons dissolved over an hour under both biologically and environmentally relevant conditions. We then compared the toxicity of MoO₃ nanoribbons and other high aspect ratio materials in macrophages. The materials with low stability, MoO₃ nanoribbons and wollastonite, both exhibited little cytotoxicity. In contrast, asbestos, a highly stable material, showed a significant increase in cytotoxicity. We then demonstrated that spherical MoO₃ nanoparticles and dissolved Mo ions, are also not toxic. Together, the data from these in vitro toxicity assays suggest that MoO₃ nanoribbons do not behave as a biopersistent high aspect ratio material and do not release toxic soluble ions. We propose a screening strategy whereby physical characterization and the stability of novel nanomaterials can be used to streamline the toxicity testing process. This research is supported by NIEHS Superfund Research Program P42 ES013660 and NIH T32 Training Grant ES00727225.

D1-17 HS. Rigor and Reproducibility is Enhanced by Absolute Quantitation in Cell Culture: The Interplay Between the Response to DNA Damage and Cellular Bioenergetics (ATP) as an example.

Visarut Buranasudja¹, Claire M. Doskey¹, Brett A. Wagner², Juan Du³, David J. Gordon⁴, Stacia
Rigor and reproducibility are now recognized as issues in biomedical research. We have previously demonstrated that specifying dose of xenobiotics in units of moles per cell can improve rigor and reproducibility in cell culture experiments [1]. In addition, this dosing metric when used with absolute quantitation increases the information content of data [2]. Here, we have employed these quantitative approaches to better understand the downstream consequences of oxidative DNA damage, including changes in cellular bioenergetics. In the current study, we leverage the basic chemical properties of ascorbate (vitamin C) to use it as a source for flux of H2O2 in vitro. Using quantitative PCR-based measurements, we have found that the high flux of H2O2 produced by ascorbate induces both nuclear and mitochondrial DNA damage. In response to this DNA damage, we observed that PARP-1 is hyperactivated. We found that activation of poly (ADP-ribose) polymerase-1 (PARP-1) by H2O2 results in utilization of NAD+, and subsequently depletion of ATP (energy) leading to mitotic cell death. Time-course studies showed that the metabolic and energetic restoration occurred concomitantly with the repair of DNA damage, indicating an interconnection between these two processes during oxidative stress. Using a Seahorse XF96 Analyzer, we observed no changes in respiration or glycolysis following an exposure to a flux of H2O2, indicating that the profound decrease in ATP is due solely to increased demand, not changes in its rate of production. We foresee that these new quantitative approaches will provide powerful new approaches for the toxicology research community. These methods can yield more information leading to new insights as well as increased rigor and reproducibility in basic studies that employ cell culture.

D1-18 HS. Environmental Sampling Strategies for Disasters: Lessons Learned from Hurricane Harvey Response

Krisa Camargo, Mikyoung Jun, Jennifer Horney, Ivan Rusyn, Weihsueh Chiu, Thomas J. McDonald, and Anthony Knap (Texas A&M University)

Introduction: Hurricane Harvey left Houston, Texas severely flooded and residents concerned about chemicals released from Superfund and Brownfield sites. Consequently, public health and other agency response plans for post-disaster sampling were questioned by residents, researchers, and the media. Since emergency response is considered dynamic, continuous refinements are needed to improve preexisting frameworks. An example of this is development of a sampling plan for post-disaster exposure assessment to characterize affected areas and facilitate risk communication.

Despite advances in emergency preparedness since 2001, gaps remain for both emergency communications and harmonization of post-disaster intervention methods.

Results: In 2016, baseline exposure data was collected from Houston environmental justice neighborhoods as part of community engaged research. In 2017, post Harvey, our team collected additional samples using two strategies. First, we sampled sites with pre-Harvey reference data. Second, we sampled around known hazardous sites in close proximity to populated areas. While this sampling strategy was community- or hazardous-site focused, it may be subject to bias. Furthermore, due to the unpredictability of disasters, baseline data is often unavailable. Therefore, we created a post-disaster exposure map through the application of statistical sampling approaches by evaluating previous and current sediment and water samples based on their locations in the Houston area. This sampling strategy will be used for a systematic evaluation of environmental exposures post-Harvey and will serve as an unbiased framework for future emergency response.
Research Translation: Implementation of a post-disaster sampling framework could aid residents, public health agencies, and the media by: (1) speeding rapid needs assessments via the generation of appropriate sampling locations required for assessment, and (2) providing a tracking method for future post-disaster investigations to develop interventions.

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D1-19. Does Aquifer Geochemistry Determine the Corrinoid Pools and Control the Activity of Corrinoid-auxotrophic, Organohalide-Respiring Bacteria?

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Organohalide-respiring bacteria use corrinoid-dependent reductive dehalogenases (RDases) to break carbon-chlorine bonds. Of particular interest to aquifer remediation are Dehalococcoides mccartyi (Dhc) strains that possess RDases to detoxify chlorinated ethenes to benign ethene. Remarkably, Dhc strains cannot de novo synthesize corrinoid and depend on corrinoids produced by microbes with the ability for de novo corrinoid biosynthesis. Dhc strains have specific requirements and only certain corrinoids support Dhc activity. To explore the effects of aquifer geochemistry on the types of corrinoids generated, microcosms were established with solids collected from two contaminated sites. Different redox conditions were established by amending microcosms with sulfate, ferric iron (as goethite), nitrate, manganese dioxide, lactate, lactate plus 2-bromoethane sulfonate, or tetrachloroethene. Corrinoids produced under these different redox conditions were analyzed using HPLC-UV/Vis spectroscopy and UPLC-MS. Dimethylbenzimidazole (DMB)-type corrinoid dominated under ferric iron-, sulfate- and nitrate-reducing conditions but were not produced in methanogenic microcosms. Further, the quantities of cobalamin (i.e., a corrinoid with DMB as the lower base) produced varied considerably under the different redox conditions tested. The microcosm studies demonstrated that the geochemical conditions affect the corrinoid pool, both in terms of quantity and the types of cobamides produced. Because key dechlorinators are corrinoid-auxotroph, these findings have implications for in situ bioremediation, and can guide site management decisions so that human exposure to harmful groundwater contaminants can be avoided.

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D1-20. Contamination of Residential Soil due to Hurricane Harvey Flooding

Gaston Casillas, Kahler Stone, MPH; Katie R. Kirsch, MS; Thomas McDonald, PhD; Jennifer A. Horney, PhD, MPH; Texas A&M University

Introduction: The Superfund Research Center (SRC) at Texas A&M University (TAMU) is focused on the development of tools and models that address exposure to complex mixtures during emergency contamination events. Manchester is a geographically compact neighborhood in East Houston adjacent to the Houston Ship Channel. Within one mile of Manchester there are 21 facilities that report to the EPA’s Toxic Release Inventory. Individuals living within this community experience typical environmental justice conditions. Top concerns include exposure to contaminated soil and surface water.

Methods: Utilizing Geographic Information Systems ArcMap (ESRI, Redlands, CA), 25 homes were randomly selected in Manchester. Community partner Texas Environmental Justice Advocacy
Services (TEJAS) assisted with data collection. Five teams from the Texas A & M University School of Public Health and TEJAS staff approached each home during August 2017 to obtain consent and collect initial soil samples. Soil samples were collected using the same protocol and in the same locations on September 1, 2017, one week after Hurricane Harvey made landfall. This project and all related materials were reviewed and approved by the Texas A & M University Institutional Review Board (IRB 2016-0698D).

Results: Soil samples were extracted and analyzed using GC-MS. Samples collected prior to Hurricane Harvey showed no evidence of contamination. Samples collected after Hurricane Harvey contained high levels of high molecular weight PAHs Chrysene/Triphenylene, Benzo(b)fluoranthene Benzo(j, k)fluoranthene and Benzo(e)pyrene detected in the highest amounts. Results indicate resident properties were contaminated with both petroleum and with by-products of wastewater treatment.

Research Translation Component: Results have been shared with the Houston Health Department for remediation activities and risk communication. Working with TEJAS results have been communicated directly to community residents.

D1-21. Commercial cow manure, used as a soil amendment, facilitates movement of asbestos in soil water

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The ability of plants to stabilize soil, a process known as phytostabilization, can be critical in remediating or restoring abandoned surface mines or other contaminated sites. Nutrient-rich soil amendments are often applied to hasten the development of vegetation and reduce soil erosion and mobility of contaminants. We tested whether asbestos (chrysotile) fibers, as a contaminant, move in sand and whether phytostabilization is relevant to preventing their movement.

In a greenhouse, we grew Brassica juncea and Sorghum bicolor in Cone-tainers™ containing either pure sand or a 1:15 ratio, by weight, of ground chrysotile:sand, layered over sand. To evaluate the utility of standard soil amendments, we added a 5.0 cm surface layer of one of the following: a commercial organic, soilless potting medium; dehydrated cow manure; garden soil; sand with 100 mg of NPK fertilizer; or pure sand. We examined (1) how the presence of asbestos and the different amendments affected plant biomass, and (2) whether leachate collected after watering contained asbestos fibers.

Most amendments improved biomass of both species compared to sand alone, while chrysotile reduced biomass for one or both species in the presence of some amendments. Surprisingly, we found large quantities (100,000 MFL) of fibers >0.5 μm in leachate with manure as the amendment but not with other amendments or pure sand.

Our finding that asbestos moves in sand in the presence of manure begs for an investigation of the mechanism and has obvious implications for remediating asbestos contaminated sites. As we have shared with the EPA, careful consideration must be given to how soil treatments affect containment of the contaminant in question, even if vegetation establishment is facilitated.

PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
D1-22. Pilot Training to Prevent Take-Home from Dirty Jobs for Different Chemicals and Work Arrangements

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*Trainees in R25 grant; Mr. Pokharel and Mr. Kalweit are both MPH students

Workers in so-called dirty jobs are likely exposed to a wide variety of chemicals at work that can be transported home; known as take-home. Existing occupational legislation is not effective at preventing take-home exposures. Many of these workers are immigrants with informal employment, complicating access to occupational safety information and prevention controls. Recent cases of lead poisoning in children from paternal employment in emerging industries employing an informal workforce, such as electronics recycling, suggest the urgent need for better take-home prevention training.

We performed a literature review of information on take-home prevention. We developed and evaluated a take-home prevention training with 20 trainees. The effectiveness of the training was measured with a pre- and post-exam and evaluation.

We found that most literature on take-home focused on case studies, specific industries and chemicals; e.g., lead in construction, pesticides in agriculture. Most educational materials had useful, accurate, and clear information and graphics. However, most materials were geared towards occupational health practitioners, not workers, designed towards a formal workforce, and focused on a specific chemical. Existing worker training was long (1-4 days) and voluntary at workplaces.

The 1-2 hr take-home prevention training we developed was not chemical specific and used plain English/Spanish activities and graphics depicting recommendations tailored to different work arrangements. Training was well received and exam responses indicated that knowledge of take-home prevention techniques improved in the majority of the trainees. We aim to expand the use of this training through stakeholders including MassCOSH, labor organizations, health professionals, lawyers, community and faith groups, and students and staff in public schools. We strive to reduce the burden of chemical exposures to these vulnerable workers and their families.

D1-23. Predicting Lead Content of Urban Soils: Using the history of lead fluxes to approximate lead content of surface soil in the NYC area

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Lead (Pb) contamination is a significant threat to health due to its wide dispersal in atmospheric emissions. Although most Pb sources have been eliminated, residual Pb-contaminated soil and dust still causes significant Pb exposure. Soil Pb concentrations are highly variable, and it is currently difficult to estimate on a larger scale, the lead content of the soil at specific locations due to considerable heterogeneity. Here, we have developed a method to approximate the lead inventory of soil attributed to atmospheric deposition; the method hypothesizes that the spatial heterogeneity in Pb inventories reflects differences in when soils were perturbed by construction. To do so, we use historical Pb fluxes obtained from new peat cores from Piermont Marsh and previously measured fluxes from Central Park. The core’s Pb inventory as a function of time is the integrated lead flux of Pb.
the core. Measured Pb inventories in New York City peat cores were reasonably similar and both contained inputs attributed to incineration and leaded gas combustion. These measured fluxes in cores were successfully used to predict local fluxes and concentrations in individual soils by assuming that construction mixed ore replaced soils with clean soil, and that deposition began subsequent to that time. Surface soil concentrations are harder to predict due to heterogeneous soil mixing, and in some instances, the addition of additional Pb sources. Since urbanization predates the atmospheric Pb deposition in NYC where maximum Pb fluxes occurred from the 1930s to the 1970s, most surface soils are 200-500 mg Pb/kg, about 10 times higher than background levels, and high enough to warrant public health concern.

D1-24. Chemosynthetic transformations of asbestos minerals
Jessica Choi, Ruggero Vigliaturo, Reto Gieré, Ileana Perez-Rodriguez (University of Pennsylvania)

It is well-documented that asbestos fibers can cause serious health effects via the physical properties of the fibers themselves and/or reactive oxygen species (ROS) generated through the fibers surficial Fe content. Here, we propose an interdisciplinary approach to investigate different microbe-mineral interactions between asbestos and chemolithoautotrophs, or microorganisms that use an inorganic energy sources for carbon fixation. Our aim is to discover microbial mechanisms able to transform asbestos by either compromising the Mg-Si framework of the fibers or by extracting the Fe(II)/Fe(III) content in many of these minerals. We hypothesize that incorporation of Si from the asbestos fibers into microbial biofilms will compromise the physical foundation of the fiber (i.e. crystal structure). Likewise, microbial respiratory reactions involving Fe(II)/Fe(III) will be tested for the removal of the Fe content from asbestos fibers, reducing their toxicity. Lastly, there is a possibility that there may be other unexpected transformations not yet anticipated. This study is the first to interrogate these microbe-asbestos mineral interactions for the development of more efficient technologies for removal, or reuse, of asbestos-mineral waste.

D1-25. The Synthetic Lignan Secoisolariciresinol Diglucoside (LGM2605) Mitigates Libby Amphibole Asbestos-Induced immune Cell Activation in Mice and Murine Macrophages
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Background: Exposure to the Libby Amphibole (LA) asbestos found in Libby Montana, is associated with autoantibody production in mice and humans, and an increased risk of developing systemic autoimmune disease. Flaxseed-derived Secoisolariciresinol diglucoside (SDG) has anti-inflammatory, anti-fibrotic and antioxidant properties. We identified potent protective properties from crocidolite-asbestos exposure modeled in mice. The current studies aimed to extend those findings by evaluating antioxidant and immunomodulatory effects of synthetic SDG (LGM2605) on asbestos-exposed mice and murine RAW264.7 macrophages (MF). Methods: Mice were given LGM2605 via gavage initiated 3 days prior to and continued for 3 days post a single i.p. dose of LA exposure and evaluated on day 3 for immune cell influx in the peritoneal cavity using flow cytometry. Spleen WBC levels were also evaluated. MFs were exposed to LA asbestos +/- LGM2605 given 30 min prior or concurrently or 30 min post exposure to LA and evaluated 24 hours later for cytokine secretion and levels of xCT transporter, a marker of oxidative stress. Results: In mice, LA induced a significant increase in spleen weight (p<0.0001), and peritoneal influx of lymphocytes, macrophages and granulocytes, which were
significantly \( (p<0.0006) \) blunted by LGM2605. Importantly, LGM2605 significantly reduced B1a B cell levels in spleens, key producers of autoantibodies implicated in autoimmune responses, elevated by LA. Additionally, LGM2605 significantly \( (p<0.04) \) reduced TNFα secretion by MF as well as the expression of xCT when given at any time relative to the LA exposure. Conclusions: LGM2605 reduced LA asbestos-induced inflammation, and WBC subtypes associated with autoimmune responses. It also blunted proinflammatory cytokine release, and oxidative stress in macrophages supporting its possible use in mitigating the asbestos-associated diseases such as autoimmune disease.

D1-26 ESE Identifying components of the heavy metal response regulatory system in plants

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The EPA lists several toxic heavy metal(loid)s among its highest priority hazardous substances; specifically, arsenic, lead, mercury, and cadmium. Toxic metal(loid)s are high priorities due to extensive soil and water contamination, and extreme impact on human health, including increasing cancer rates, liver disease, respiratory disorders and causing learning disabilities. Uptake of toxic metal(loid)s in plants primarily occurs through essential nutrient transporters. Once inside the plant, toxic metal(loid)s can be bound by thiol-based ligands which inhibit toxicity and allow for transport and sequestration. However, these toxic metal(loid)s remain available to organisms by ingestion providing a major source of human exposure. While many components of the heavy metal(loid) detoxification pathway are known, and a rapid heavy metal(loid)-induced transcriptional response has been shown, the transcriptional regulators remain largely unknown. These unknown transcriptional regulators are likely key to engineering enhanced bioremediation capacity of plants for toxic metal(loid)s. To identify components in this response pathway we generated a heavy metal(loid) reporter Arabidopsis line and performed a forward genetic screen using EMS mutagenesis. The mutants were classified based on shifts in luciferase response and include Super-Response and Constitutive-Response mutants. We are currently using both SSLPs and whole-genome deep sequencing to map these mutations. SSLP mapping has identified a 3.6 Mb region of the Arabidopsis genome containing a Super-Response mutation. Bulk segregant analysis of crossed mutant population genomic sequences has allowed us to identify candidate causative mutations. In addition, data will be presented showing specific heavy metal(loid) responses in a Constitutive-Response mutant.

D1-27. Remediation of Dioxins and Property Values

Jeffrey Cox (Michigan State); Adam Zwickle (Michigan State); James W. Dearing (Michigan State); Jie Zhuang (Texas Christian); Joseph Hamm (Michigan State); Brad Upham (Michigan State), Minwoong Chung (Michigan State)

Loss of property value is a primary concern for many residents who are faced with the toxic byproducts of industrial practices, affecting their livelihoods and economic health. Even after site remediation, stigma may persist and negatively affect market values. In order to study the effect of remediation on property values, we conducted a longitudinal analysis over 18 years of the assessed values of 664 properties in Midland, Michigan, where Dow Chemical had released dioxins into the environment through incineration and water discharge for years. We compared properties that met the actionable level of dioxin (>250/parts per trillion) and were remediated, those that had lesser levels (<250/parts per trillion) and were not remediated, and a comparison group of nearby properties.
not tested for dioxins. We found no consistent or significant differences between the three time series with respect to property valuation. Remediation of properties contaminated with dioxins does not appear to have negatively affected the value of those properties, nor were properties contaminated with lesser amounts of dioxins and not remediated negatively affected in value. Results may have implications for federal and state agency policy, as well as for allaying the fears of home and landowners about loss of value due to dioxins contamination and remediation.

D1-28 HS. Development of an Indirect Competitive ELISA for Glycocholic Acid Based on Chicken Single-Chain Variable Fragment Antibody

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Environmental pollution will increase the risk of liver diseases. It is now clear that certain environmental factors, such as exposure to vinyl chloride and aflatoxins, play a role in the development of hepatocellular carcinoma (HCC). Although investigating the environmental contamination is important, monitoring the diseases which caused by environmental contamination are even more important. Glycocholic acid (GCA) is an important metabolite of bile acids, whose urine levels are expected to be a specific diagnostic biomarker for HCC. A high-throughput immunoassay for determination of GCA would be of significant advantage and useful for primary diagnosis, surveillance and early detection of HCC. Single chain variable fragments (scFv) have several desirable characteristics and are an attractive alternative to traditional antibodies for the immunoassay. Because chicken antibodies possess single heavy and light variable functional domains, it is an ideal framework for simplified generation of recombinant antibodies for GCA detection. In this study, a scFv library was generated from chickens immunized with a GCA hapten coupled to bovine serum albumin (BSA), and anti-GCA scFvs were isolated by a phage-displayed method. Compared to the homologous coating antigen, using a heterologous coating antigen resulted in about an 85-fold improvement in sensitivity in the immunoassay. This assay, under optimized conditions, had a linear range of 0.02 ~ 0.18 μg/mL, with an IC50 of 0.06 μg/mL. The assay showed negligible cross-reactivity with various related bile acids, except for taurocholic acid. The detection of GCA from spiked human urine samples ranged from 86.7 to 123.3 %. These results, combined with the advantage of the scFv antibody, indicated that a chicken scFv-based ELISA is a suitable method for high-throughput screening of GCA in human urine.

D1-29 HS. Early-life Arsenic Exposure Has a Long-Term Effect on Plasma Glucocorticoid Levels

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Inorganic arsenic (iAs) is a naturally occurring element that contaminates the groundwater in multiple countries worldwide. This is of public health concern because chronic ingestion of arsenic-contaminated drinking water increases the risk of multiple cancers, cardiovascular and respiratory disease, diabetes, and adverse developmental and neurological effects. Disruption of the endocrine

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system provides a possible mechanism linking iAs exposure to a vast array of disease processes. Early-life iAs exposure alters plasma glucocorticoid (GC) levels in adult mice. GCs are steroid hormones that have widespread effects on the metabolic, cardiovascular, immune, reproductive, and central nervous systems. Consequently, arsenic-related health effects may result in part from the effect of iAs on GC homeostasis. This study investigates the long-term effect of early-life iAs exposure on GC homeostasis in humans. Differences in plasma GC levels between individuals with high (N=54) versus low (N=47) early-life iAs exposure currently living in Antofagasta, a city in northern Chile historically exposed to arsenic-contaminated drinking water, were measured using a novel cell-based bioassay. Individuals in the highest tertile of cumulative iAs exposure had lower plasma GC levels than those in the lowest tertile of exposure. A flatter diurnal GC slope was also observed among the highest cumulative exposure group. These results demonstrate that early-life iAs exposure may have long-term effects on GC homeostasis and highlights the potential endocrine disrupting effects of iAs in humans. Future studies should evaluate the role of GCs in the etiology of arsenic-related disease in order to inform interventions and policy aimed at reducing iAs exposure, particularly during early-life.

D1-30. Metabolic profile changes in a liver injury mouse model following PCB 126 exposure

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Exposure to PCB126 can lead to wasting disorders, metabolic diseases, and nonalcoholic fatty liver disease. However, the role of a compromised liver in modifying dioxin-like PCB126 toxicity is unclear, and the association of metabolic profiles with toxicity can help to understand disease risks. In this 14-week study, mice were fed either an amino acid control diet or a methionine-choline deficient diet (MCD) which promoted liver dysfunction, and were subsequently exposed to PCB 126 (0.5 mg/kg). The liver metabolome was profiled by global metabolomics analysis using LC-MS. We identified specific metabolites that contributed to pathways of perturbed energy metabolism. In addition, PCB exposure markedly increased metabolites associated with the pentose phosphate pathway in MCD treated mice, events which overlapped with elevated levels of uric acid. Furthermore, several pathways involved in increased inflammation were also induced in MCD+PCB126 treated mice, which agrees with our gene analyses. Finally, increased activity of the pentose phosphate pathway suggests a dysfunctional cellular redox status due to a compromised liver and exposure to PCB 126. In conclusion, this study demonstrates that liver injury can markedly modify the metabolic profile induced by PCB exposure. These data have translational implications, suggesting that people with liver dysfunction, e.g., non-alcoholic fatty liver disease, may be more vulnerable to environmental insults. (Supported in part by NIEHS/NIH grant P42ES007380)

D1-31 ESE. Nanostructured Metal-Polymer Reactive Membranes for PCB Remediation

Michael J Detisch, T. John Balk, Dibakar Bhattacharyya (University of Kentucky, Department of Chemical & Materials Engineering)

Polymer membranes are used in industries from desalination to dairy production to pharmaceuticals for separations applications. The incorporation of transition metals into these well understood commercial materials allow for their use in extreme environments and for the addition of catalytic capabilities to the membrane’s application. In this research thin films of Fe/Pd have been produced on top of commercial polymer membranes via magnetron sputtering. These relatively dense films are made nanoporous through dealloying and form high surface area structures. For the Fe/Pd films produced here, a nanoporous structure with characteristic ligament size of 7.7 ± 2.5 nm was
generated. Through this method the membrane may be used for typical separations and also as a catalyst to drive reactions, for instance in the degradation of pollutants in wastewater.

In this study, membranes with a porous metallic top layer have been used with hydrogen gas in order to degrade 2-chlorobiphenyl (PCB-1), a toxic pollutant found in many US superfund sites. In batch testing at a Pd loading of 6.6 mg/L in a 2.5 ppm PCB-1 solution with 1.5 ppm dissolved H2, the composite membranes were found to remove over 90% of PCB-1 from solution in 30 minutes. Biphenyl, the product of the dechlorination reaction of PCB-1, was detected confirming the reaction took place. This novel method for producing composite membranes constitutes an alternative approach to incorporate catalytic materials into membrane structures by anchoring thin films to the membrane’s surface. These composites function both as membranes for separations in conditions that may otherwise destroy or damage the polymer membrane surface and as reactors for converting or degrading compounds as they pass through the membrane structure.

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**D1-32. NIEHS Translational Research Framework**

Christie Drew, Michelle Heacock (NIEHS), Kristianna Pettibone (NIEHS) et al.

The National Institute of Environmental Health Sciences (NIEHS) is proposing a translational research framework (TRF) that introduces three key adaptations from previous models. First, we re-envision the basic science phase of translation to better capture the nuance of the fundamental questions studied there. Second, we change the graphic representation from linear connections to concentric circles and added nodes on each ring to describe activities that might be conducted as part of each translational phase. And third, we define any research that either bridges nodes within a ring, or that crosses rings, as translational. The TRF reflects grantee input and builds on previous NIH models that focused on improving health via clinical strategies. To ensure broad applicability, the TRF includes environmental health prevention strategies, mechanistic and epidemiological research, engineering strategies, clinical research, community engagement and policy. As a portfolio analysis and evaluation tool, the TRF enables us to track and describe research as it moves through the translational research spectrum and to give “credit” to research that bridges nodes in the fundamental questions (basic science) ring.

This poster illustrates the TRF and shows an example of how it can be used to assess the translational research nature of a project.

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**D1-33 ESE. The effects of LED blue-enriched white light on self-reported worker wellbeing**

Ariane Dumas, Dr. Eileen McNeely, Co-Director of SHINE at the Harvard TH Chan School of Public Health Center for Health and the Global Environment

Objectives Ambient exposures to 17,000 K LED blue-enriched white light have been associated with improvements in worker wellbeing. The authors chose to evaluate the impact of 17,000 K LEDs on self-reported worker wellbeing to 4,000 K standard fluorescent white light and verify that sleep quality would be improved among those exposed to 17,000 K LEDs compared to 4,000 K standard white light. Unlike other studies, participants were blinded to the lighting intervention.

Methods The experiment was conducted on 13 workers in two offices with identical layouts. After baseline assessments under existing lighting conditions (4,000 K standard white light), an Experimental Group composed of five engineers moved to a new office space lit with 17,000 K LEDs. The new space was identical to the previous space with the exception of lighting conditions. Surveys were used to assess alertness, mood, sleep quality, feelings of stress, headache and eyestrain.
throughout the 12-week intervention.

Results Altogether, 11 participants were included in the analysis. Compared with 4,000 K white light, 17,000 K LED light improved symptoms of headache and eyestrain, time to sleep latency, and length of nocturnal sleep, although these results were not statistically significant. Those exposed to 17,000 K LEDs also exhibited increased symptoms of stress, decreased self-reported quality of nocturnal sleep, decreased job engagement, and decreased job satisfaction, although these results were not statistically significant.

Conclusions Exposure to 17,000 K LEDs seems to improve alertness, comfort, and feelings of fatigue, although expansion of data collection to a larger population is recommended to achieve statistical significance.

D1-34 HS. Assessment of mouse and human serum cumulative, ligand-induced peroxisome proliferator activated receptor $\gamma$ agonist activity

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Peroxisome proliferator activated receptor-gamma (PPAR$\gamma$) coordinates fat and bone cell differentiation, as well as fat cell function and insulin sensitivity, and thus is an essential regulator of both metabolic and bone homeostasis. PPAR$\gamma$ is targeted by a growing class of environmental, endocrine disrupting chemicals. Here, we developed and validated a bioassay to quantify cumulative PPAR$\gamma$ agonist activity in biological samples, using a rodent model and commercial human serum samples. Further, we analyzed the PPAR$\gamma$ Agonist Activity Assay using serum from a Danish based cohort study (Snart Foraeldre) with well-characterized chemical exposures measured in serum and urine samples (N=73). In the bioassay, Cos-7 cells are transfected with an expression vector for human PPAR$\gamma$, a DR1, PPRE-driven luciferase reporter construct and an eGFP-expressing control vector. We found that Cos-7 cells express sufficient endogenous RXR to support robust PPAR$\gamma$ transcriptional activity. Rosiglitazone, a highly potent and efficacious synthetic PPAR$\gamma$ ligand, was used to characterize the dose response of PPAR$\gamma$ activation in the bioassay and then was used as a positive control in which to normalize experimental samples. Sera from mice dosed with known quantities of rosiglitazone activated PPAR$\gamma$-dependent transcription in the bioassay in a dose-dependent manner. By titrating the amount of human commercial serum in the bioassay, we characterized the shape of the dose response and determined the lowest volume that would provide a maximal signal. Comparison of human serum from different commercial sources showed a range of PPAR$\gamma$ Agonist Activities. Finally, we tested the assay using human sera from a cohort with known environmental chemical exposures. By correlating the measured activity from Danish cohort samples with their exposure histories, we are testing the biomarker’s applicability in epidemiological assessments.

D1-35 HS. Association between maternal stress during pregnancy and pregnancy outcomes in Puerto Rico

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Preterm birth, the leading cause of infant morbidity and mortality worldwide, disproportionally impacts infants in Puerto Rico. Maternal stress may be a potentially modifiable risk factor for preterm birth. We examined associations between perceived stress and negative life experiences during pregnancy on gestational age using the Perceived Stress Scale and Life Experiences Scale. We included 840 mother-infant pairs of the Puerto Rico Testsite for Contamination Threats (PROTECT) Cohort, which examines environmental risk factors for preterm birth. All infants were born in the Northern Karst region of Puerto Rico. Data are collected during prenatal visit using structured interviews including demographics, medical, family, and occupational history. Perceived stress was classified as low (33%), medium (22%), and high (44%). Life Experiences Scale was based on the sum of negative life events experienced during pregnancy (median=1, range 0-12). Younger maternal age and lower maternal education were associated with higher perceived stress and increased number of negative life experiences. High compared to low perceived stress was associated with a non-significant decrease in gestational age ($\beta$: -0.04; 95% confidence interval (CI): -0.33, 0.25). An increase in the number of negative life events was similarly associated with a non-significant decrease in gestational age ($\beta$: -0.02; 95% CI: -0.08, 0.05). Although our findings show that perceived stress and negative life experiences are not associated gestational age, there are many other facets of stress, such as depression and anxiety that should be considered. Puerto Rican women may experience greater socioeconomic burden, making them a high-risk group for adverse effects of stress. Future research should examine how maternal stress impacts other environmental exposures, such as chemical and phthalates, and how these exposure impact gestational age.

D1-36 ESE. Multiple Electron Transfer Components Participate in the First Step of Dioxin Metabolism

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Sphingomonas wittichii RW1 is of great interest for its diverse metabolic activities. S. wittichii RW1 uses a unique angular dioxygenase system to break down the recalcitrant carbon structure of dioxin. Previous studies showed that the RW1 dioxygenase possibly functions with multiple ferredoxins and reductases. However, how many genes are actually involved in the electron transfer remains to be elucidated. Here we report the characterization of the essential electron carrier proteins, a ferredoxin and a reductase implicated in dioxin metabolism by generating single and/or double knockout mutants of each electron transfer component. The single and double knockout mutants were examined on minimal medium supplemented with dioxin or dibenzofuran for growth ability. Screening tests revealed that either RedA1 or RedA2 and Fdx1 or Fdx3 are able to serve as an electron donor and to oxidize NADH in the first step of the dioxin degradation pathway. The single knockout mutant of each of the electron transfer components showed no effect when S. wittichii RW1 was grown on dioxin or dibenzofuran while the double knockout mutant of the same component abolished growth on both of the substrates, confirming that two electron carrier proteins, Fdx1 and Fdx3, RedA1 and RedA2 participate in transferring electrons to the initial dioxygenase. This proves that the two ferredoxins and the two reductases are reciprocal in their function. Our work provides in vivo physiological proof of the role of the two reductases and two ferredoxins in dioxin metabolism thus complementing the
D1-37 HS. Effects of the Trichloroethylene Metabolite S-(1,2-Dichlorovinyl)-L-cysteine on Programed Cell Death in Human Cytotrophoblasts

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Trichloroethylene (TCE), a prevalent Superfund contaminant, poses an ongoing risk to human health. Despite acceptance as a renal toxicant, the effects of TCE and its metabolite S-(1, 2-dichlorovinyl)-L-cysteine (DCVC) on the human placenta have only minimally been explored. Elevated apoptosis, a type of programed cell death, has been observed in placental cells in various placental pathologies. Our study assessed the effects of DCVC exposure on apoptosis in human placental cells. Human extravillous trophoblast cells, HTR-8/SVneo, were exposed in vitro to 10–100 µM DCVC for 12 or 24 hours. Following exposure, apoptosis was measured using flow cytometry. In addition, caspase 3/7, 8 and 9 activities were measured using the Caspase Gl® luminescence assay. The study demonstrated that exposure to DCVC for 24 h significantly (p<0.05) increased apoptosis, accompanied by increases in caspase 3, 7, 8 and 9 activity in HTR-8/SVneo cells. Total apoptosis increased from 6.38% (control) to 14.73% and 23.48% with 50 and 100 µM DCVC treatment, respectively. Treatment with 20 and 100 µM DCVC increased caspase 3/7 activity by 88.6% and 155.5% at 24 h, respectively, compared with time-matched controls. Caspase 8 showed 30.6% and 70.2% increases in activity, whereas caspase 9 showed 41.4% and 69.6% increases in activity. These findings add to evidence that exposure to TCE may contribute to adverse pregnancy outcomes, warranting further assessments on the impact of pregnant women living near Superfund Sites. Furthermore, as part of an effort to educate regulatory stakeholders, we recently presented our results to the California Department of Public Health which manages multiple Superfund Sites contaminated with TCE.

D1-38 HS. Dioxin increases bone density in male and female mouse femurs

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Dioxins including 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) are a class of environmental contaminants which elicit a broad spectrum of toxic responses through activation of the aryl hydrocarbon receptor (AhR). Accumulating evidence demonstrates that the AhR regulates bone structure and density in a species-, ligand-, and age-specific manner, however the underlying mechanisms remain poorly understood. We examined the effects of TCDD (0.01-30 μg/kg) on the microarchitecture and gene expression of femurs from male and female mice treated every 4 days for 28 days. Trabecular (‘spongy’) bone mineral density (BMD) and bone volume fraction (BVF) were increased 2.5- and 2.9-fold respectively, in male femurs, with similar increases in females. Additionally, the number of fat cells in the trabecular region of the femur was reduced 4.1-fold in both sexes. Decreased serum levels of bone turnover markers including tartrate-resistant acid phosphatase (TRAP), amino-terminal propeptide of type 1 collagen (P1NP), and osteocalcin, combined with the femoral repression of genes required for bone degradation, suggest both bone degradation (‘resorption’) and formation were affected by TCDD. Gene expression changes in the male femur were associated with bone development and regulation of mineralization, ion transport,
heme synthesis, and inflammation. Notably, femoral expression of transmembrane glycoprotein NMB (Gpnmb), which plays a crucial role in bone cell activation and function, was induced 18.8-fold. Moreover, increased serum levels of active vitamin D3 may contribute to impaired bone turnover. In summary, AhR activation by TCDD alters the bone resorption - formation balance, resulting in increased bone density. These results suggest that environmental contaminants may contribute to the development of metabolic bone disorders such as osteopetrosis.

D1-39. Characterization of a silent pathway for biphenyl degradation in Sphingomonas wittichii RW1
Rayan Faisal, Thamer Mutter, and Gerben Zylstra

Sphingomonas wittichii RW1 is known for its unique ability to degrade dibenzofuran and dibenzo-p-dioxin. Even though this strain is unable to use biphenyl as a sole carbon source, our previous experiments showed that its angular dioxygenase can attack biphenyl at a lateral position producing 2,3-dihydro-2,3-dihydroxybiphenyl. Furthermore, the 2,2',3-trihydroxybiphenyl dioxygenase involved in the DBF and DD pathway, dbfB1, showed activity towards 2,3 dihydroxybiphenyl almost the same as measured for the 2,2',3-trihydroxybiphenyl formed from the DBF degradation pathway. All these facts collectively led us to hypothesize that the same genes for DBF and DD degradation can show activity toward biphenyl intermediates and that the only missing step would be the cis-dihydrodiol dehydrogenase. To prove our hypothesis, the gene for cis-dihydrodiol dehydrogenase, bphB, from the biphenyl degrader Sphingobium yanaikuyae B1 was placed downstream the fdx3 gene under the control of the constitutive promoter of the dxn locus in S. wittichii RW1. Interestingly, this engineered strain grew on biphenyl with a doubling time of 3.2 hours revealing a hidden pathway for biphenyl degradation in RW1. To determine the ring cleavage dioxygenase and the hydrolase involved in this pathway, multiple mutants for ring cleavage and hydrolases were tested for their ability to grow on biphenyl after introducing a pRK415 vector carrying bphB. Our results showed the involvement of two different ring-cleavage dioxygenases and two different hydrolases in the biphenyl degradation pathway. This work demonstrates that the enzymes in the upper pathway for DBF and DD degradation have a wide substrate range with activity towards other aromatic hydrocarbons.

D1-40. Application of Bioavailability in Evaluating Remediation Effectiveness
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Compared to the total chemical concentration, bioavailability is a better measurement of risks of hydrophobic organic contaminants (HOCs) to biota in contaminated soil or sediment. Many different bioavailability estimation methods have been introduced to assess the effectiveness of remediation treatments. However, to date the different methods have rarely been evaluated against each other, leading to confusions in method selection. In this study, four different bioavailability estimation methods, including solid phase microextraction (SPME) and polyethylene passive sampling (PE) aiming to detect free chemical concentartion (Cfree), and Tenax desorption and isotope dilution method (IDM) aiming to measure chemical accessibility, were used in parallel to estimate bioavailability of DDT residues (DDXs) in a historically contaminated soil after addition of different black carbon sorbents. Bioaccumulation into earthworm (Eisenia fetida) was measured concurrently for validation. Activated carbon or biochar amendment at 0.2-2% decreased earthworm bioaccumulation of DDXs by 83.9-99.4%, while multi-walled carbon nanotubes had a limited effect (4.3-20.7%). While all methods correctly predicted changes in DDX bioavailability after black carbon amendment, passive samplers offered more accurate predictions. Predicted levels of DDXs in
earthworm lipid using the estimated bioavailability and empirical BCFs matched closely with the experimentally derived tissue concentrations. However, Tenax and IDM underestimated bioavailability when the available DDX levels were low. Our findings suggested that both passive samplers and bioaccessibility methods may be used in assessing remediation efficiency, presenting flexibility in method selection. While accessibility-oriented methods offer better sensitivity and shorter sampling time, passive samplers may be more advantageous because of their better performance and compatibility for in situ deployment.

D1-41 HS. RNA sequencing of regenerating zebrafish fin reveals miRNA-mRNA regulatory networks

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The zebrafish is a well-established model for elucidating molecular pathways involved in tissue regeneration. Understanding how chemicals inhibit the regenerative process has provided valuable insight into mechanisms of chemical toxicity, including toxicity mediated through the aryl hydrocarbon receptor (AHR)[1]. To better understand the regenerative model, we performed RNA sequencing during fin regeneration. Tissue from the initial amputation served as a homeostatic control, and regenerating tissue was collected 24 h later for comparison. Since miRNAs are well-known regulators of regeneration, we isolated both mRNA and small RNA from each sample to establish miRNA-mRNA regulatory networks. Using GOrilla, gene ontology enrichment from the top 500 most up-regulated mRNA transcripts was dominated by nitrogen metabolism, non-coding RNA processing, macromolecule methylation, and the ERAD pathway. The 500 most down-regulated mRNA transcripts included those involved in BMP signaling, MAPK cascade regulation, negative chemotaxis, circadian regulation of gene expression, and aromatic amino acid metabolism. In the miRNA analysis we identified a trend for the up-regulation of oncomiRs (e.g. miR-17 cluster) and down-regulation of tumor-suppressor miRNAs (e.g. miR-216, miR-138). We used Pacific Northwest National Laboratory’s Bioinformatics Resource Manager (BRM) to identify potential targets of miRNAs using our mRNA data. Up-regulated miRNAs anti-correlated with down-regulation of mRNAs involved in axon guidance, cell surface receptor signaling, and ameboidal-type cell migration. Down-regulated miRNAs anti-correlated with upregulated mRNAs involved in rRNA maturation, nitrogen metabolism, redox homeostasis, and protein localization. These data will be valuable for understanding how miRNAs control molecular pathways during regeneration. Furthermore, it will facilitate research on understanding how molecular signaling during developmental processes is perturbed by environmental pollutants.

D1-42 HS. Modulation of the Antioxidant and Antiinflammatory Enzyme Paraoxonase-2 (PON2) in the CNS

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PON2 is a ubiquitously expressed intracellular enzyme with antioxidant functionality. Located at the inner mitochondrial membrane, PON2 associates with respiratory complex III and is thought to play a role in scavenging radicals generated through electron transport during cellular respiration. Several lines of evidence also indicate that PON2 plays an important role in protecting the CNS from oxidative
stress. Neuronal cells from PON2 deficient mice are more sensitive to oxidative challenge (H2O2 and DMNQ) than cells from wildtype mice, despite similar levels of glutathione. In the brain, PON2 expression levels vary by region, with the highest expression found in dopaminergic regions (substantia nigra and striatum). PON2 has been shown to play a role in the renal dopaminergic system, with PON2 associating with dopamine receptors (DR) 1, 2 and 5 in the proximal tubules and functioning to maintain homeostatic blood pressure in an antioxidant capacity by inhibiting NADPH oxidase 2 (NOX2). With this, we sought to investigate the role of PON2 in the CNS dopaminergic system. Initial studies indicate no alterations in dopamine receptors 2 and 5 protein expression between wildtype and PON2 deficient striatal tissue, owed to the possibly that PON2 acts downstream of these receptors. As well, minimal changes in NOX2 protein levels were observed between PON2 deficient and wildtype striatal tissue, suggesting potential compensatory mechanisms in the brain that are not present in renal tissue. Given the potential antioxidant benefit, modulation of PON2 in the brain may represent a fruitful, novel avenue for neuroprotective strategies. (Supported in part by P42ES04696, P30ES07033, T32 ES007032-37, R01ES022949, R01ES028273).

D1-43 HS. Characterization of asbestosis-induced DNA adducts of lipid peroxidation products
Kevin Gillespie, Clementina Mesaros, PhD, Ian A Blair, PhD (University of Pennsylvania)
A persistent issue in monitoring and preventing asbestos-related disease is the absence of accessible biomarkers that track with disease progression. Although much of the work has focused on protein biomarkers, known asbestos-driven pathologies provide other exploitable areas of biomarker discovery. Asbestos fibers induce oxidative stress-related transcription factors nuclear factor kappa-B (NF-kappa B) and activator protein-1 (AP-1) in mammalian cells. However, prevention of this induction by inhibition of lipoxygenases suggests that chronic lipid peroxidation may be an important mediator of asbestos-related disease. To monitor certain biological consequences of asbestos-driven lipid peroxidation, we have expanded a previously developed liquid chromatography tandem mass spectrometry (LC-MS/MS) methodology for DNA adducts derived from lipid peroxidation products. Historically, asbestos-induced lipid peroxidation has been most commonly demonstrated with thiobarbituric acid reactive substances (TBARS) assays. However, this assay is neither selective for lipid peroxidation products nor informative of their diversity, and it is also not easily amenable to clinical applications. To better distinguish asbestos-driven DNA adduction from general oxidative effects, we have chosen to monitor both nuclear and mitochondrial DNA in human cell culture cell lines for specific nucleotide modifications with lipid peroxidation products, including 4-hydroxynonenal (HNE) and 4-oxononenal (ONE). Crocidolite asbestos fibers are herein shown to increase a subset of lipid peroxidation product-derived DNA adducts in human cell culture, which is consistent with other forms of asbestos-driven oxidative damage.

D1-44. An Overview of Activated Carbon as a Remediation Tool for Mercury-Contaminated Marsh Soils
Cynthia Gilmore, and Grace Schwartz (Smithsonian Environmental Research Center, Edgewater, MD, USA); Upal Gosh and James Sanders (University of Maryland Baltimore County); Drew Bodaly (Penobscot River Mercury Project); Steven Brown (The Dow Chemical Company)
In situ Activated Carbon (AC) amendments offer an attractive, potentially low impact approach for reducing contaminant bioavailability in ecologically sensitive environments. Over the last few years, we have carried out several field and laboratory trials to evaluate the efficacy of activated carbon (AC) as a remediation tool for mercury (Hg) in contaminated marsh soils and estuarine sediments. Field trials of thin-layer AC placement were carried out at the plot scale in three Hg-contaminated locations: a salt marsh in Maine, a Phragmites marsh in, NJ, and a tidal creek bottom in the Chesapeake. These
studies showed that AC can successfully reduce inorganic mercury (Hg) and methylmercury (MeHg) in porewater (up to 95%), and bioavailability to benthic organisms. However, the effectiveness of AC in reducing Hg and MeHg bioavailability varies among sites and soils. We will discuss the efficacy of AC in each of the field studies, in relation to site geochemistry, and over time. Field work has been supported by laboratory studies on the impact of sediment chemistry and microbial activity on AC efficacy, and the impact of AC amendments on net MeHg production. The work is supported by industry stakeholders and the NIEHS Superfund program. Our goal is to develop an empirical model that will allow end-users to evaluate the potential efficacy of AC as a Hg-remediation tool for specific sites. We are currently working with stakeholders to develop thin-layer AC placement as a potential remediation tool for the NJ and Maine sites.

D1-45. Investigating the kynurenine pathway as a link between environmental exposures and related health outcomes: Building laboratory capacity

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Tryptophan is an essential amino acid involved in critical biological processes of humans. The majority of ingested tryptophan is processed through the kynurenine pathway where tryptophan is enzymatically metabolized into a variety of metabolites known as kynurenines. The up-regulation of the principal enzyme in the kynurenine pathway depletes tryptophan thus increases the production of kynurenines which causes a significant imbalance in tryptophan and its metabolites. This observation has been linked to many diseases including neurodegenerative, mood and immune disorders. Inflammatory markers such as cytokines, reactive oxygen species and interleukins are all capable of causing this enzymatic up-regulation. Studies have shown significant associations between exposures to environmental contaminants and kynurenine pathway dysregulation. In addition, environmental exposures have been linked to inflammatory responses markers that are capable of up-regulating the kynurenine pathway. However, the interrelation of environmental exposures, kynurenine pathway dysregulation, and observed health outcomes has not been fully explored. We present a core function of the Laboratory of Exposure Assessment and Development for Environmental Research (LEADER): building the capacity to simultaneously characterize human exposures to environmental contaminants and evaluate the regulation of the kynurenine pathway by analyzing a large number of exposure biomarkers and tryptophan and its major kynurenine metabolites in biological matrices using a single liquid chromatography-Fourier Transform-high resolution mass spectrometry method. Integration of this capacity into existing and future epidemiological investigations aiming to evaluate the relation between health outcomes and environmental exposures will enable us to gain insight into plausible, biological mechanisms contributing to the development of environmentally-related diseases or outcomes.

D1-46. Mixture Toxicity Prediction via Quantitative Toxicogenomics-based Approach

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Mixture assessments from toxicogenomic studies is as yet mainly observational and quantitative prediction of the combined effects is lacking. In this study, we demonstrated the application of a toxicogenomic-based approach for investigating the combined effects of various binary mixtures with a range from environmental relevant concentration to the benchmark level. A high-throughput mechanistic toxicicogenomics assay was employed to measure the altered gene expression level in
over 100 genes that cover most known stress response pathways in 5 binary mixtures. Quantitative omic-index TELI was used to quantify the molecular response. Two additive models, concentration addition (CA) and independent action (IA), were explored for mixture toxicity prediction and comparison.

Distinct gene expression profile were obtained for the mixtures and their single components. The toxicity profiles were both chemical-specific and concentration-dependent. The toxicity profiles indicate both conservative and distinct responses among mixtures and their single components. PCA analysis of stress response profiles show that some mixtures are clearly separated from with their single components, while others are mixed with their components. Cellular level responses (indicated by quantitative omic-index TELI) evoked by the mixtures exposure exhibited clear dose-response patterns as single chemicals did. The modified CA and IA model predicts the mixture effects well for some mixtures.

Our results for the first time demonstrated that the concept of combined effects are presented at molecular level and they seem to comply with current mixture toxicity model for some chemicals binaries. The possibility to explicitly predict the combined effects at the molecular level have been showed. Although most of the mixture exhibited additive effect in our results, further investigation is required for better understanding of the factors that influence the combined effects.

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**D1-47 ESE. Influence of Fe2O3 Content in Fly Ash on PCDD/Fs Formation**

Xia Guan, Slawo Lomnicki, Department of Environmental Sciences, Louisiana State University

Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) are byproducts of industrial and thermal processes. As one of the predominant transition metals in fly ash, the catalytic activity of iron for the formation of PCDD/Fs has been extensively investigated. However, the concentration of iron in fly ashes from municipal waste incinerators vary depending on facilities and sampling time. The correlation between the content of iron and the yields of PCDD/Fs has never been studied. Three fly ash surrogates containing 1%, 2.5%, and 4% of Fe2O3 were prepared and their effects on the PCDD/Fs formation were investigated and compared to typical 5% iron oxide sample. Our results showed that under pyrolysis conditions, the total PCDD/Fs yields increased with the increasing content of iron in the fly ash surrogates. The yields of mono-chlorodibenzo-p-dioxin and dichlorodibenzofuran followed the same trend; dibenzofuran and dibenzodioxin were only formed on 5% of Fe2O3.

PCDD/Fs formation was by chemisorption of chlorinated phenols to Fe2O3 to form phenoxy-type, environmental persistent free radicals (EPFRs), which subsequently react to form PCDD/Fs. 1%, 2.5%, 4% and 5% of Fe2O3 were dosed with 2-monochlorophenol vapor for the study of EPFRs formation. The results showed concentration of the EPFRs increased with the increasing amount of iron, which is consistent with the yields of PCDD/Fs. The surrogates were characterized using transmission electron microscopy and X-ray diffraction. The size of the Fe2O3 particles was within 3-9 nm; 1% of Fe2O3 sample was amorphous; crystalized and larger Fe2O3 particles formed on 4% and 5% surrogates. Our results demonstrate iron content in the fly ash influences the morphology and structure of the Fe2O3 nanoparticles, thus EPFRs and PCDD/Fs formation. It will provide a guide in developing predictive models for PCDD/Fs emissions for iron rich fly ashes.

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**D1-48. Perturbation of mitochondrial function and endoplasmic reticulum stress are key cellular mechanisms in the chronic toxic effects of xenobiotics**

Nipavan Chiamvimonvat,1 Aldrin V. Gomes,2 Fawaz G. Haj,3 Christophe Morisseau,4 and Bruce D

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**PLEASE NOTE:** Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
Hazardous waste sites contain complex mixtures of a wide variety of toxic chemicals that contaminate and linger in the environment. The acute toxicities of numerous Superfund (SF) chemicals have been extensively investigated; however, further studies are needed to determine their chronic effects on human health. Our preliminary studies suggest that most of the reactive oxygen species (ROS) induced by SF chemicals originate mainly from the mitochondria (named MOS) and that, for example, CCl₄-induced cardiomyocyte cell death is partly caused by impaired proteasome activity. Separately, we observed that increases in ROS levels affects several cellular pathways including cellular proteostasis, apoptosis, and endoplasmic reticulum (ER) function. Furthermore, in animal models, long-term exposure to CCl₄ leads to ER stress in tissues, resulting in fibrosis and organ damage. The mitochondrial - ROS - ER stress axis of cellular damages is not only affected by xenobiotics but also by drugs, such as diclofenac, and nutritional status, such as the type of fat intake, highlighting possible overall effect of the environment on health. Additionally, we showed that natural epoxy-fatty acids can reduce mitochondrial dysfunction, decreasing subsequent ROS formation and preventing changes in cellular signaling cascades, primarily the ER stress, opening an avenue for potential therapy. Beside understanding the mechanism of chronic toxicity of SF-chemicals, we are developing fast, inexpensive and reliable new cell-based bioassays to detect, assess and quantitate the effects of hazardous substances on mitochondria functions and ER stress to assess risk on human health from exposure to chemicals.

D1-49 HS. Polychlorinated biphenyls and trace metals in soil and blood of participants in the AESOP Study cohort in East Chicago

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Polychlorinated biphenyls (PCBs) are mixtures of persistent organic pollutants comprised of 209 congeners depending on the number and position of chlorine atoms. Despite being banned from production in 1979 in the U.S., their physicochemical properties have kept them prevalent in the environment today and for the future. PCBs are commonly found in areas with industrial activities, which tend to also have presence of other toxic, bioaccumulative environmental pollutants such as trace metals. Recently, there has been a rise in concern for potential adverse effects from co-exposure to PCBs and trace metals. For this study, we assessed concentrations of trace metals in sidewalk surficial soils in proximity to a cohort in the Airborne Exposure to Semivolatile Organic Pollutants (AESOP) Study which has been following mothers and their children in East Chicago, IN and Columbus Junction, IA since 2008. Surficial soil samples (n=200) from sidewalks were collected in accordance to U.S. EPA Soil Sampling Guidelines (Method #SESDPROC-300-RI) using a soil sampling core which were then analyzed in situ using X-ray fluorescence spectroscopy (XRF) for Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Zr, Mo, Ag, Cd, Sn, Sb, Ba, Hg, and Pb. Concentration of lead in East Chicago was found to be significantly greater than Columbus Junction (p<0.01). Furthermore, lead in soil was found to be greater than the EPA maximum contaminant level (MCL) of
400 ppm in 40% and 0% of the samples from East Chicago and Columbus Junction, respectively. Trace metals in clotted blood were analyzed using inductively coupled plasma-mass spectrometry (ICP-MS) using an acid digestion protocol from the CDC (Method 8005). Results from analysis of a subset of blood clot samples indicate the presence of trace metals in blood of AESOP Study participants in East Chicago. These preliminary results indicate the presence of aforementioned pollutants in East Chicago soil environment and blood and in some cases significantly above the regulatory limits. Ongoing work seeks to better understand the mechanisms responsible for synergistic toxicity resulting from co-exposure to PCBs and trace metals.

D1-50. Genome-wide Expression Profiling Reveals Group B Streptococcus Activates Pathways Related to Inflammation and Premature Birth Outcomes In Human Extraplacental Membranes In Vitro

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Streptococcus agalactiae (group B streptococcus, GBS) infection in pregnant women is the leading cause of infectious neonatal morbidity and mortality in the United States. Genital GBS colonization of pregnant women is associated with preterm birth and low birth weight. Although inflammation during infection has been associated with preterm birth and the potential contribution of GBS to adverse birth outcomes has been implicated, the early mechanisms by which GBS interacts with gestational tissue to affect these outcomes are poorly understood. In addition, potential interaction effects between microbial infections and toxicants in gestational tissues are largely unstudied. The current study describes preliminary experiments in which we utilized transcriptomics to evaluate an in vitro model of placental membranes under a state of GBS infection. A transcriptomic analysis of gene expression changes in GBS-inoculated membranes revealed that GBS activated pathways related to inflammation and preterm birth as early as 4 hours post inoculation. In addition, pathways related to DNA replication and repair were down-regulated with GBS treatment. Conclusions based on our transcriptomics data were further supported by responses of prostaglandin E2 (PGE2) and matrix metalloproteinases 1 (MMP1) and 3 (MMP3), which are known to be involved in parturition and premature rupture of membranes. These results demonstrate that fetal membranes in this in vitro model respond to GBS inoculation in a manner consistent with microbially-induced pregnancy complications, setting the stage for future experiments investigating co-treatment with GBS and environmental toxicants found at Superfund sites. Our lab collaborates with PROTECT’s Research Translation Core to coordinate the dissemination of findings to entities including local stakeholders in Puerto Rico as well as the entire Superfund Research Program community.

D1-51. Humanized, Transgenic Caenorhabditis elegans to Study CYP2E1-Induced Mitochondrial Dysfunction and Neurodegeneration

Jessica H. Hartman (1), Kacy L. Gordon (2), David R. Sherwood (2), and Joel N. Meyer (1)

PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
Cytochrome P450 2E1 (CYP2E1) is a mammalian enzyme primarily expressed in the liver that metabolizes small hydrophobic pollutants, drugs, and endogenous molecules. CYP2E1 metabolism results in detoxification and improved elimination or, paradoxically, bioactivation to reactive (toxic) metabolites. Understanding CYP2E1 metabolism and its consequences will therefore improve risk assessment for exposures to CYP2E1-activated compounds. Of particular interest to this project is mitochondrial toxicity and neurotoxicity associated with the volatile organic pollutants trichloroethylene and methanol, processes which we hypothesize are CYP2E1-dependent. To test this hypothesis, we generated novel C. elegans nematode strains that express human CYP2E1. Wild-type nematodes do not express CYP2E1, and therefore have no background activity, while our transgenic animals displayed robust CYP2E1 activity. CYP2E1 expression alone caused changes to mitochondrial morphology, manifesting in more fragmentation and disruption of mitochondrial networks compared to age-matched wild-type controls (p<0.001). Furthermore, a 48-hour exposure of adult CYP2E1-expressing nematodes to the classic CYP2E1-activated drug acetaminophen resulted in significantly more lethality (25% at 3mM, 50% at 25mM) compared to wild-type N2 nematodes, which did not show any lethality up to 25mM acetaminophen. By contrast, wild-type larval nematodes were sensitive to acetaminophen-induced growth delay, possibly due to disruption of developmental signaling, while CYP2E1-expressing nematodes were protected from this delay (p<0.01). Future and ongoing experiments will determine the relative sensitivity of CYP2E1-expressing nematodes to CYP2E1-activated mitochondrial toxicants methanol and trichloroethylene, including lethality and sublethal endpoints such as neurodegeneration and mitochondrial dysfunction. Ultimately, the results of this study will reveal the role of CYP2E1 in driving toxicant-induced mitochondrial dysfunction and neurodegeneration.

D1-52. Sex Differences in Neurotoxic Effects and Neurotoxic Effects on Sex Differences

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The most common genetic polymorphism is sex. The most obvious sex differences are in reproduction but other sex differences exist. As with factors like height, sex differences in non-reproductive behaviors are not dichotomous but have overlapping continuous distributions. Many studies including our own have shown that neurotoxicants can have differential effects in females and males. In some cases, these effects diminish or reverse normal sex differences in neurobehavioral function. In rats, we have found that exposure to the organophosphate insecticide chlorpyrifos (CPF) significantly reduces normal sex differences in radial-arm maze spatial working memory, where males typically have fewer working memory errors than females. Low-dose neonatal CPF exposure (1 mg/kg/day, postnatal days 1-4) to rats reduces errors in females and increases them in males, eliminating this normal sex difference. Neurotoxic diminution of normal sex differences is not limited to insecticides. Developmental exposure of rats to a low dose (0.03 mg/kg/day throughout gestation) of the polyaromatic hydrocarbon (PAH), benzo-a-pyrene (BaP) causes a significant reversal of a normal sex difference in locomotor activity in which female rats are normally more active than male rats. Prenatal BaP exposure causes hyperactivity in males but not females, eliminating the normal sex difference in locomotor behavior. Sex-selective effects are also seen with nicotine and BaP exposures in emotional and cognitive tests. Low dose developmental exposure to BaP can have diverse, persistent effects on behavior that impact typical sex differences. The present data will be used to
D1-53. Determining olfactory toxicity for three common metals present at Superfund sites using zebrafish (Danio rerio) as a model species

Kevin Heffern, and Evan P. Gallagher

Olfactory-mediated behaviors are critical for fish survival, but studies have shown that these behaviors can be disrupted on exposure to certain metals. Although aquatic Superfund sites often contain elevated levels of various metals, few have been characterized for potential olfactory toxicity. Here, larval zebrafish are used as a model system to study changes in olfactory function following exposure to under investigated metals. A behavioral assay was developed to characterize dose-response curves for zinc (Zn), hexavalent chromium (Cr), and arsenate (As) olfaction inhibition. Cadmium (Cd), a known olfactory toxicant, is used as a positive control. As expected, following a 24-hour exposure to Cd, a reduced response to the aversive odorant TCA was observed, validating the behavioral assay. At higher concentrations, Zn also elicited a decrease in response to TCA (EC50: 30µg/L and 64.4µg/L respectively). No significant changes in response were observed for Cr and As, even at exposures far exceeding environmental concentrations. Binary mixtures of Cd and Zn demonstrated a protective effect of Zn against Cd toxicity at low concentrations not present at higher concentrations. Following exposure, whole body expression of genes important in maintaining the redox status of cells including prdx1, gstpi, nqo1, sod1/2, hmox1a, gclc and gpx1a showed minimal induction suggesting that NRF2 is not critical in Zn, As, and Cr cellular response. This study supports the use of zebrafish as a model species for olfactory injury of teleost species. Supported by NIEHS Superfund P42-04696.

D1-54 HS. Accurate Quantification of HMGB1 as a Potential Biomarker for Mesothelioma

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High mobility group box-1 (HMGB1) is an important non-histone chromosomal protein for transcriptional regulation. HMGB1 is normally localized to the nucleus where it facilitates transcription by binding to minor grooves in DNA and allowing other proteins to bind. HMGB1 can also be acetylated on its two nuclear localization sites (NLS) preventing its re-entry into the nucleus. HMGB1 can also be secreted by immune cells and interact with members of the pro-inflammatory pathway. The role of HMGB1 in the infectious inflammatory responses demonstrates that HMGB1 is a potential biomarker for malignant mesothelioma (MM) and asbestos exposure. A recent report reveals that the serum levels of both HMGB1 and acetylated HMGB1 are elevated in MM patients using an HMBG1 ELISA kit. Herein, we developed a stable isotope dilution HPLC-MS method, which has higher sensitivity and specificity compared with ELISAs, to accurately quantify the HMGB1 levels in serum. Stable isotopically labeled HMGB1 was expressed using stable isotope labeling amino acids in cell culture (SILAC) strategy and was added as the internal standard. Following the enrichment of low-abundant HMGB1 in serum using anti-HMGB1 antibody, gel electrophoresis was applied to further purify the targeted HMGB1 from other non-specific binding of abundant proteins. Finally, the gel piece containing HMGB1 was sliced and Glu-C was used to digest HMGB1 in gel and yield peptides including two NLS fragments. Absolute quantification was achieved by analyzing the ratio of these peptides from endogenous form and ISTD. The serum HMGB1 levels in mesothelioma patients were
compared with healthy controls and with individuals that were heavily exposed to asbestos. The improved accuracy and enhanced sensitivity of this assay provides a thorough quantification method for HMGB1. Supported by T32 019581 and P42 ES023720.

D1-55 HS. PCB 126 perturbs gut microbiota and increases intestinal inflammation in a mouse model of atherosclerosis

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The gut microbiome is sensitive to diet and environmental factors and is involved in the regulation of many host metabolic responses. Dioxin-like pollutants contaminate many food sources, and thus human exposure begins within the gut, which may play a role in pollutant-induced systemic toxicity. Additionally, gut dysbiosis and inflammation pose risk factors for the development of cardiovascular diseases, specifically atherosclerosis. We hypothesize that the dioxin-like pollutant PCB 126 will perturb gut microbial populations and impair gut health, which may contribute to pollutant-induced systemic toxicity in an atherosclerotic mouse model. LDLr -/- mice were fed a low fat atherogenic diet (10% fat, 0.15% cholesterol) for 14 weeks and exposed to PCB 126 at week 2 and 4. Exposure to PCB 126 reduced gut microbial diversity and shifted populations at the phylum and genus levels in ways that mimic observations in chronic inflammatory diseases. Furthermore, PCB exposed mice exhibited increased markers of inflammation in intestinal and plasma samples. Interestingly, Cyp1a1 gene expression was increased in intestinal samples even 10 weeks after PCB exposure, indicating a slow continual passage of pollutants through the enterohepatic circulation. These data imply that PCB toxicity is already initiated in the gut through disruption of healthy microbiota, and increases in gut inflammation. These observations highlight a unique opportunity for dietary interventions that are beneficial for both gut and overall health. Further research should examine how nutritional components can combat pollutant induced toxicity initiated at the gut level.

D1-56 ESE. Theoretical model of reactive species transport

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Electroremediation involves using direct current across porous electrodes to intercept and transform contamination in groundwater through oxidation and reduction reactions. The system undergoes significant changes in pH, redox potential and therefore species concentrations due to electrolysis reactions. A comprehensive theoretical model that integrates coupled effects of chemical and electrochemical processes facilitates the design, analysis, and implementation. However, developing new models is challenging due to multicomponent species transport. As organic species, e.g. trichloroethylene, are present in different phases and can easily transform, tracking inorganic species, e.g. chromium, is the best way to develop a general theoretical reaction model. Here we present a theoretical model to describe pH changes as a tool to monitor the efficiency of the remediation system.
and chromium concentration as the main contaminant species. This study is to evaluate the result of experimental study by a developed theoretical reaction model that incorporates complexation reactions, acid/base reactions, and precipitation and co-precipitation reactions of chromium and iron species in a batch reactor. pH is evaluated closely as it is one of the main contributors to the system’s efficiency. The model uses volumetric current density to evaluate the iron dissolution in the reactor and uses equilibrium reaction model to evaluate the species concentrations during the transformation process.

D1-57. Quantification of Mercury Biomethylation Potential in Sediments

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Mercury (Hg) in contaminated sediments comprises a variety of chemical forms that are associated with organic matter and sulfide particles, yet only a small fraction of the total Hg pool is generally bioavailable to microorganisms that produce monomethylmercury (MeHg), a bioaccumulative neurotoxin. The reactivity of inorganic Hg at microbial interfaces is likely crucial to determining the uptake and bioavailability of this metal. The development of effective remediation strategies at contaminated sites is greatly limited by the lack of reliable methods to quantify this reactive Hg pool for biomethylation. The objective of this study was to compare the efficacy of diffusive gradient in thin-film (DGT) passive samplers, a thiol-based selective extraction with glutathione, and conventional filtration (<0.2 um) as indicators of Hg bioavailability to methylating microbial communities. These methods were tested on a series of anaerobic sediment slurry microcosms that were amended with multiple, isotopically labelled endmembers of inorganic Hg (204-Hg²⁺, 196-Hg-humic acid, 199-Hg-sorbed to FeS, 200-HgS nanoparticles) with a known range of bioavailability and methylation potentials. Net production of MeHg (as a % of the total) over a one week time frame was generally greater for the dissolved endmembers than the particulate endmembers, as expected. The accumulation of each isotopic Hg(II) endmember on DGTs correlated with %MeHg at each time point in the experiment. In contrast, net methylation poorly correlated with the 0.2-um filter passing fraction of Hg and only sometimes correlated with the thiol extractable fraction of Hg in the slurries. These results suggest that inorganic Hg uptake in DGTs might be useful indicators of bioavailability for methylating sediment microbes. While field testing of this hypothesis is needed, the use of DGTs might be a valuable tool, in conjunction with measures of the methylating microbial community and MeHg degradation, in assessing net Hg methylation potential in contaminated sediment sites.

D1-58 HS. Can Profiles of Poly- and Perfluoroalkyl Substances (PFASs) in Human Serum Provide Information on Major Exposure Sources?

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Humans are exposed to poly- and perfluoroalkyl substances (PFASs) from diverse sources and this has been associated with many negative health impacts. Advances in analytical methods have enabled routine detection of more than 15 PFASs in human sera and this number is growing. Within a population, the composition of PFASs in human sera reflects the complexity of exposure sources but can be confounded by differences in pharmacokinetic processes. In this study, we use available
serum PFAS concentrations from several demographic groups in a North Atlantic seafood consuming community (Faroe Islands) to explore whether the chemical fingerprint in human sera can be used to provide insight into predominant exposure sources. We compare serum PFAS profiles from Faroese individuals to other North American populations to investigate commonalities in potential exposure sources. We minimize confounding by pharmacokinetic differences across demographic groups and changing production and environmental releases by comparing sera collected over similar time periods and individuals with the same genders/ages.

Using principal components analysis (PCA) confirmed by hierarchical clustering, we identify two major groupings of PFASs in the Faroese population. The first cluster consists of C9-C12 perfluoroalkyl carboxylates and is consistent with measured PFAS profiles in consumed seafood. The second major cluster includes perfluorohexanesulfonic acid and PFOS precursor N-ethyl perfluorooctane sulfonamidoacetate, which are directly used or metabolized from fluorochemicals used in consumer products such as carpet and food packaging. We find that the same compounds are associated with the same exposure sources in two North American populations, suggesting generalizability of results from the Faroese population. Research Translation Component: Serum PFAS homologue profiles can provide valuable information on major exposure sources. This information is essential for prioritizing actions to minimize health risks.

D1-59 ESE. Salicylate metabolism by the dioxin and dibenzofuran degrading organism Sphingomonas wittichii RW1

Igor Ivanovski, Suha Eleya, and Gerben J. Zylstra

The polycyclic aromatic hydrocarbons dibenzo-p-dioxin (DD) and dibenzofuran (DF) are among the most pervasive pollutants found in both terrestrial and aquatic environments. DD and DF are persistent in the food chain due to their lipophilic and hydrophobic properties. DD and DF both contain two benzene rings, but DD contains two bridging oxygen atoms while DF has only one bridging oxygen atom. Sphingomonas wittichii RW1 is capable of fully degrading both DD and DF by similar catabolic pathways to carbon dioxide and water. Metabolism of dibenzofuran begins with a multicomponent dioxygenase (oxygenase, ferredoxin, and reductase) forming an unstable dihydrodiol which rapidly ring-opens to form 2,2',3-dihydroxybiphenyl. Cleavage of the dihydroxylated biphenyl ring by a meta-ring cleavage dioxygenase followed by carbon chain cleavage by a hydrolase results in salicylate and a five carbon fragment. Further metabolism of salicylate in S. wittichii RW1 is currently unknown but of the two known salicylate degradation pathways it is suspected that metabolism continues through gentisate rather than through catechol. Three lines of evidence lead to this hypothesis: transcriptomic and proteomic experiments, localization of a suspected salicylate dioxygenase within the gentisate operon, and gene knockout data showing that the initial DD/DF dioxygenase and salicylate dioxygenase share a common ferredoxin and a reductase. We identified other genes and enzymes responsible for salicylate metabolism in S. wittichii RW1 through the construction and testing of knockout mutations. Our results show that salicylate metabolism is a very complicated metabolic function in S. wittichii RW1.

D1-60 ESE. A Framework for Describing PCB Emissions from Paint

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PCBs are inadvertently created in the manufacturing process of pigments used in commercial paints

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and other consumer products. Most of the congeners produced through these processes are the most volatile of PCBs: Monochloro- and dichlorobiphenyls associated with pigments have been measured in air worldwide. Although it is possible that the manufacturing process and use of pigment-embedded consumer products contribute to environmental contamination, we hypothesize that use of architectural paint is the major source of these congeners to air. For example, previous work has shown that paint is responsible for 0.000001% of the PCB stocks in Chicago but is responsible for up to 7% of total PCB emissions. This may be due to the fact that paint is spread in thin layers over large surface areas and readily available for volatilization. Here we report an investigation of the emission of PCB congeners from freshly applied pigment. Preliminary results indicate that gas-phase PCB congeners are released from a pigment sample and captured on polyurethane foam (PUF). The mass of congeners on the PUF increases over time and appears to be independent of drying process. We use this framework to extrapolate small environment data to the city of Chicago and evaluate if paint is the contributing factor to concentrations of PCBs 1, 2, 3, 4, 6, 8, 11, 12/13, and 209. We conclude, from preliminary experiments, that emissions of non-Aroclor PCBs associated with pigments readily volatilize, consistent with reports of the same compounds in ambient air.

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D1-61. Chrysotile Induced Malignant Mesothelioma in a Genetically Engineered Mouse Model

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Malignant mesothelioma (MM) is an incurable cancer linked with asbestos exposure. Although relatively uncommon (3,200 cases annually in the U.S.), clustering of MM occurs in some families, particularly families with germline mutations of the BAP1 tumor suppressor gene. Moreover, somatic mutations of BAP1 occur frequently in MM. Somatic mutations of the CDKN2A and NF2 are also commonly observed in MM, and alterations of all three tumor suppressor genes can occur in combination. Germline mutations of NF2 or CDKN2A have been reported in rare cases of MM. Although there is abundant evidence that a mesoite and crocidolite cause MM, there is less evidence that chrysotile produces MM in animals and humans. Because of its wider use and its predominance at the Ambler, PA Superfund site, we sought to assess the carcinogenicity of chrysotile in two genetically engineered mouse (GEM) models with mutations relevant to human MM: Bap1 heterozygous (+/-) knockout mice and Nf2/Cdkn2a +/- mice. We exposed Bap1+/-, Nf2/Cdkn2a+/-, and wild-type littermates to chrysotile intraperitoneally (8 doses of 400 µg at 21-day intervals). MMs were observed in 17/28 (60%) Bap1+/- mice, 12/16 (75%) Nf2/Cdkn2a+/- mice, and 2/21 (10%) wild-type mice, with median survivals from initial asbestos exposure being 26 weeks, 21 weeks, and 29 weeks, respectively. Notably, all chrysotile-exposed mice had extensive adhesions in the peritoneal cavity due to an overwhelming inflammatory response. Whereas most mutant mice died of MM, 19/21 wild-type animals died of intestinal obstruction complicated by adhesions. These data indicate that, under the conditions used here, chrysotile causes extensive intraperitoneal inflammation that, in the context of a (mutant) gene-environment interaction, leads to a high incidence and rapid onset of MM.

D1-62. Arsenic Induced Endothelial Activaton and Atherosclerosis: Role of Unfolded Protein Response

PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)

Louisville Superfund Center, Diabetes and Obesity Center, and Institute of Molecular Cardiology, University of Louisville, Louisville, Kentucky

Arsenic is a naturally occurring metalloid present in soil, water, food and air. It is listed as the number one hazardous chemical by the Agency for Toxic Substances and Disease Registry (ATSDR). High level of ground water arsenic (up to 2.5 ppm) is found in several parts of the world including Bangladesh, Taiwan, eastern India, and southern United States. Pre-clinical and epidemiological studies suggest that exposure to arsenic could exacerbate atherosclerosis, the underlying cause of myocardial ischemia and stroke. However, little is known about the atherogenic mechanisms of arsenic. We observed that, in vitro, sodium arsenite (1µM; 4 days) increased the surface expression of ICAM-1, VCAM-1, and E-selectin in endothelial cells by 1.3-1.5-fold; augmented monocyte adhesion and trans endothelial migration by 1.7-fold; and enhanced IL-8 formation by 7-fold. Sodium arsenite also enriched ubiquitination of proteins and decreased proteasome activity by 30%, which could cause endoplasmic reticulum (ER)-stress. These processes were accompanied by increased unfolded protein response (UPR; an adaptive response to ER-stress) characterized by the activation of inositol requiring endoplasmic reticulum-to-nucleus signal kinase 1 (IRE-1; inflammatory pathway) and upregulation of activating transcription factor 6 (ATF6; adaptive signaling). siRNA-mediated knockdown of IRE-1 prevented arsenic-induced endothelial activation by 90%; and adenovirus-induced upregulation of molecular chaperons of protein folding inhibited arsenic-induced endothelial activation by 65%. Chemical chaperon of protein folding, phenyl butyric acid (PBA) prevented arsenic-induced endothelial activation and ER-stress/UPR by 60%. PBA also prevented sodium arsenite (1ppm, 16 weeks)-induced endothelial activation, ER-stress/UPR, and atherosclerotic lesion formation (by 80%) in apoE-null mice. Collectively, these data suggest that arsenic exposure enhances endothelial activation and vascular inflammation in ubiquitination, proteosomal degradation, and ER-stress/UPR dependent manner; and this could exacerbate atherosclerosis.

D1-63. Community Engagement to Support Community Gardeners in North Carolina With Reducing Exposure to Soil Contaminants and Pesticides

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Community gardens can provide many health benefits, but contaminants in soils such as lead, arsenic, and pesticide residues can also create health concerns. The Duke Superfund Center’s Community Engagement Core (CEC) is partnering with gardeners in North Carolina to help them understand how to minimize exposure to soil contaminants, especially for children and women of reproductive age. The CEC completed research in 2016-2017 on gardener management choices related to soil contaminants and pesticides, as well as knowledge, attitudes, and behaviors associated with possible exposure pathways and health impacts. To select the gardens, the CEC partnered with community-based organizations like North Carolina Cooperative Extension and created an interactive
GIS map and screening tool with potential sources of contaminants in North Carolina, including Superfund sites, using public datasets. We conducted interviews and observations at six community garden sites, with additional in-depth focus groups at three sites. We also conducted a statewide online survey of community gardeners.

Our results demonstrated that gardeners are generally aware of risks associated with pesticide use, but had limited knowledge about sources and types of other soil contaminants and how to prevent exposure to them, except for lead. Gardeners commonly introduced materials like compost that are potential sources of contamination, and reported infrequent use of protective behaviors such as hand-washing. Barriers to behavior change included an incomplete understanding of the soil testing process and testing results, lack of access to land use history, and limited economic and human resources. These results are being used to inform a social marketing campaign that aims to change gardener behavior, promote informed decision making, and reduce overall exposure to soil contaminants.

D1-64 ESE. Application of Digital Gene Expression to Identify Adipogenic Gene Signatures of Environmental Metabolism-Disrupting Chemicals

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Exposure to metabolism-disrupting chemicals may be contributing to increased obesity rates by modifying critical pathways regulating lipid, glucose, and energy homeostasis. There are approximately 84,000 chemicals in commerce in the United States; however, few have been profiled for their ability to disrupt metabolic homeostasis. We and others have shown that a growing number of environmental pollutants inappropriately activate the fat-forming pathway and enhance weight gain through activation of peroxisome proliferator activated receptor γ (PPARγ). PPARγ is well known as the master regulator of fat cell differentiation; however, ligand-specific activation of its disparate functions (i.e. regulating white, beige, or brown adipocyte differentiation as well as insulin sensitivity) can result in either a homeostasis-promoting or -disrupting adipocyte phenotype. Here, we exposed 3T3-L1 pre-adipocytes, a common mouse cell line used in adipose biology, to known and suspected therapeutic, synthetic and environmental PPARγ ligands. During differentiation, cells were exposed to test chemicals for two time periods (24 hours or 10 days). Gene expression was assessed at both time periods, and lipid accumulation, an indicator of adipocyte differentiation, was assessed at 10 days. Gene expression was profiled using 3′ digital gene expression (3′DGE), a novel method of highly multiplexed RNA sequencing. Using the gene expression patterns, we aim to evaluate the biological effects on adipose or lipid homeostasis upon chemical exposure. The results of our work can be translated to potential stakeholders (e.g. EPA, ATSDR, and state agencies) interest in applying gene expression-based models for characterizing and predicting metabolic-disrupting effects of emerging commercially produced chemicals.

D1-65. Gaining insight into AHR-mediated inhibition of osteogenesis

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Multipotent mesenchymal stem cells maintain the ability to differentiate into adipogenic (fat), chondrogenic (cartilage), or osteogenic (bone) lineages. There is increasing concern, however, that developmental exposure to environmental xenobiotic stressors may perturb mesenchymal stem cell fate determinations. Aryl hydrocarbon receptor (AHR) ligands are one class of chemicals known to disrupt bone and cartilage formation. Using TCDD as a prototypic AHR agonist, we investigate AHR-mediated osteogenic inhibition in human bone-derived mesenchymal stromal cells (hBMSCs) during phases of early differentiation, extracellular matrix synthesis, and apical matrix mineralization. Across donors we demonstrate a consistent TCDD-mediated attenuation of alkaline phosphatase (ALP) activity and matrix mineralization at terminal stages of differentiation. At the transcriptional level, expression of select transcriptional regulators and osteogenic markers were also attenuated including DLX5, ALP, OPN, IBSP. Members of the FGF family, FGF9 and FGF18, were consistently upregulated suggesting that TCDD may influence pathways associated with maintaining stemness or multipotency in hBMSCs. Relative to undifferentiated cells, expression of stemness/potency markers SOX2, OCT4, and NANOG exhibit consistent trends with diminished expression in osteogenic controls, while expression in TCDD-treated cells remained higher and more similar to undifferentiated cells. Co-exposure with GNF351, an AHR antagonist, partially rescued Alizarin red staining and expression of select transcriptional regulators and apical markers, thus suggesting that AHR activation is mechanistically associated with TCDD-mediated inhibition of osteogenesis. This study highlights the translational potential of hBMSCs in vitro to investigate the osteotoxic and osteoinductive potential of pharmaceutical mediators and other xenobiotics present in the environment.

**D1-66 ESE. Community outreach to identify highly contaminated backyards in New York City**

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Soil lead has been linked to child exposure, based largely on observed seasonality of resuspended soil-dust and child blood lead levels. While piloting a new field test kit for bio-accessible Pb with New York City, several backyards with soil lead levels greater 1,200 mg/kg were identified. In 2015, Cheng et al. first reported 68% of home garden samples exceeded the 400 mg/kg NY Restricted Residential standard in comparison to 10% of community garden samples. However, no systematic mapping effort had been conducted in one neighborhood. Students from Columbia University and Barnard College collected (n=463) public samples and (n=264) private samples from (n=52) backyards in Greenpoint and Williamsburg, Brooklyn in 2017. Total lead concentrations were measured by a handheld X-ray fluorescence (XRF).

84% of private backyard samples exceeded the 400 mg/kg standard, while only 15% of the public samples did. In addition, 35% of the private samples also exceeded the 1,200 mg/kg EPA soil standard for residential soils (compared with 1% of public samples). Of the 52 backyards sampled, 62% had at least one sample above 1,200 mg/kg and 92% had at least one sample above 400 mg/kg. Soil sample results and tips to reduce exposure were sent to participants and general descriptive statistics were sent to local community organizations.

Without engaging local community members and testing backyard soils for lead, we might have missed this highly contaminated soil. These recent experiences indicate that, in addition to providing citizens with crucial data to make informed health decisions, public participation increases the density of sampling, especially in private locations, and leads to a better understanding of the distribution of a contaminant.
D1-67 HS. Pyocyanin, a pathogen-associated ligand of the aryl hydrocarbon receptor, reduces differentiation of 3T3-L1 adipocytes

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The aryl hydrocarbon receptor (AhR) is a ligand-activated transcription factor known for regulation of genes involved in xenobiotic metabolism of environmental toxins, such as polychlorinated biphenyls (PCBs). Several biological compounds have been shown to interact with AhR to regulate immune and inflammatory responses. Previously, we demonstrated PCB-induced activation of AhR regulated adipocyte differentiation in vitro and promoted adipose inflammation in mice with diet-induced obesity. Recent studies demonstrated that AhR senses bacterial pigments, suggesting a link between innate immunity and AhR activation. The purpose of this study was to determine if pyocyanin, a pigment produced by the sepsis-causing bacteria *P. aeruginosa*, could regulate differentiation of 3T3-L1 adipocytes and contribute to sepsis-associated cachexia. Preadipocytes were incubated with vehicle (VEH) or increasing concentrations of pyocyanin throughout differentiation. Pyocyanin (100 μM) significantly reduced 3T3-L1 differentiation as quantified by neutral lipid staining with Oil Red O (VEH: 0.88 ± 0.09; pyocyanin: 0.42 ± 0.05; absorbance of Oil Red O; P<0.0001) corresponding with reduced mRNA abundance of aP2 (VEH: 1.3 ± 1.3; pyocyanin: 0.25 ± 0.1; P<0.05) and PPARγ (VEH: 1.1 ± 0.6; pyocyanin: 0.64 ± 0.2; P<0.05). Moreover, pyocyanin robustly increased mRNA abundance of both AhR (VEH: 1.0 ± 0.3; pyocyanin: 13.1 ± 2.7; P<0.0001) and CYP1A1 (VEH: 1.2 ± 0.6; pyocyanin: 3.4 ± 1.1; P<0.0001). Similarly, in fully differentiated adipocytes, pyocyanin (100 μM) reduced neutral lipid staining (VEH: 0.17 ± 0.012; pyocyanin: 0.08 ± 0.008; absorbance of Oil Red O; P<0.0001) and significantly increased AhR mRNA abundance (VEH: 1.0 ± 0.3; pyocyanin: 3.3 ± 0.8; P<0.0001). Current studies are investigating pyocyanin’s effects on adiposity and body weight by administering the compound to mice.

D1-68. The Dragonfly Project: A collaborative approach to mercury detection and education

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Every year high school students from Vermont and New Hampshire work with Dartmouth Toxic Metals Superfund Research Program mercury experts and Community Engagement Core staff to explore spatial and temporal variation of mercury in dragonfly larvae. Atmospheric deposition of mercury is an issue of concern in northern New England, and mercury bioaccumulation research allows students to engage with data and increase scientific literacy through a locally relevant topic. This project was developed in partnership with Schoodic Education Research Center Institute and the University of Maine and linked to the National Parks Dragonfly Mercury Project.

Our project is divided into three phases. During phase one of this citizen science project, members of Dartmouth’s Project 2 educate students about mercury in the environment, dragonfly nymphs, and proper sample collection techniques. Once trained, students and teachers collect larvae from local water bodies. They also collect site descriptions and ancillary data including types of vegetation, sediment descriptions, and water quality metrics (e.g. pH, nitrites, phosphate). Samples are analyzed for total mercury concentration by our Trace Elements Analysis Laboratory and results shared with the schools. During phase two, students use a variety of STEM education principles to better understand...
and utilize their data. Students work in teams to create a research question and utilize the data to explore this topic in the form of a scientific poster. Phase three of the project is our public poster session. Students from participating schools attend a keynote presentation by a local environmental researcher, present their findings to the public, and engage with each other. Between 200 and 400 people attend the event. We will share insights and lessons learned from this ongoing project.

D1-69 HS. Comparison of the Near Field/Far Field Model and the Advanced Reach Tool (ART) Model V1.5: Exposure Estimates to Benzene During Parts Washing with Mineral Spirits

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A major goal of occupational hygiene programs is to measure or estimate workers’ exposures to chemical and physical agents. Mathematical modeling can be a useful tool to estimate exposures during an operation that no longer exists, is not easily simulated, utilized a chemical agent that is no longer used, or when a new chemical process/product is anticipated. The Advanced Reach Tool V1.5 (ART) is a mathematical model for occupational exposures conceptually based on, but implemented differently than, the “classic” Near Field/Far Field (NF/FF) exposure model. The NF/FF model conceptualizes two distinct exposure “zones”; the near field, within approximately 1 meter of the breathing zone, and the far field, consisting of the rest of the room. In this study, benzene exposure during the use of a metal parts washer was modeled using ART V1.5, and compared to actual measured workers samples and to NF/FF model results from three previous studies. Because ART can directly incorporate specific types of tasks that are part of the exposure scenario, the present analysis identified each task’s determinants of exposure and performance time, thus extending the work of the previous three studies where the process of parts washing was modeled as one event. The ART 50th percentile exposure estimate for benzene (0.425 ppm) more closely approximated the reported measured mean value of 0.50 ppm than the NF/FF model estimates of 0.33 ppm, 0.070 ppm or 0.2 ppm of (Nicas, M., Plisko, M.J., Spencer, JW., 2006, Sheehan et al., 2010 and Williams, et al., 2008, respectively).

D1-70 HS. Penalized Estimation of Sparse Concentration Matrices Based on Prior Knowledge with Applications to Placenta Elemental Data

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Identifying patterns of association or dependency among high-dimensional biological datasets remains a challenge. So, analyzing sparse precision matrix which defines interactions of elements in the datasets is essential. In this paper, we introduce a weighted sparse Gaussian graphical model that can incorporate prior knowledge to infer the structure of the network of trace element concentrations, including both essential elements and toxic metals present in the human placenta. We present the L1 weighted penalized regularization procedure of introducing additional information for estimating the
sparse precision matrix in the setting of Gaussian graphical models which express the conditional
dependence structure between elements. First, we use simulation models to demonstrate that the
proposed method yields a better estimate of the precision matrix than the procedures that fail to
account for the prior knowledge of the network structure. Then, we apply this method to estimate
sparse precision matrix of placental biopsies from the New Hampshire Birth Cohort Study. The
chemical architecture for elements is complex; hence, the method proposed herein was applied to
infer the dependency structures of the elements using prior knowledge of their biological roles. In
results, weighting elements which had a high number of neighbors in the network significantly
increased accuracy in estimating interactions of elements. Also, our method successfully identified
fundamental elemental associations consistent with known chemical and biological roles which
contained a separate network of Ca and K, an interconnected sub-network of Mg, P, Ba and Sr, and
the appearance of Zn as a hub of multiple elemental associations. Furthermore, our proposed method
can be applied broadly to any biological datasets with prior knowledge of patterns of associations
among the measured entities.

D1-71. Nanobody Based Reverse Plasmonic Immunoassay for Detection of Environmental
Chemicals
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Rapid, sensitive, and cost-effective high throughput detection can greatly assist in determining
exposure to hazardous substances, of which most are small molecules. A variable domain of the
heavy chain antibody (termed sdAb, nanobody or VHH) possesses advantages of small size, high
stability, ease of genetic manipulation, and ability for continuous manufacture, making such nanobody
a superior choice as an immunoreagent. In this work, we developed a nanobody based reverse
plasmonic immunoassay for small molecules detection, with 3-phenoxbenzoic acid (3-PBA), a major
metabolite of pyrethroid insecticides as a model analyte. The enzyme label of the enzyme-linked
immunosorbent assay (ELISA) regulates the growth of gold nanoparticles and produces colored
solutions with distinct tonality when the analyte is present. Contrary to the traditional horseradish
peroxidase (HRP) based competitive ELISA, this catalase based plasmonic immunnoassay gave
increasing signal with increasing concentration of targets of small molecules. This reversed signal
pattern makes the reading of signal generation direct and simple. The sensitivity of the plasmonic
assay is comparable to the traditional ELISA, with detection limit in the range of ppb (ng/mL). This
study demonstrated the potential of this adapted method in practical applications allowing the
sensitive detection of small environmental contaminants with the naked eye. Research Translation
Component Rapid, sensitive, and cost-effective high throughput detection can greatly assist in
determining exposure to hazardous substances, of which most are small molecules. The proposed
assay allows signal reading using naked eyes without need for complicated instrument. This can be
advantageous to the on-spot detection where access to laboratory resources is quite limited. This
assay may be used for monitoring of environmental contaminants in the Yurok tribal land.

D1-72. Application of Toxicogenomics Assay for Mixture Toxicity Assessment of Water
Samples from Puerto Rico
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Y. Padilla³, Akram N. Alshawabkeh¹, Roger W. Giese² and April Z. Gu*¹

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Novel and feasible approaches are urgently needed to investigate the potential adverse effects of contaminant mixtures present in aquatic systems on ecosystem and human health. As part of the PROTECT (Puerto Rico Testsite for Exploring Contamination Threats) program supported by SRP from NIEHS, this study will provide a fast, initial screening and assessment of the toxicity response of chemical mixtures in water samples along the north coast of Puerto Rico. Organic substances in the 15 water samples (well or spring) were enriched via polar solid phase extraction (SPE) and subjected to both untargeted chemical screening on GC-MS and quantitative toxicogenomics assay based on translational changes of 148 protein biomarkers in yeast reporter stains involved in know stress response pathways. The results revealed distinct pathway-specific molecular toxicity levels (quantified as PELI, Protein Effect Level Index) and toxicity fingerprints (altered protein expression profiles) among different sites. For example, the Pozo Mita (MIT) well sample featuring the highest number of organics including pesticides and phthalates, showed the highest PELI value in protein stress (unfolded protein sensing and response through molecular chaperones, ubiquitin-proteasome, and proteolytic systems), whereas the Pozo Pollera Ochoa (POL) well sample showed the highest general stress (osmotic stress, electron transport, and copper chaperone) and oxidative stress (oxidative stress activator and defense through glutathione/glutaredoxin, thioredoxin and catalase systems). Correlation analysis between chemical analysis and toxicity endpoints showed that the occurrence of pesticides such as terbacil, heptachlor, atrazine and aldrin was significantly correlated with protein damage (R> 0.8, p<0.01). Overall, groundwater in PR showed different contamination levels on a site-specific basis which can induce pathway-specific toxicity response in the reporter yeast strain. The presence of pesticides and heavy metals in these waters may be associated with the toxicity observed, which require further investigation.

D1-73-ESE. Ultra-stretchable Graphene-Based Molecular Barriers for Chemical Protection, Detection, and Actuation

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Personal protective equipment and environmental barrier materials incorporate functional layers that impede molecular transport between some external environment and a desired internal microclimate. Adding stretchability to barrier films would improve many applications, but classical barrier materials have dense, ordered molecular architectures that easily fracture under small tensile strain. Here, we show that textured graphene-based coatings can serve as ultra-stretchable molecular barriers expandable to 1600% through programmed unfolding that mimics the elasticity of polymers. We investigate their barrier performance to a range of liquid-phase organic chemicals in both the folded and fully extended states. These coatings retain barrier function under large deformation and can be conformally applied to planar or curved surfaces, where they are washfast and mechanically robust to cycling. These graphene-polymer bilayer structures also function as sensors for organic chemical exposure and can transduce the chemical stimuli into mechanical deformation and electrical resistance change through asymmetric polymer swelling.
Research Translation Component: this technique offers a new concept to the long-standing challenge of designing stretchable barrier technologies. The findings may enable the development of improved technologies for reducing human exposure to toxic chemicals, including personal protective equipment in civilian and military sectors, barrier packaging to prevent migration of leachables and extractables into food or pharmaceutical products, environmental barriers, and multifunctional smart fabrics.

D1-74. Field Testing of a Newly Developed Reactive Barrier for Treatment of Chlorobenzenes in Discharging Groundwater and Sediment at a Superfund Site

Michelle M. Lorah, U.S. Geological Survey - Baltimore, MD; Steven J. Chow, Johns Hopkins University - Baltimore, MD; Amar Wadhawan, Arcadis U.S. Inc. Hanover, MD; Neal Durant, Geosyntec Consultants - Columbia, MD; Edward Bouwer, Johns Hopkins University - Baltimore, MD

Although granular activated carbon (GAC) seeded with contaminant-degrading cultures has been tested as a method to treat PCBs in sediment, reactive barriers with GAC have not been tested for treatment of chlorobenzenes, or for treatment in areas that receive a high flux of dissolved contaminants in addition to presence of sediment contamination. Wetland and creek sediments at the Standard Chlorine of Delaware (SCD) Superfund site were impacted by spills of chlorobenzenes and continue to be impacted by discharging groundwater plumes. As part of a NIEHS- and EPA-funded study, we applied reactive barriers (developed with initial laboratory testing) containing GAC seeded with aerobic and anaerobic cultures in a 2-year pilot test at SCD to determine performance in treating the chlorobenzenes and mitigating exposure risks.

Contaminant mass removal from sediment and groundwater has been maintained in the reactive barriers through 19 months, or 1,900 pore volumes of groundwater discharge. Groundwater chlorobenzene concentrations consistently decreased to below detection, and the contaminant mass removal rate from the sediment within the barrier was greater than 100 mg/day. Increases in chloride concentrations provide evidence that chlorobenzene mass removal was due to biodegradation. Ferrous iron, sulfide, ammonia, and methane concentrations in the treatment plots indicated that anaerobic conditions were predominant. Microbial community analyses, however, indicated prevalence of both anaerobic and aerobic chlorobenzene-degrading populations. In situ microcosms with 13C-labeled chlorobenzene were recently completed to better determine the dominant biodegradation processes and quantify rates, and results will be presented. Both ongoing laboratory tests and the field application of the developed technology are critical in informing EPA’s remediation decision-making at SCD, as well as in technology transfer to other contaminated sites.

D1-75: Risk and Remediation of Metal-Mining Wastes

Raina M. Maier1* and R. Clark Lantz2

1Department of Soil, Water, and Environmental Science, 2Department of Cellular and Molecular Medicine, The University of Arizona, Tucson, AZ, USA

The University of Arizona Superfund Research Program (UA SRP) investigates the human and environmental risks associated with metal mining. A majority of metal mining takes place in the Western United States and other arid and semi-arid parts of the world. A central challenge for arid environments is that human exposure routes and the fate and cleanup of mining contamination are different than for areas that receive more rainfall. This has led to a large knowledge gap in regard to health and environmental effects of such mine waste systems. Our Center will address two major issues within this overall gap. The first is the lack of understanding of mining waste behavior and

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containment and the relative impacts of airborne and waterborne spread of mine waste into arid environments. Mine wastes, in particular legacy mine tailings, generate dust- borne toxic metals (for example, arsenic and lead). These wastes also generate acid mine drainage, resulting in contamination of groundwater which is often the primary potable water source for surrounding communities. The second knowledge gap is a lack of understanding of the human health consequences of inhalation of mine dusts, specifically regarding the development of chronic lung diseases. To further its impact, the UA SRP partners with complementary initiatives, such as the Center for Environmentally Sustainable Mining (an industryacademic cooperative) to move research results into the field in real time. The principle guiding the UA SRP is that its research should be both innovative in advancing individual scientific fields and transformative in changing industry-wide practices in mining to improve environment/ecosystem preservation and protect human health.

**D1-76 HS: Analyzing Chemical Mixtures in Rhode Island: A Machine Learning Approach**

Thomas Marlow, Brown University

Researchers face many difficulties in understanding the composition and sources of chemical mixtures in the environment. One such issue is a lack of historical data on hazardous facilities predating the implementation of CERCLA. Another is the reliance on administrative units such as census tracts to delineate neighborhoods. This paper addresses both by demonstrating a machine learning technique for defining neighborhood boundaries based on the location and manufacturing type of all industrial facilities active in Rhode Island between 1953 and 2017. This method follows three steps. First, I calculate the frequency of each type of manufacturing facility surrounding an individual facility. This produces a set of neighborhood composition profiles equal to the number of facilities in the dataset. These neighborhood profiles are also rough estimates of potential chemical mixtures based on known toxic releases associated with manufacturing types. Next, I classify groups of similar neighborhood/chemical profiles using a hierarchical clustering algorithm. Every individual facility is assigned a new class value and plotted to visualize patterns. Finally, I generate a Voronoi diagram around the points. Voronoi diagrams create contiguous polygons that maximize the area around points. I combine these polygons based on each point's new class to generate larger neighborhood boundaries. The result is a set of endogenously defined, and materially meaningful areal units that leverage a unique dataset of industrial facilities to classify the potential chemical mixtures within them. This research is useful for environmental health and science research to evaluate health outcomes based on residential location. Additionally, this method gives regulators and researchers an empirical approach for identifying target areas for exploratory data collection related to emergent contaminants.

**D1-77: Paraoxonases in chronic manganese exposures**

*Paraoxonases in chronic manganese exposures*

Judit Marsillach\(^1\), Rebecca J. Richter\(^1\), Jacqueline M. Garrick\(^2\), Toby B. Cole\(^2\), Lucio G. Costa\(^2\), Clement E. Furlong\(^1,3\)

*University of Washington, Departments of \(^1\)Medicine, \(^2\)Environmental and Occupational Health Sciences, and \(^3\)Genome Sciences*

Human environmental exposures to heavy metals are common and represent adverse risks to health. Manganese occurs naturally in surface water, groundwater and soils. Manganese can also be released in industrial fumes and affect workers and residents of the area. Environmental and occupational chronic manganese exposure has been associated with an increase of oxidative stress.

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that leads to neuroinflammation and results in an array of neurotoxic health effects. The paraoxonases (PONs; PON1, 2 and 3) are lipolactonases involved in modulating oxidative stress and inflammation.

A major aim of our research is to understand the roles of PON1 and PON2 in protecting against oxidative stress effects and neurotoxicity from chronic heavy metal exposures such as manganese. We have demonstrated that in vitro exposure of PON1 to an array of heavy metals, including manganese, inhibited plasma PON1 activity. Furthermore, incubation of PON1 with products of oxidative stress also showed a strong inhibitory effect of PON1 activity. In vivo chronic exposure of wild-type and Pon2 deficient mice resulted in a significant decrease of plasma PON1 activity in Pon2 deficient mice, accompanied by an increase in plasma malondialdehyde concentrations. Although exposure to manganese did not affect locomotion or learning abilities as measured with the rotarod neurobehavioral test, exposed and un-exposed Pon2 deficient mice had a poor performance on the rotarod, compared to their wild-type littermates.

These results suggest that PON2 in wild-type mice is protecting PON1 from the manganese-induced inhibitory effects.

The results from our work are relevant for communities whose drinking water contains high levels of manganese, as well as communities that work and/or live in proximity to industrial areas that generate manganese fumes.

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**D1-78 HS: Effects of perfluorinated compounds on zebrafish organogenesis**

Nathan Martin¹ and Jessica Plavicki¹,²

*Pathobiology Graduate Program, Brown University¹. Department of Pathology and Laboratory Medicine, Brown University²*

Perfluorinated compounds (PFCs) are persistent compounds utilized in a variety of industrial and commercial applications including surfactants, lubricants, flame retardants, and medicines. Byproducts of PFCs have different chemical structures and properties; however, many bioaccumulate and are eliminated slowly. Previous studies have demonstrated that early-life exposure to perfluorooctanesulphonic acid (PFOS) disrupts pancreatic development in the zebrafish model (*Danio rerio*). To address the effects of different PFCs on the development of multiple organ systems in zebrafish, we selected four PFCs with varying chain lengths and functional groups: perfluorooctanesulfonic acid (PFOS), perfluoroctanoic acid (PFOA), perfluorononanoic acid (PFNA), and heptafluorobutyric acid (PFBA). Using stable transgenic lines with organ-specific fluorescent protein markers, we are assessing the impact of chronic exposure of the aforementioned PFCs on vasculogenesis, neurogenesis, cardiogenesis, liver, and pancreatic development. Embryos are chronically exposed from 3-120 hours post-fertilization to a single PFC (0-64 μM concentrations). To examine the effects of exposure on organ formation, we are using confocal microscopy to image live embryos at multiple developmental time points. We are also performing behavioral assays to assess several neurobehavioral endpoints. In addition, we will use metabolomics to assess cellular changes that occur following PFC exposure. Using the zebrafish model to study the effects of PFCs on organogenesis can provide insight into the potential risks of PFC exposure on human health.

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## Poster Presentations

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D2-1. Purinyl-cobamide serves as cofactor of tetrachloroethene reductive dehalogenases in Desulfitobacterium

Allen K. Bourdon¹, Abigail Tester¹, Jun Yan²,³,⁵,⁶, Meng Bi¹,²,³, Frank E. Löffler²,³,⁴,⁵,⁶, Shawn R. Campagna¹,³,⁶

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Corrinoids are the requisite prosthetic groups for the carbon-chlorine bond-cleaving reductive dehalogenases (RDases) in organohalide respiration. Some members of the genus Desulfitobacterium are capable of de novo corrinoid biosynthesis and assemble catalytically functional RDases implicated in reductive dechlorination of tetrachloroethene (PCE), but the identity of the Desulfitobacterium native corrinoid is unknown. Ultra-performance liquid chromatography-high resolution mass spectrometric characterization indicated that PCE-dechlorinating Desulfitobacterium isolates produced a novel corrinoid carrying an unknown lower base with a molecular weight of 120.11. ¹⁵N isotope labeling experiments using ¹⁵NH₄Cl as the sole nitrogen source for Desulfitobacterium hafniense strain Y51 grown revealed that the lower base of the native corrinoid contains four N atoms, suggestive of unsubstituted purine. The combined results of proton (¹H) and correlation nuclear magnetic resonance spectroscopic data confirmed purine as the native lower base in the Desulfitobacterium native corrinoid. This finding expands the list of naturally occurring cobamides to include Coα-purinyl-cobamide (purinyl-Cba). The addition of purinyl-Cba supported PCE reductive dechlorination by the corrinoid-auxotroph Dehalobacter restrictus but not Dehalococcoides mccartyi, emphasizing the crucial role of the corrinoid lower base on RDase activity. The findings expand the structural diversity and functionality of naturally occurring corrinoids, and assign unsubstituted purine a first biological function. The realization that lower bases can effectively modulate enzyme activities generates opportunities to manipulate (i.e., control) functionalities of many microbiomes.

D2-2. The Synthetic Lignan Secoisolariciresinol Diglucoside (LGM2605) Prevents Asbestos-Induced NLRP3 Inflammasome Activation in Murine Macrophages

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Background: The interaction of asbestos fibers with macrophages drives two key processes that are linked to malignancy: (1) the generation of reactive oxygen (ROS)/nitrogen (RNS) species and (2) the activation of an inflammation cascade that drives acute and chronic inflammation, with the NLRP3 inflammasome, IL-1ß and TNFα playing key roles. Synthetic secoisolariciresinol diglucoside (SDG), Secoisolariciresinol diglucoside (SDG) is a non-toxic, flaxseed-derived pluripotent compound that has anti-inflammatory and antioxidant properties and may potentially function as a chemopreventive agent. We evaluated the effect of synthetic SDG (LGM2605) on conferring protection from asbestos by studying the effect of SDG pretreatment on asbestos-exposed murine peritoneal macrophages (MF). Methods: MFs were exposed to crocidolite asbestos +/- LGM2605 given 4 hours prior to exposure and evaluated at various times for NLRP3 expression, secretion levels of inflammasome-activated cytokines (IL- 1ß and IL-18), proinflammatory cytokines (IL-6, TNFα and HMGB1), NF-κB
activation, and indices of cell injury markers malondialdehyde (MDA), and total nitrates/nitrites.

Results: Asbestos induces a significant (p<0.0001) increase in the NLRP3 subunit, release of proinflammatory cytokines, NLRP3-activated cytokines, NF-κB and levels of nitrates/nitrites. LGM2605 significantly reduced NLRP3 ranging from 40-81%, IL-1β by 89-96% and TNFα by 67-78%, as well as activated NF-κB by 48-49% while decreasing levels of nitrates/nitrites by 85-93%.

Conclusions: LGM2605 reduced asbestos-induced NLRP3 inflammasome expression, proinflammatory cytokine release, NF-κB activation and nitrosative stress in murine peritoneal macrophages supporting its possible use in preventing the asbestos-induced inflammatory cascade leading to malignancy.

D2-3. Dioxin-mediated disruption of bile acid metabolism and circulation promotes fatty liver disease

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Dioxins such as 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) are a family of environmental contaminants which contribute to the development of chronic metabolic disorders including fatty liver disease. This toxicity is mediated through activation of the aryl hydrocarbon receptor (AhR), which regulates gene expression in a species-, sex-, age-, and tissue-specific manner. Male mice treated with TCDD (0.01-30 µg/kg) every 4 days for 28 days exhibit increased gallbladder volume, as well as fat accumulation, bile duct proliferation, and inflammation of the liver. To further investigate disruption of bile homeostasis, bile acid profiling of the liver, serum, and feces was combined with hepatic gene expression changes and measurements of intestinal function. Total bile acid levels in the liver were increased 5-fold by TCDD, despite coordinated repression of genes involved in bile acid synthesis. Specifically, TCDD elicited a >200-fold increase in tauroliothocholic acid (TLCA), a highly toxic bile acid species associated with bile duct proliferation. Fecal levels of microbial genes involved in bile acid metabolism were also increased, consistent with accumulation of microbially-synthesized bile acids such as TLCA. Bile acid levels in the feces were decreased 3-fold, suggesting enhanced intestinal reabsorption due to induction of intestinal transporters and increased gut permeability. Moreover, serum bile acids were increased 45-fold, consistent with repression of blood-to-liver transporters and induction of liver-to-blood transporters. In summary, AhR-mediated alterations in synthesis, circulation, and metabolism promote bile acid accumulation, which contributes to the progression of fatty liver disease. These results provide novel insight into the mechanisms responsible for dioxin-mediated liver toxicity and should be considered in the risk assessment of AhR activators. Funded by SRP P42ES04911 and DFS-140386.

D2-4. Dioxin-mediated loss of liver- and sex-specific gene expression in mice

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Accumulating evidence suggests that dioxins including 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) play an underappreciated role in the development of nonalcoholic fatty liver disease (NAFLD) in humans. Its toxicity is mediated through activation of the aryl hydrocarbon receptor (AhR), a transcription factor which causes a broad spectrum of species-, sex-, age-, and tissue-specific responses. To further investigate the role of dioxins in the development of NAFLD, the effects on liver-
and sex-specific gene expression were examined in male and female mice treated with TCDD every 4 days for 28 or 92 days. Gene expression changes in the male liver revealed the coordinated repression of 181 liver-specific genes including albumin (3.7-fold), α-fibrinogen (14.5-fold), and β-fibrinogen (17.4-fold), with corresponding binding of the AhR in the gene regulatory region. Liver-specific genes exhibiting sex-specific expression also demonstrated reduced divergence between sexes. For example, male-biased Gstp1 was repressed 3.0-fold in males and induced 4.5-fold in females, which was confirmed at the protein level. Disrupted regulation is consistent with impairment of the growth hormone signaling pathway and inhibition of female-specific transcription factors such as Cut Like Homeobox 2 (CUX2). Additionally, TCDD induced fetal genes such as alpha-fetoprotein, which should only be expressed during early development. The results suggest that dioxin causes the loss of liver- and sex-specific gene expression, potentially impairing the liver’s ability to perform its specialized functions. Funded by SRP P42ES04911 and DFS- 140386.

D2-5. Swimming Exercise and Dietary Restriction in Caenorhabditis elegans Promotes Mitochondrial Health and Protects Against Mitotoxicants

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Exercise greatly improves health, reducing risk of cardiovascular disease, neurological disease, and cancer. However, the molecular mechanisms that underlie these protections are not well-understood, partly due to the cost and time investment of long-term exercise intervention studies in rodents or humans. We developed a long-term exercise protocol in C. elegans nematodes, which included a 6-day, twice daily swimming exercise regimen (corresponding to the reproductively active young adult portion of life). While exercising, nematodes were also without food, so we used two control groups: one group which was fed ad libitum, and one control group which was given the same food restriction as the exercise group, but did not swim. Following this regimen, we assessed mitochondrial health and sensitivity to mitochondrial toxicants. Dietary restriction (exercise and food-restriction control) protected against age-related decline in mitochondrial morphology in the body-wall muscle, as visualized with mitochondria-localized GFP (p<0.0001). Dietary restriction also increased basal mitochondrial respiration (20% for dietary restriction alone, 30% for exercise, p<0.0001 for each compared to food control), as measured with the Seahorse XFe24 Extracellular Flux Analyzer. By contrast, exercise increased spare respiratory capacity 30% (p<0.05), while dietary restriction alone decreased spare capacity more than 50% (p<0.0001). We measured a modest increase in lifespan in exercised animals compared to both control groups (p=0.0067). Finally, exercised animals, and to a lesser extent, dietary restricted animals were significantly protected against lethality from rotenone and arsenic exposures. Overall, dietary restriction and swimming exercise provided an effective intervention in C. elegans, resulting in protection of mitochondria from age-associated morphological and functional declines, as well as resistance to 24-hour acute exposures to the mitochondrial toxicants rotenone and arsenic.

D2-6. Challenges and Opportunities for Managing Aquatic Mercury Pollution in Altered Landscapes

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PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
The environmental cycling of mercury (Hg) can be affected by natural and anthropogenic perturbations. Of particular concern is how these perturbations increase mobilization of Hg from sites and alter the formation of monomethylmercury (MeHg), a bioaccumulative form of Hg for humans and wildlife. The scientific community has made significant advances in recent years in understanding the processes contributing to the risk of MeHg in the environment, including the elucidation of biogeochemical processes that alter the distribution, bioavailability and biomagnification of MeHg in fisheries. This presentation will provide the results of a scientific synthesis effort conducted for the 13th International Conference on Mercury as a Global Pollutant. Our aim was to describe how mercury cycling in the aquatic environment is influenced by natural and anthropogenic perturbations at the local scale, perturbations that include deforestation, reservoir and wetland creation, rice production, and mining. We compared these landscape alterations for their potential to mobilize Hg to downstream ecosystems and re-emission to the atmosphere. A major outcome of our work was the identification of key opportunities that may enable policy makers and site managers to lessen both MeHg levels in biota and exposure to humans. For example, our compilation of the research literature demonstrates that individual water bodies vary widely in terms of the relative inputs of Hg from direct atmospheric deposition and Hg inputs from terrestrial runoff, suggesting that response times toward Hg emissions reductions will also span a wide range. With knowledge of the relative impacts of different Hg loads, decision makers could implement policies to prioritize the avoidance of certain activities in the most vulnerable systems and implement technologies that sequester Hg in deep soil and sediment pools. While the complexity of processes contributing to MeHg in fish remains to be fully elucidated, several opportunities exist in helping decision makers to improve management approaches for Hg contaminated watersheds and to better anticipate impacts at the local level during the implementation of the international Minamata Convention on Mercury.

D2-7. Studies of Non-occupational Asbestos Exposure and Mesothelioma: Development of Study Quality Rating Scale and Meta-analysis

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Objective: We aim to develop a quality rating scale for studies that evaluate the associations between mesothelioma and non-occupational asbestos exposure, and to synthesize risk estimates from the published reports through meta-analysis.

Methods: A systematic literature review was conducted in PubMed to identify case-control and cohort studies that examined the association between mesothelioma and non-occupational exposure to asbestos. We adapted the quality scoring methodology that used by Goodman et al. (2004) in the
occupational setting to rate study quality based on study designs, analyses and, reporting. Selected studies were rated by two investigators and agreement between raters was assessed. Characteristics of high quality studies were described. Meta-analysis was performed to estimate a combined relative risk (RR) and 95% confidence intervals using random-effects models. Subgroup analyses were conducted by three tiers of study quality scores.

Results: 25 case-control and cohort studies were selected. The proposed quality rating scale included multiple rating criteria with regards to the definition and confirmation of asbestos exposure and outcome, measurement asbestos exposure history, potential confounding, duration of follow-up, participation rate, and potential biases. Based on the total quality score, 32% of the studies are tier 1 studies, 50% were in tier 2, and 18% were in tier 3. Preliminary meta-analyses suggested a combined RR of mesothelioma of 5.33 for any neighborhood exposure, 2.41 for any household exposure, and 4.31 for any domestic exposure. The combined RR among tier 1 studies was 3.56 for any non-occupational asbestos exposure.

Conclusion: Study quality scores varied in selected studies. Non-occupational exposure to asbestos is associated with an elevated risk of mesothelioma even if the analyses were restricted to studies with top tier study quality.

Funding sources: P42 ES023720 Penn Superfund Research Program Center Grant

D2-8 ESE. Analyzing Key PCBs and Hidden Contaminants in Air Sample Data

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The Iowa Superfund Research Program is interested in the sources, exposures, and toxicities of polychlorinated biphenyls (PCBs) in the environment. Large-scale analysis of gas chromatographic and mass spectrometry (GC-MS) data from diverse repositories is essential to understanding prevalence, agents, transport, and public health effects of PCBs. Using air samples collected between November 2006 to November 2007 in Chicago[1], we develop signal processing and informational techniques for quantitative documentation of similarities between PCBs and non-target contaminants typically overlooked in target-centric data analysis. The primary objective behind our raw signal analysis is to identify missed contaminants and enhance our understanding of PCBs associated with each other as well as co-occurring contaminants. We employ a multi-scale suite of computational techniques for identifying associations between target PCBs and non-target contaminants across raw signals from 150 field samples analyzed using gas chromatography with triple quadrupole mass selective detector in multiple reaction monitoring mode. Through peak detection and constrained optimization techniques, we detect and disentangle potentially co-eluting peaks across the TIC and MRM signals and present results that quantify variability as well as discover missed target and non-target peaks. Furthermore, we use these findings to perform a principal component analysis to analyze similarities in contaminant concentrations and employ a clustering algorithm to find similarities. Applying raw signal analysis to discover hidden contaminations, principal component analysis to look at similarities in containment variability in the data set, and clustering techniques can be beneficial to finding relationships not only between PCBs but other potentially harmful contaminants. Moreover, developing these techniques can help aim to minimize uncertainty of human error in gas chromatography and mass spectrometry interpretation and develop better analysis in raw signals.


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**D2-9 HS. Association of Volatile Organic Compounds with Blood Pressure**


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Volatile organic compounds (VOCs) are industrial solvents, which are also ubiquitous environmental pollutants. Major sources of VOCs in the outdoor air are automobile exhaust, tobacco smoke, and combustion products. Indoor air is contaminated from VOCs arising from paints, laundry detergents, carpet, wood preservatives, cleansers, and disinfectants. Superfund sites where industrial waste were stored, also have high levels of VOCs. Little is known about the effect of VOCs on cardiovascular disease (CVD). We hypothesized that exposure to VOCs increases the risk for CVD by augmenting blood pressure. Our cross-sectional study consisted of 260 nonsmokers who had low to high cardiovascular disease risk. On the day of enrollment, blood pressure of the participants was measured and urine samples were obtained. Urinary levels of twenty parent VOCs (26 metabolites) were quantified by ultra fast performance liquid chromatography-mass spectrometry. Generalized linear models were used to examine the association between VOC metabolites and systolic and diastolic blood pressure. Of all the metabolites measured, we observed that the two urinary metabolites of acrolein (N-acetyl-S-(2-hydroxypropyl) cysteine dicyclohexlammonium salt, 2HPMA and N-acetyl-S-(3-hydroxypropyl) cysteine dicyclohexlammonium salt, 3HPMA) were positively associated with systolic blood pressure, of 1.0mmHg and 1.2mmHg per interquartile range (IQR) change in acrolein. The urinary metabolite of xylene (2-methyl hippuric acid, 2MHA) was positively associated with diastolic blood pressure, of 0.4mmHg per IQR change in xylene. Changes in blood pressure occurred independent of particulate matter2.5 exposure, and blood pressure medications such as calcium channel blockers, \( \beta \)-blockers and ace inhibitors. None of the other VOCs were associated with blood pressure in this cohort. Together, these data suggest that exposure to acrolein and xylene could increase blood pressure, and therefore augment the risk for CVD.

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**D2-10. Assessing Health Risks from Multiple Environmental Stressors using an IxE Approach**

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Individuals living in proximity to Superfund sites are exposed to a range of stressors (e.g. chemical, economic, and psychosocial) that interact with lifestyle (e.g. diet, smoking) and biological factors (e.g. genetics, pre-existing disease) and influence susceptibility to environmental exposures and associated adverse health outcomes. Assessment and mitigation of cumulative health risks arising from multiple factors in these vulnerable communities are key goals of the Superfund Research Program (SRP), risk assessment agencies, and concerned community groups. However, research
studies have largely focused on interactions between genes and a narrow range of environmental exposures (G×E) and usually consider other factors as confounders rather than evaluating them for their potential interactive contribution. Faced with these limited data, risk assessment practitioners must apply “uncertainty factors” to account for differences in susceptibility. In order to address these limitations, we (SRP researchers in environmental health science, policy, and environmental justice and risk assessment experts at California EPA) propose a conceptual model called I×E, which we developed through a series of discussions. Our I×E model illustrates how interactions between multiple intrinsic (I) factors beyond the genome and a broad range of extrinsic (E) factors modulate vulnerability and resilience and health outcomes throughout the lifespan. We recommend that studies measure and test for multifactorial and interactive effects using newer laboratory and bioinformatic methods. The resulting quantitative data on I×E interactive effects over the life course would better define the variability in human response to environmental factors. Our proposed approach highlights the need for updated study design in order to identify factors amenable to interventions at the individual and population levels so as to enhance resilience, reduce vulnerability and improve health.

D2-11 ESE. Limited retardation of arsenic in the Holocene and Pleistocene alluvial aquifers of Bangladesh

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The contamination of alluvial aquifers of Bangladesh with elevated levels of arsenic (As) in groundwater has been characterized as the largest mass poisoning in the history of mankind. SRP research conducted in Bangladesh aims to decrease the 40,000 deaths/year attributed to 45 million inhabitants that are still exposed to high (often >100 µg/L) As concentrations in well water. Deep low-As aquifers throughout the region are increasingly used to lower exposure by installing community wells. It is therefore crucial to know how vulnerable these aquifers might be to inflow of As from nearby contaminated aquifers. To address this issue, we conducted long-term column experiments in the field to measure the extent to which adsorption delays As relative to groundwater flow under realistic conditions. Sediment cores were freshly collected from the two geologic units from 40-60 ft depth, one containing Holocene reduced grey sands and other from Pleistocene (>12 ky) oxides orange sands to test the belief that As adsorbs much more strongly to orange compared to grey sand. A total of 14 undisturbed columns and a sand control were eluted for 23 consecutive days at controlled flow rates directly at a wellhead with unaltered shallow groundwater elevated in As (320 µg/L) and dissolved Fe (7 mg/L). The modeled results indicate that, As is retarded (Rf = 20-60) relative to groundwater in both gray and orange sands, but that gray sands contain a pool of readily desorbable As that contributes As to effluent. This indicates that low-As aquifers are to some extent but not indefinitely protected by adsorption and retardation.

D2-12 HS. Investigating Knowledge of Healthcare Provider Education and Attitudes About Environmental Health Threats and Outcomes in Puerto Rico (PR)

Colleen Murphy1, Carmen M. Vélez Vega1, Phil Brown2, Stephanie Clark2, Xavier Lopez Leon1, Zulmarie Diaz Reguero1, Nancy Cardona1, Lorena Cortes Torres1, José F Cordero3, Akram Alshawabkeh4

PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
Background & Objectives: The Institute of Medicine recommends increased education regarding environmental determinants of health among healthcare providers (HCPs). However, studies reveal deficiencies in environmental health (EH) knowledge among them. HCPs may recognize that environmental hazards have potential negative impact on patient health, but many do not conduct EH exposure histories with their patient due to lack of education and time. Building off existing research that is currently taking place through the Superfund Research Program, PROTECT (PR Testsite for Exploring Contamination Threats) provides an ideal location for examining questions about perceptions of HCPs in Puerto Rico on EH. PROTECT is well-suited to investigate perceptions and practices pertaining to emerging understanding of EH contaminant exposures. Methods: An anonymous questionnaire, administered in person and online via Survey Monkey was used to identify perceptions of EH knowledge across HCPs employed by community health centers in PR. Descriptive analysis of participant responses was conducted. Results: Respondents indicate low levels of knowledge and education relating to EH effects on patient health. Additionally, responses indicate lack of preparedness to address EH related interventions and an increased desire for education regarding EH knowledge. Conclusion: HCPs who acknowledge the importance of environmental determinants of health incorporate this knowledge into their professional practice. However, the majority of respondents do not have knowledge of EH, providing an opportunity to develop programming for education. The passing of hurricanes Irma and Maria have left Puerto Rico devastated on innumerable levels; intensifying the already alarming EH risks. Study results and subsequent EH education will be provided to HCPs in Community Health Centers; future RTC/CEC activities will include EH education to HCPs at a broader level.

D2-13 ESE. Growth of Sphingomonas wittichii RW1 on dibenzo-p-dioxidin requires a chromosomally encoded hydrolase.

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Sphingomonas wittichii RW1 is one of a few strains known for the ability to grow on the related compounds dibenzofuran (DBF) and dibenzo-p-dioxidin (DD). The genes for the initial steps in the DBF catabolic pathway (ring hydroxylating dioxygenase, ring cleavage dioxygenase, and a hydrolase) which result in the formation of salicylate and a five carbon fragment have been localized to a megaplasmid designated pSWIT02 in RW1. Plasmids highly similar to pSWIT02 have been found in other DBF degrading Sphingomonas strains but these bacteria are not capable of growth on DD. In previous work we discovered that a ring cleavage enzyme encoded by a RW1 chromosomal gene is absolutely required for DD degradation. In the present work we hypothesized that a chromosomally encoded hydrolase (third enzymatic step) is also involved in RW1 DD metabolism. We initially knocked out the pSWIT02 dxnB gene as previous studies showed involvement of the encoded hydrolase in the DBF pathway. Growth curves indicate that RW1deltadxnB grows normally on both DBF and DD. We then examined previously published transcriptomic and proteomic data which showed that the hydrolase like enzymes encoded by genes SWIT3055 and SWIT0910 are up regulated during growth on DBF and DD. In the present work we hypothesized that a chromosomally encoded hydrolase (third enzymatic step) is also involved in RW1 DD metabolism. We initially knocked out the pSWIT02 dxnB gene as previous studies showed involvement of the encoded hydrolase in the DBF pathway. Growth curves indicate that RW1deltadxnB grows normally on both DBF and DD. We then examined previously published transcriptomic and proteomic data which showed that the hydrolase like enzymes encoded by genes SWIT3055 and SWIT0910 are up regulated during growth on DBF and DD. Growth curves indicate that RW1deltadxnB grows normally on both DBF and DD but that RW1deltaxSWIT0910 grows normally on DBF but does not grow at all on DD. Growth curves of the double knockout strain RW1deltadxnBSWIT3055 show no growth on DBF and normal growth on DD. Our results demonstrate that a chromosomally encoded hydrolase is
absolutely required for growth on DD and that two different hydrolases (chromosomally and plasmid encoded) contribute equally to growth on DBF.

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D2-15. A novel metabolomics method to indicate exposure to contaminants in the aquatic environment

Malin L. Nording1,2, Jana Späth2, Stina Jansson, Jerker Fick at the Department of Chemistry, Umeå University, Sweden; Magnus Bergknut at MTC, Environmental Technology Center, Sweden; Bruce D. Hammock at the Department of Entomology and Nematology, University of California, Davis

The threat of pharmaceuticals and other emerging contaminants have received increased attention during the last decade since they are potent and biologically active chemicals. They enter waterways primarily via treated wastewater effluents and remain biochemically active in aquatic systems. Environmental metabolomics investigations have increased markedly in studies to detect stress from abiotic factors such as exposure to various anthropogenic contaminants, as well as biotic stressors and competition. Metabolomics is an appropriate tool for such investigations since it enables sensitive analyses on the molecular level and can provide novel insights into the underlying biological mechanisms. We are developing a new metabolomics method to indicate exposure to contaminants in the aquatic environment. It will be applied in studies to evaluate the removal efficiency of biochars used as adsorbents to decontaminate wastewater effluent. Biochar adsorbents derived from agricultural waste will be tested in our metabolomics studies on Damselfly larvae, which is highly suitable as sentinel species since they are resilient and easily captured. After validation of the method in Damselfly larvae, we will continue with exposure studies. First by using complex, environmental relevant mixtures at lab scale, and then in large-scale experiments at MTC, Sweden, where they have a test bed facility specializing in the implementation of emerging environmental technologies linked to contaminated soil, sludge and water. MTC will offer a site for demonstration of our new and innovative metabolomics technology in a realistic environment. Results so far include the detection of 20 newly discovered fatty acid metabolites in Damselfly larvae. The ultimate goal is to develop a novel tool for indication of exposure to contaminants that can be used as an early-warning system for monitoring water quality.

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D2-16 ESE. Finite Element Modeling of Sub-Slab Depressurization with Multiple Collection Points

Ana S. Oliveira, Eric M. Suuberg, School of Engineering, Brown University

Vapor intrusion is defined as the migration of volatile contaminants from the subsurface into indoor air spaces of overlying buildings. A potential vapor intrusion problem possesses three conditions:

- Contaminants in the soil gas
- Entry routes for soil gas
- Driving forces (pressure gradients or diffusion gradients) to draw the contaminants into the building.

A method for removing any one of these three conditions constitutes mitigation. The pressure gradient that drives advective flow into the building can be diverted by inducing a negative pressure in sub-slab soil gas. Installing a network of pipes under the slab that uses a fan to extract soil gas from under the slab and vent it to the atmosphere is the most common approach and is called sub-slab depressurization system.

For simplicity, assume Trichloroethylene is initially located only in the soil gas and that it does not
change with time. Suppose the contaminants do not adsorb on surfaces significantly and do not react chemically, then a steady indoor concentration exists when the entry rate matches the removal rate. In this poster, we study the effects of the location and quantity of collection points on indoor air concentration at various soil types.

**D2-17 ESE. Optimization of Clustering Algorithms for Grouping of Complex Chemical Substances Based on Chemical and Biological Characteristics**

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The ultimate goal of the Texas A&M Superfund program is to develop comprehensive tools and models for addressing exposure to chemical mixtures during environmental emergency-related contamination events. With that goal, we aim to design a framework for optimal grouping of chemical mixtures based on their chemical characteristics and bioactivity properties, and facilitate comparative assessment of their human health impacts through read-across. In order to explore the most optimal clustering algorithms that may be used to establish the chemical and biological similarity between complex substances or mixtures, we used several recent examples of chemical substances of Unknown or Variable composition Complex reaction products, and Biological materials (UVCB substances). Tested UVCBs had extensive multi-dimensional analytical chemistry profiles (GC-GC-FID and IM-MS; Grimm et al. ES&T 51, 7197, 2017) as well as bioactivity profiles from in vitro screening in human cells (Grimm et al. Green Chem 18, 4407, 2016). To test how well chemical and biological data can group these UVCB into their production classes, we performed simultaneous dimensionality reduction and clustering analyses. We exploit hierarchical clustering methodology using Kendall, Pearson, and Spearman correlations as similarity metrics for clustering analysis, and a nonlinear Support Vector Machine based feature selection for dimensionality reduction of the high dimensional input data sets. Finally, the obtained results are evaluated with the Fowlkes–Mallows (JASA, 78, 553, 1983) index in order to provide a comparative assessment for the clustering quality. We show how the choice of a clustering method and visualization approach may affect communication of the groupings for read-across. This study is supported by NIEHS Superfund Research Program P42 ES027704.

**D2-18. Preliminary assessment of contaminant exposure through water after Hurricane Maria in Puerto Rico**

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The Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) has been studying the

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potential relationship between contaminant exposure and preterm birth in Puerto Rico, which are among the highest in the nation and around the world. Previous work has shown extensive contamination of water sources. Many contaminant metabolites have also been found in urine of pregnant women, indicating potential exposure. The path of Hurricane Maria through the island left enormous impacts on water sources and infrastructure. Consequently, people have been exposed to water of potentially harmful quality. This work aims at assessing preliminary impacts of water sources in Puerto Rico after the path of Hurricane Maria. Qualitative observations are annotated on the water sources and use. Water samples are also collected from ground water, surface water, and tap water sources and analyzed for water quality, targeted contaminants, as well as overall toxicity of water from mixture of contaminants. Bulk water quality parameters are compared with those taken before the Hurricane. Initial observations indicate that people are using water for multiple purposes from unsafe sources, particularly many distress communities. Water is either untreated or over-chlorinated, which create other potential harmful effects. Initial measurements of standard water quality indicate high turbidity and bacteria counts. Other measurements will also be reported. Preliminary results indicate that people are being exposed to contaminated water, and that this is to continue for an extended period of time.

D2-19. Extrapolating Disposition of Polycyclic Aromatic Hydrocarbon (PAH) Across Dose and Species Using Physiologically Based Pharmacokinetic Modeling

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Dibenzo[def,p]chrysene (DBC) is an environmental polycyclic aromatic hydrocarbon (PAH) that causes tumors in mice and has been classified as a probable human carcinogen (2A). Animal toxicity studies often utilize higher doses than are found in relevant human exposures. Additionally, like many PAHs, DBC requires metabolic bioactivation to form the ultimate toxicant (e.g. diol-epoxide metabolite), and species differences in DBC metabolism have been observed. In order to understand the implications of dose and species differences on DBC disposition, a physiologically based pharmacokinetic model (PBPK) originally developed to describe DBC disposition in mice was extended to humans. Metabolism rates of DBC and metabolite dibenzo[def,p]chrysene-11,12 diol (DBC diol) were measured in mouse and human liver microsomes. Mice demonstrated higher rates of DBC and DBC diol metabolism compared to humans after applying allometric scaling. PBPK model simulations were evaluated against human volunteers were orally microdosed with 29 ng of [14C]-DBC and mice dosed with 15 mg/kg DBC by oral gavage. DBC and DBC diol were the primary metabolites measured in blood of mice and humans, while in urine, the majority of DBC metabolites were conjugated DBC diol, conjugated DBC tetroles, and unconjugated DBC tetroles. The PBPK model was able to accurately simulate time course concentrations of DBC and DBC diol in human and mouse plasma. In vitro-to-in vivo scaling of measured metabolism resulted in reasonably accurate predictions of total DBC tetroles and conjugated DBC diol in urine, which suggests that these compounds are short-lived in blood and rapidly excreted. The resulting PBPK model is a tool that can be used to predict pharmacokinetics, assess potential risks for humans exposed to PAHs, and/or for biomonitoring/reverse dosimetry applications.
D2-20. Developmental Exposures: Mechanisms, Consequences and Remediation

Sarah Phillips, Duke University Superfund Research Center - faculty, post-docs, students, researchers and staff.

Project Summary: Research conducted within the Duke University’s Superfund Research Center (DUSRC) focuses on a central research question: How does early life exposure to hazardous substances elicit developmental toxicity, and what are the later-life consequences? As such the theme of our center is Developmental Exposures: Mechanisms, Consequences and Remediation, and we remain committed to investigating the vulnerability of the developing organism to hazardous chemical exposures. Within the DUSRC we emphasize research on both ATSDR priority chemicals (e.g. PAHs, metals, organophosphate chemicals) and emerging chemicals of concern (e.g. halogenated flame retardants) that are known to, or have potential to, adversely effect development. Mechanisms of action that are central to the mission and research conducted within the DUSRC include mechanisms underlying molecular and physiological effects from developmental exposures, mechanisms underlying ameliorations of and adaptations to these effects, and mechanisms and approaches to engineering solutions for the ultimate removal of these chemicals from the environment. A unifying theme across the DUSRC projects is effects on neurobehavioral and neurodevelopmental outcomes from these exposures. DUSRC researchers are conducting research using in vitro (e.g. cell culture) and in vivo (e.g. zebrafish, rats) models to determine effects of these hazardous chemicals on neurodevelopmental across projects, but several individual projects are also exploring effects on skeletal and fat development, cardiovascular development and bioenergetics. Of key interest is the ability of some contaminants to converge on similar phenotypes through multiple mechanisms of action. With the heightened interest in developing Adverse Outcome Pathways (AOPs) within regulatory agencies, the DUSRC is well poised to support these endeavors. Our interdisciplinary team of biomedical/environmental scientists and engineers provide the DUSRC with a unique opportunity to address and examine “holistic” consequences of developmental exposures. This integration is central to evaluating the true risk from exposure to hazardous substances. The DUSRC directly addresses the program mandates by investigating health effects and risks and remediation of hazardous substances in an interdisciplinary fashion. In addition to responding to SRP mandates, the DUSRC’s research, research translation, and community engagement activities are also highly relevant to numerous stakeholders, including the Environmental Protection Agency.

D2-21. A missense variant in FTCD is associated with arsenic metabolism efficiency and arsenic toxicity in Bangladesh

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Exposure to drinking water contaminated with inorganic arsenic (iAs), a known human carcinogen, affects >100 million people worldwide. Arsenic-induced skin lesions are an early sign of arsenic toxicity and a risk factor for subsequent cancer. Once absorbed into the blood, iAs can be converted to mono-methylated (MMA) and then di-methylated (DMA) forms of arsenic, with methylation facilitating the excretion of arsenic in urine. The relative abundance of these arsenic species in urine (iAs%, MMA%, DMA%) represents the efficiency with which an individual metabolizes arsenic. The AS3MT region is the only locus known to harbor variants that influence arsenic metabolism efficiency in humans. In order to identify additional variants that impact arsenic metabolism, we measured
protein-coding variants across the human exome using Illumina’s Exome Chip for 1,660 Bangladeshi individuals participating in the Health Effects of Arsenic Longitudinal Study. Among 20,265 exonic variants with a minor allele frequency >1%, only rs61735836 showed associations of experiment-wide significance for all three arsenic metabolite percentages (P=8x10-22, P=7x10-16, and P=2x10-12 for DMA%, MMA%, and iAs%, respectively). The minor allele (A) has a frequency of ~7% in our study (consistent with 1,000 Genomes data) and is associated with decreased DMA% and increased MMA% and iAs%. In subsequent analyses of 2,401 skin lesions cases and 2,472 controls, the low-efficiency allele (A) was associated with increased skin lesion risk (OR=1.25; P=5x10-4), suggesting this variant impacts arsenic toxicity through its impact on metabolism and internal dose of arsenic. rs61735836 is a missense variant (p.Val101Met) in exon 3 of FTCD, which codes for forminidoyltransferase cyclodeaminase. This enzyme is involved in one-carbon metabolism and is critical for production of methenyltetrahydrofolate, a donor of one-carbon groups to the methionine cycle. Methionine provides methyl groups for arsenic metabolism, and variation in folate status and one-carbon metabolism have long been hypothesized to influence arsenic metabolism, with folate supplementation resulting in increased arsenic metabolism efficiency in a randomized trial. FTCD expression in liver (the primary site of arsenic metabolism) is higher than in any other human tissue, but rs614735826 is not associated with gene expression in any tissue (based on GTEx). Furthermore, rs61735836 is not in LD (r2<0.1) with any nearby variant in South Asian populations, suggesting its effect on arsenic metabolism is likely through an amino acid substitution that alters FTCD function. This work implicates FTCD as a novel locus influencing arsenic metabolism efficiency, with potential implications for arsenic-induced cancer risk, and establishes an additional link between one-carbon metabolism and the methylation/metabolism of inorganic arsenic.

D2-22 HS. Low-moderate arsenic exposure and respiratory health in American Indian communities

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Background: Inorganic arsenic, through drinking water exposure, is associated with numerous negative health outcomes including cancer of the lung. However, evidence on the impact of arsenic exposure on lung function is less conclusive. Studies examining low-moderate levels (<50 µg/L) of water arsenic exposure, the level relevant for the United States, are limited.

Methods: The Strong Heart Study (SHS) is a prospective study of American Indian adults in Arizona, Oklahoma, and North/South Dakota, US. The present analysis used lung function assessment by
spirometry at the SHS second examination (1993-1995) in 2,257 adults with urinary arsenic measurements at baseline (1989-1991). The association between arsenic exposure and lung function and lung obstruction (FEV1/FVC ratio <0.70) were evaluated.

Results: The overall prevalence of lung obstruction was 21.4%, (484/2,257). In those with lung obstruction, the median (IQR) arsenic level was 10.1 (5.7-14.7) µg/g creatinine, and in non-obstructed individuals, 7.9 (4.9-13.5). When the highest to the lowest tertiles of arsenic concentrations (>11.9 vs. <6.0 µg/g creatinine) were compared, the odds ratio for lung obstruction after adjustment for sociodemographic factors, smoking, BMI, and diabetes was 1.58 (95% CI, 1.11 to 1.50; P for trend 0.001).

Conclusions: In this study examining the association of arsenic biomarker of exposure with spirometry measurements, elevated urinary arsenic levels were related to a higher burden of lung obstruction, independent of smoking exposure, suggesting a role for low-moderate arsenic levels in nonmalignant obstructive lung disease.

Research Translation: The impact that reducing arsenic exposure may have on respiratory health is being assessed in the Strong Heart Water Study, an ongoing randomized controlled trial of an arsenic intervention in South Dakota.

D2-23. Radiocarbon Analysis of RNA Collected from Pleistocene Aquifers in Bangladesh: Are the Ages Anomally Young?

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Kazi Matin Ahmed, (Department of Geology, University of Dhaka, Dhaka, Bangladesh);
Mahfuz Khan, (Department of Geology, University of Dhaka, Dhaka, Bangladesh)

Shallow Holocene aquifers in Bangladesh are typically used as a drinking water source but can be contaminated with geogenic arsenic. In the Holocene aquifers, relatively young, advected organic carbon has been linked with microbial respiration driving arsenic release. Deeper, low-arsenic, Pleistocene aquifers are being utilized more often as a safe drinking water source. The goal of this work was to determine carbon sources utilized by the microbes in the Pleistocene Aquifer to better understand long-term geochemical stability. This study focuses on community well number 24502 (site Cat), a 238 m deep well located in the peri-urban center of Araihazar, Bangladesh. The arsenic is 2.4 µg/L with a radiocarbon age of the dissolved inorganic carbon (DIC) of 9798108 yrs (n=4), typical of wells in the study area. This site was chosen as a location where microbes might use organic carbon associated with the sediment or through slow advection might be older than the DIC. Multi-day, large-scale filtering was undertaken to collect enough sample to radiocarbon date both the RNA and DNA. The radiocarbon DNA age was 2030120 yrs (n=1) and the RNA age was 523070 yrs (n=1), both considerably younger than the DIC. Two separate radiocarbon DOC samples had ages of 90020 yrs and 193025 yrs, again younger than the DIC. These young dates were surprising and analysis of another 234m deep well (24459) located 5.3 km away had similar results. More DOC and DIC radiocarbon samples have been collected from nearby wells. The source of the young, reactive organic carbon is not known, but these results may alter thinking about deep aquifer stability.

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D2-24. Exposure to PCB 126 during the Nursing Period Significantly Impairs Early-Life Glucose Tolerance

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Pharmacology & Nutritional Sciences, University of Kentucky College of Medicine, Lexington, KY

Introduction: Polychlorinated Biphenyls (PCBs) are persistent environmental organic pollutants that are known to have detrimental health effects. In a mouse model in our laboratory, PCB126 exposure during pregnancy and nursing alters offspring body composition and glucose tolerance. This purpose of this study was to expose dams to PCB126 during the nursing period only.

Methods: Female ICR mice were bred and half of the dams were exposed to either vehicle (safflower oil) or 1 µmole PCB126 per kg of body weight via oral gavage on postnatal days 3, 10, and 17 (n = 9/group). Offspring body weight, lean and fat mass, and glucose tolerance were measured.

Results: Both male and female offspring displayed normal body weight as well as body composition (p > 0.05). However, both male and female offspring that were exposed to PCBs during the nursing period had significantly impaired glucose tolerance at 3 weeks of age (p < 0.05). This persisted until 9 weeks of age in the female offspring (p < 0.05), but the difference disappeared as the male offspring aged (p > 0.05).

Conclusion: Our earlier work suggests that in utero and postnatal PCB126 exposure predisposes offspring to having lower lean mass and impaired glucose tolerance later in life. However, our current study shows that exposure to PCB126 through the mother's milk impairs glucose tolerance in the short-term and is likely caused by impairments in insulin receptor signaling in the periphery as others have shown with direct PCB exposures in adult mice. Future experiments will investigate the mechanisms of dysfunction caused by in utero PCB126 exposure, which may be driving the increased risk of obesity and insulin resistance in adult offspring.

D2-25. Potential titles: After more than 35,000 Samples of Homeowners wells in New Jersey, can we detect temporal trends in groundwater arsenic?

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Stuart Braman, Lamont Doherty Earth Observatory, Columbia University, Palisades, NY 10964
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Naturally-occurring arsenic in groundwater is a concern for homeowners with private wells in the United States. The New Jersey Private Well Testing Act (PWTA) requires arsenic testing whenever a house with a private well is sold. Through the PWTA, 35,500 wells have been sampled for arsenic between 2001 and 2014. Some wells have been sampled multiple times. The overall goal of this SRP-NJDEP partnership is to develop a method that can regularly evaluate the NJ PWTA data for temporal changes in arsenic in unique wells. Households with 2 or 3 samples were monitored for unidirectional trends and households with 4 to 6 samples were analyzed using statistical trend analyses. By 2014, the NJ PWTA data contained 5,438 households with 2 samples, 805 households with 3 samples and 127 households with 4 or more samples, with 6 being the largest. In wells tested twice, 85% had both samples either below the State’s 5 ug/L MCL or below the detection limit, and another 7% of the wells had one of the duplicate pair below 5 ug/L with the other above 5, with

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another 6% showing similar concentrations above 5 ug/L. The data show well-specific arsenic concentrations have changed in a low percentage of the wells, and the number with an increasing concentration trend are roughly matched by those that decrease. Overall these results indicate that multiple laboratories have produced consistent data and that the primary concern in NJ is intervention in areas with high arsenic concentrations and testing of additional private wells, not temporal changes in arsenic.

D2-26 HS. Evaluation of new and rapid antibody-based PAH measurement techniques for determining the distribution and flux of PAH at contaminated sediment sites

Kristen Prossner, George G. Vadas, Michele Cochran, Mary Ann Vogelbein and Michael A. Unger, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA; Joe Reiger, The Elizabeth River Project, Portsmouth, VA

Hydrophobic organic contaminants such as polycyclic aromatic hydrocarbons (PAHs) accumulate in estuarine sediments and are often the target for remediation efforts via dredging and or capping. Understanding the site-specific factors governing the fate and transport of these contaminants is critical to the long-term success of sediment remediation plans. Transport of the dissolved phase contaminants may occur by diffusion, groundwater pressure gradients, or by advection near the sediment surface. Contaminant flux to the water column at the sediment-water interface ultimately controls the bioavailability to organisms. New antibody-based biosensor methods allow near real-time quantification of total PAH in small volume (2-5mL) aqueous samples and can provide the direct measurement of PAH concentrations in porewater (Li et al, 2016). When coupled with new radionuclide techniques that measure Ra:Th disequilibrium in sediment samples, time averaged PAH flux can be estimated by one time sampling of sediment and porewater. Short-term variations in PAH flux were calculated by measuring PAH concentrations in the output of seepage meters with the biosensor on an hourly basis. A comparison of the new antibody-based biosensor measurements with radionuclide techniques and more traditional GC-MS analysis of passive sampling devices showed similar trends of PAH flux across sampling stations with the highest levels of PAH flux at one previously remediated site in the Elizabeth River in Chesapeake, VA. Biosensor data from multi-year monitoring is being shared with the Elizabeth River Project, a collaborating non-profit restoration group based in Portsmouth, VA, in order to optimize future remediation efforts to reduce contaminant flux to the water column. Future applications of biosensor technology will expand beyond porewater analysis to evaluate near real-time PAH quantification in Elizabeth River oysters.

D2-27 ESE. Uptake and fractionation of thallium by Brassica juncea in geogenic Tl-amended substrate

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Our foundational work has shown a distinct mineralogic control on the geochemical signature of thallium (Tl) in geologic samples. Concentrations can vary at least four orders of magnitude, from below detection limit (<200 ppb) to nearly 3200 ppm. This range spans values considerably higher than average crustal whole rock concentrations (0.7 ppm), with an enrichment factor of up to 5x in mica versus coexisting K-feldspar. Additionally, this work has also demonstrated that underlying mineralogy plays a vital role in Tl isotope ratios, with bonding environment thought to be a local control on fractionation. Sulfides consistently display significantly heavier ε²⁰⁵Tl values compared
with coexisting feldspar and even more isotopically light mica samples. Overall, Tl isotope ratios have shown greater than 20$\%$ variability among coexisting mineral phases.

Given the mineralogic control on Tl geochemistry, this applied study has focused on Tl uptake by Brassica juncea cultivated in silica sand with four Tl-amended substrates: 1) Amelia Courthouse, VA, USA amazonite 2) Sterling Hill, NJ, USA hendricksite 3) USGS reference material NOD-A-1 and 4) NIST 997 standard solution. Each of these substrates has been previously characterized for Tl concentrations and isotope ratios, allowing for the determination of fractionation and translocation after biologic processes. Utilizing multcollector inductively coupled plasma mass spectrometry (MC-ICP-MS) coupled with a two-stage extraction chromatography column procedure, we measured Tl concentrations and isotope ratios among plant organs for each substrate, demonstrating unique translocation and fractionation patterns for Tl.

Quantifying the extent of accumulation and fractionation induced by biologic activity is vital in understanding the utility of Tl geochemical markers. This information may be applied in biogeochemical prospecting, tracing anthropogenic contamination from source to sink, and phytoremediation.

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**D2-28 ESE. Molecular Mixture Toxicity Modeling using Toxicogenomic Data via Parallel Factor (PARAFAC) Decomposition**

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Prediction and modeling of mixture toxicity are challenging due to complex interactive modes of action including concentration addition, independent action, synergism, or antagonism. Toxicogenomic technologies in combination with bioinformatics show promises to transcend the limitations of conventional approaches by quantifying and predicting mixture toxicity. Several limitations including lack of quantitative dose-dependent data, data complexities due to small sample size coupled with large no. of variables, scarcity of established theoretical and modeling frameworks, and lack of consensus in computational methodologies — hinder their wider applicability. Here, we explored the application of a tensor decomposition method, Parallel Factor (PARAFAC), to model the molecular toxicity of a binary mixture of two metals (As and Cr) from their time-series transcriptomic responses of 120 genes generated by GFP-fused E.coli K12, MG1655. PARAFAC model decomposed 3D toxicogenomic data (genetimeconcentration) of the mixture and its constituents into multiple factors and revealed the gene response profiles, associated temporal pattern and dose-response effects of these factors. Gene set enrichment analysis revealed the dominant molecular toxicity mechanism of the decomposed factors — representing conserved fundamental biological/molecular features. The fundamental temporal and dose-response profiles differed across chemicals and decomposed factors, representing varying biological responses of the conserved sub-modules. Multiple linear regression analyses revealed the efficacy of the decomposed factors of the individual chemicals as descriptors to model the fundamental mixture toxicity profiles. Highly significant regression models were obtained ($p<0.001$) at all three modes (gene, time, concentration), indicating the ability to model the conserved mixture toxicity profiles from the PARAFAC decomposed factors of the constituent chemicals. The proposed novel application of PARAFAC decomposition can provide significant insights into toxicogenomics based mixture toxicity characterization and prediction at molecular level.

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D2-29. The Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) Program

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The Puerto Rico Testsite for Exploring Contamination Threats (PROTECT) Center studies exposure to environmental contamination in Puerto Rico and its contribution to preterm births (less than 37 completed weeks of gestation). The study is conducted in Puerto Rico because of its high preterm birth rate and because of the extent of hazardous waste contamination on the island (more than 200 contaminated sites). Puerto Rico’s preterm birth rate has dropped to 11.4% in 2016 from close to 20% in 2008, encouraging news for PROTECT after years of research and community engagement in an effort to reduce preterm births in the region. Through June 1, 2017, a total of 1,358 study subjects have been enrolled, 13,000+ forms have been administered, and 14,000+ biological samples have been collected.

PROTECT Project 1 is a molecular epidemiology study of phthalate exposure and preterm birth in Puerto Rico; Project 2 explores toxicant activation of pathways of preterm birth in gestational tissues; and Project 3 focuses on discovery of xenobiotics associated with preterm birth. Through these projects, we provide new evidence that DCVC (a trichloroethylene or TCE metabolite) exposure increased cellular generation of reactive oxygen species and increased mRNA expression and release of IL-6, a pro-inflammatory cytokine associated with normal and preterm labor. Also, PROTECT encompasses two environmental projects: Project 4 studies dynamic transport and exposure pathways of contaminants in karst groundwater systems, while Project 5 focuses on the development of a solar-powered remediation process for contaminated groundwater. Through these integrated studies, along with a centralized, indexed data repository, PROTECT delivers new knowledge and technology in the area of contaminants of interest to the Superfund Research Program as a potential cause of preterm birth.

D2-30. Chemical and Biological Recovery of a Remediated Mining Impacted Stream, Black Hawk/Central City, CO

James Ranville, Elizabeth Traudt, Jill Murphy, Department of Chemistry, Colorado School of Mines; Christopher Kotalik, Will Clements, Department of Fish, Wildlife, and Conservation Biology, Colorado State University; Danielle L. Ivey, Chris Vulpe, Center for Environmental & Human Toxicology, University of Florida; Joseph Meyer, ALPS LLC; Pete Cadmus, Colorado Division of Wildlife.

The legacy impacts of hardrock mining are complex and difficult to fully mitigate. Though the effects of hardrock mining on water quality have been extensively researched, there is a paucity of data documenting the real-time responses of mining impacted waterways to remediation efforts. In seeking to breach this informational gap, we collected water, streambed rocks, and biological samples from a stream impacted by the Central City, CO, CERCLA site. Sampling occurred at 7 different locations along the mining impacted North Fork of Clear Creek (NFCC) beginning west of Black Hawk, CO, moving downstream to a recently completed lime treatment plant, and ending at the confluence of
NFCC and the main stem of Clear Creek. Water samples were analyzed for metal and cation concentrations by ICP-AES, anion concentrations by IC, and dissolved and total organic carbon by a Shimadzu TOC-V analyzer. Additionally, we collected field measurements of pH, alkalinity, ferrous, and conductivity. Our analyses have revealed that although pH has remained relatively stable over the duration of the sampling period (a moderate range between 6 and 7.5 for all sites), drastic decreases in both ferrous concentrations (approximately five-fold) and conductivity (approximately three-fold initially, and up to nearly ten-fold at the most recent sample date) were observed immediately following the first treatment period. Metals exhibited a sharp initial decrease and continued decreases over the entire sample period as well. For example, total copper measured ~0.1 mg/l prior to treatment, ~0.06 mg/l following 2 days of treatment, and ~0.02 mg/l following nearly 2 months of treatment. Iron exhibited a similar trend, measuring ~19 mg/l prior to treatment, ~9 mg/l following 2 days of treatment, and ~3 mg/l following nearly 2 months of treatment. The low, but non-zero metals concentration suggest continued contributions from the untreated AMD, unidentified ground water sources, or the bed sediments. Two forms of iron-rich sediment were extracted from the streambed rocks; a loose, easily removed flocculent and a hard, armored coating that was removed by placing the rocks in a tumbler. Copper bioavailability in these two phases was examined by use of reverse isotope labeling of snails (L. stagnalis) using 65Cu. Species diversity and abundance was determined by regular benthic sampling of the stream. Information on post-remediation water chemistry, metal bioavailability from sediments, and biological recovery is being shared with local stake holders including the non-profit Upper Clear Creek Association and the Colorado Department of Public Health and Environment, and the Colorado Division of Wildlife.

D2-31. Superfund Research Program Mercury Science to Policy: Research Translation on an International Scale

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Aiding our scientists in translating and making their research available to policy stakeholders is essential to ensuring that sound science is used to make national and international policy and regulatory decisions. The 2015 Superfund Research Program (SRP) Strategic Plan identifies promoting interaction between SRP and its stakeholders as a key programmatic goal.

Building upon the foundation laid by our previous mercury (and arsenic) science-to-policy-workshops, our RTC collaboratively led the development of four synthesis papers which established the scientific themes of the 13th International Conference on Mercury as a Global Pollutant. The four synthesis papers were developed on: global mercury processes in response to human perturbations; managing aquatic mercury pollution in altered landscapes; mercury exposure, bioaccumulation and effects on wildlife and humans; and linking science and policy to support implementation of the Minamata Convention.

Following the development of the draft papers, the RTC team brought together the four groups of synthesis authors with stakeholders and policymakers for a workshop entitled, Integrating Mercury Research and Policy in a Changing World, to have dialogue about the mercury science relevant to the first Conference of Parties (COP) of the Minamata Convention. The workshop discussion focused on the translation of the synthesis papers into a format that would be useful to delegates at the COP, convened in September 2017 in Geneva Switzerland. The RTC, in collaboration with colleagues at MIT, produced four two-page synthesis summaries targeting thematic sessions of the COP on land, air, water, and high level policy. The translation of mercury science to policy at the international level was greatly improved by bi-directional communication between scientists and policymakers.

Please note: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
D2-32. Midwest Emerging Technologies Public Health & Safety Training (METPHAST) Program Update

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The long-term goal of the METPHAST Program is to ensure that emerging technologies grow without causing illness or injury to workers and the public. The program’s objective is to develop a comprehensive web-based curriculum on occupational hygiene, with emphasis on worker health and safety applications in emerging technologies. To date, the METPHAST Program team has developed 17 one-hour, web-based modules and supplemental hands-on activities about working safely with engineered nanomaterials. These modules serve as the basis for a blended-learning Nanotechnology Health & Safety academic course and a series of free on-line continuing education courses offered by the University of Minnesota. Portions of the modules have been utilized in other academic courses at the University of Minnesota and University of Iowa, and in professional development courses for occupational hygiene practitioners. The modules are also freely available to instructors at high schools and two-year colleges through Nano-Link, a website that disseminates web-based nanotechnology training materials. Currently, the METPHAST Program team is developing three online cores for professional training of occupational health and safety specialists and others in the areas of chemical hazard recognition, chemical hazard detection technologies, and risk management. Each core will contain 10-15 web-based modules. In turn, each module will be comprised of short learning assets that can collectively be completed in about one hour. Real-world applications of concepts introduced in the learning assets will be drawn from emerging technologies, including green chemistry, electronic products and waste, and nanotechnology. These online cores will serve as the basis for modified occupational hygiene academic courses at the University of Minnesota and the University of Iowa and new continuing education courses at the University of Minnesota.

D2-33 ESE. Characterization of an Integrative and Conjugative Element Isolated from a Contaminated Passaic River Sediment

Aakansha J. Roberts (Department of Biochemistry & Microbiology, Rutgers University, New Brunswick, New Jersey); Gerben J. Zylstra (Department of Biochemistry & Microbiology, Rutgers University, New Brunswick, New Jersey)

Integrative and conjugative elements (ICE) are a family of mobile genetic elements that can be transferred between different cells/organisms, and once in the recipient they integrate into the host’s chromosome using very specific recombination sites. We isolated three Pseudomonas species from a contaminated former industrial site along the Passaic River based on their ability to grow on diphenylmethane, a hazardous compound structurally similar to biphenyl. The strains were later tested on biphenyl and were found to be able to metabolize it using the same pathway as for diphenylmethane degradation. One of the three strains, a P. stutzeri, was mated with the well characterized P. putida KT2440 which subsequently gained the ability to grow on biphenyl, diphenylmethane, and salicylate. This led us to believe that the genes for degradation of the three compounds must be horizontally transferred in the environment. The whole genomes of the three Passaic River strains and the KT2440 recipient were sequenced and assembled to reveal that the degradative genes are indeed present on an ICE. The ICE is over 120 kb in length and inserts at a 9 base pair sequence at the end of a tRNAGly(ACC). It contains an integrase and other genes involved in the transfer of the ICE, and genes for diphenylmethane/biphenyl and salicylate degradation. It also
contains a number of repeated sequences. Our work demonstrates that integrative and conjugative elements play a large role in the spread of biodegradative genes in the environment.

D2-34. Impact of carbon nanomaterial physical properties on bioavailability of benzo(a)pyrene in model aquatic organisms.

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Engineered carbon nanomaterials are widely commercialized for applications ranging from semiconductors to tires. This has the potential to result in nanomaterials into aquatic environments, many of which already contain chemical pollutants. Using 2D few-layer graphene microsheets and carbon black nanoparticles, we are studying how nanomaterial physical properties influence their interactions with the model contaminant benzo(a)pyrene. Two models of aquatic toxicology, fish liver cells and the invertebrate brine shrimp, were used to assess the bioavailability and toxicity of benzo(a)pyrene in mixtures with the carbon nanomaterials. Preliminary results show the nanomaterials can reduce the level of uptake and response to benzo(a)pyrene in a surface area-dependent manner. Comparison of graphene and carbon black of comparable surface area show that graphene causes a greater reduction. Additionally, when benzo(a)pyrene and carbon nanomaterials are mixed at specific ratios, different concentrations show different levels of reduction. Together, this suggests that shape plays a role in benzo(a)pyrene toxicity, but that materials must be closely matched to measure the effect of shape separately from the influence of other factors including concentration. Our ongoing studies will allow us to compare acute and subchronic exposures to evaluate the potential implications of nanomaterial differences on cellular adaptive and toxic responses to benzo(a)pyrene mixtures. To connect my laboratory research with communities, I have collaborated with the Brown SRP Community Engagement Core “Namaus: All Things Fish” project to gain comparative data for my fish liver microtissue model and to add histological analysis to their fish survey. This research is supported by NIEHS Superfund Research Program P42 ES013660, the Institute at Brown for Environment & Society, and the generous support of Donna McGraw Weiss ‘89 and Jason Weiss.

D2-35. Research Translation to Improve Knowledge and Decision-Making

Diana Rohlman (College of Public Health and Human Sciences, P42 - Research Translation Core, P42 Community Engagement Core)
Mike Barton (P42- Research Translation Core)
Kim A Anderson (Environmental and Molecular Toxicology, P42 - Chemistry Core, P42 - BRIDGES project)
Molly Kile (College of Public Health and Human Sciences, P42 - Community Engagement Core)
Justin Teeguarden (Pacific Northwest National Laboratories, P42 - Research Translation Core)
Stacey Harper (Environmental and Molecular Toxicology, P42 - Research Translation Core, P42 - Training Core)

The Research Translation Core (RTC) of the Oregon State University Superfund Research Program partners with investigators to translate scientific finding for stakeholders and community partners. The RTC hope to provide timely, needed data to these groups to improve knowledge and aid in decision-making, at the individual and community level. Here, we present two case studies of research translation and dissemination projects done in tandem with the Community Engagement Core and the

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BRIDGES research project. The Community Engagement Core (CEC) works in collaboration with tribal communities to evaluate unique exposure pathways. In partnership with the RTC, the CEC reports all data back to tribal leadership and individual participants. Here, the RTC was able to provide information regarding putative health effects following exposure to polycyclic aromatic hydrocarbons, as well as putative sources of these specific chemicals. This information was used in community meetings, tribal newsletters, individual and aggregate reports by the CEC. Secondly, the RTC recently partnered with the BRIDGES research project and Chemistry Core to respond in the wake of Hurricane Harvey. In the days after the hurricane hit, 13 Superfund sites in Texas reported flooding, along with multiple other toxic waste sites. It remains unknown if the flooding resulted in unanticipated chemical releases and exposures. Working under a novel OSU disaster IRB, Oregon State Superfund Research Program was able to respond within 3 weeks, recruiting individuals from flooded areas to wear passive sampling wristbands for a week. The goal of this project is to determine what individuals are exposed to during and after flooding from Hurricane Harvey. This information is currently needed by impacted communities within the Houston area. The RTC, BRIDGES and Chemistry Core will continue to work collaboratively to return individual and aggregated results to participants and the larger community.

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Rice consumption is the major dietary source of inorganic arsenic, an established lung carcinogen, in general populations. Research is needed to evaluate the respiratory health effects of chronic low-level arsenic exposure from dietary sources. This study examined the association of rice consumption with clinical and subclinical markers of chronic lung disease in a multi-ethnic US population. We included 2297 participants of the Multi-Ethnic Study of Atherosclerosis-Lung Study (MESA-Lung), who underwent spirometry testing, a full-lung computed tomography (CT) radiologic scan, and completed a food frequency questionnaire in 2010-2012. In a subset (n=168) arsenic was measured in urine. 9% of the study population reported eating 1 or more serving of rice per day. Eating at least one serving of rice per day was associated with significantly lower FEV1 (mean difference (MD)= -5.31 %predicted, 95% CI=-8.6, -2.02) and FVC (MD= -3.09 %predicted, 95% CI=-6.06, -0.12) levels compared to rarely or never eating rice, after adjusting for race/ethnicity, location, education, BMI, and smoking-status. FEV1/FVC was not significantly different (MD= -0.01, 95% CI= -0.03, 0.001). Eating one or more servings of rice per day vs. rarely/never eating rice was associated with higher %high attenuation area, a marker of interstitial lung disease (geometric mean ratio=1.05 (95% CI=1.01, 1.11). Among participants with urinary arsenic, associations between urinary arsenic lung function and lung imaging were similar to results for rice, although not statistically significant. Findings show that daily rice consumption has an adverse relationship with lung function and structure. We have communicated our findings to stakeholders, including local NYC communities, through a webinar that will soon be posted to social media. We intend to publish our results in a peer-reviewed, open access journal.

D2-37. Healthy fish, healthy people: Ecological and human health impacts of early life exposures to endocrine disruptors on metabolic and bone development.

PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
Fish inhabiting the New Bedford Harbor (NBH), Massachusetts, marine Superfund site can serve both as biological models for contaminant effects and indicators of human dietary exposure, contributing importantly to the assessment of ecological and human health risks of contaminant exposure. Polychlorinated biphenyls (PCB) and tributyltin (TBT) are bioaccumulative contaminants associated with NBH industries that belong to a growing class of metabolism-disrupting compounds believed to contribute to obesity, liver steatosis, and Type 2 diabetes in humans and other species. Here we show that embryonic exposure to PCBs and TBT produced phenotypic abnormalities and altered the expression of genes related to metabolic homeostasis in laboratory-reared killifish (Fundulus heteroclitus), an ecologically-important NBH fish. These biological effects suggest perturbations to metabolic and bone homeostasis in fish, consistent with effects seen in mammalian species; future transcriptomic analyses will provide insight into the underlying molecular mechanisms of toxicity for these compounds in fish. In a complementary investigation, we also used information from NBH seafood as a proxy for human dietary exposure to harbor-based Superfund chemicals, and show here that PCBs in human-consumed species from NBH have generally declined since 2003. This information may be useful in understanding the contribution of chemical metabolic disruptors in human obesity and metabolic disease. The combination of mechanistic studies using fish and the assessment of potential human exposure through consumption of contaminated seafood provides an effective and holistic approach to characterize both ecological and human health risks of exposure to environmental chemicals, including those frequently found at sites highly contaminated with multiple Superfund chemicals.

D2-38. Deletion of the circadian gene, Bmal1, affects cytochrome p450 gene expression in liver

Erica L. Schoeller, McKenna R. Sinkovic, Rujing Chi, Pamela L. Mellon

Circadian rhythm is the biological process by which organisms adapt their physiology to anticipate changes in daily activity. Circadian rhythms regulate many physiological processes, including hormone secretion, glucose homeostasis, and importantly, the rate of drug metabolism. We utilize a mouse model of circadian disruption, with a deletion of the core clock gene, Bmal1, to study the effects of disruptions in circadian rhythms on the expression of Phase I drug metabolizing enzymes, the Cytochrome p450s genes (Cyps) in liver. We found that many Cyp genes had significantly different expression in WT vs. KO mice, including Cyp2a4, 7b1, and 2b13. Since the growth hormone (GH) axis is a known regulator of Cyp expression, we investigated altered growth hormone secretion as a potential mechanism for dysregulation of Cyp genes in Bmal1 KO mice. The sexually dimorphic pattern of GH secretion is critical for governing the expression patterns of the sexually dimorphic Cyp enzymes. In males, GH secretion is pulsatile and in females GH secretion is more continuous. We hypothesized that loss of Bmal1 in males feminizes the GH pulse patterns would result in altered expression of Cyp genes. We found that Bmal1 KO males have disrupted GH pulse patterns, which could account for the aberrant Cyp expression observed in Bmal1 KO male mice. Analyses of serial samples of serum GH levels revealed that KO males have disrupted GH pulse frequencies (WT male=3.6, KO male = 6.5, WT female 7.8). Thus, we conclude that deletion of Bmal1 impairs the expression of the drug metabolizing Cyp enzymes, potentially through modulation of the GH axis.
D2-39 Perceptions of risk and eco-anxiety: results from a community survey
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For residents living near environmental hazards, perceived risk can be a source of psychosocial stress which impacts mental health while also increasing an individual's susceptibility to environmental toxins. We conceptualize anxiety and stress resulting from the uncertainty surrounding these environmental risks and their implications as eco-anxiety. In this analysis, we assess the relationship between eco-anxiety and perceptions of environmental risk posed by contaminated bodies of water surrounded by industry. In 2016, 161 community members participated in interviews regarding environmental risk perceptions. Eco-anxiety was assessed by 26 questions instructing participants to rate their levels of concern and stress related to the environment, exposures, and implications of industrial activity. Results from multivariate logistic regression models suggest that participants who perceived the risk from the contaminated body of water to be a threat to them personally (OR=2.4; 95% CI= (1.1, 4.9)) and to affect many people (OR= 2.5; 95% CI= (1.2, 4.9)) had higher levels of eco-anxiety. Eco-anxiety was also related to having more friends that lived in the area (p=0.002). Understanding the mechanisms of eco-anxiety will help policy-makers and mental health providers better serve communities near environmental hazards and address the associated physical and mental health problems.

D2-40 ESE. Development of Novel Crosslinked Polymers for the Capture of Polychlorinated Biphenyls
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The ubiquitous nature of persistent organic pollutants (POP), such as polychlorinated biphenyls (PCBs), have gained great attention, and many efforts are being made to eliminate these contaminants from the environment. Capture of these pollutants using polymeric materials from the environment is one remediation strategy. In this research, aromatic monomers and crosslinkers based on polyphenolic compounds have been studied, since we expect these functionalities to have high affinity for PCBs due to π-π stacking interactions.

The overall goal of this project was to develop novel crosslinked polymers and their composites that have high affinity towards PCBs and compare their binding properties. Novel monomers and crosslinkers were initially synthesized by acrylation of 4,4-dihydroxybiphenyl, 4-phenylphenol, 2-phenylphenol, and the acrylated forms were identified as 44BDA, 4PPMA, 2PPMA respectively. These monomers were characterized by various techniques, including differential scanning calorimetry (DSC) for their melting temperature and NMR to confirm their structure. Subsequently, crosslinked polymer films were synthesized using styrene, 4PPMA, and 2PPMA as monomers and crosslinked with different amounts of 44BDA. These films were then characterized using swelling studies in different solvents, and binding studies with PCBs, etc.

D2-41 HS. The Role of a Novel Long Noncoding RNA in the Regulation of Sox9b and its Contribution to TCDD-induced Toxicity End-points
Gloria R. Garcia, Prarthana Shankar, Cheryl L. Dunham, Jane K. La Du and Robert L. Tanguay (Dept. of Environmental and Molecular Toxicology, Oregon State University, Corvallis, OR.)

PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
In zebrafish, sox9b is one of the most-reduced transcripts on activation of the aryl hydrocarbon receptor (AHR) by 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). We previously identified an AHR2-dependent long noncoding RNA (slincR) located adjacent to sox9b that is up-regulated by strong AHR2 ligands, and is required for proper sox9b expression. We performed qRT-PCR Capture Hybridization Analysis of RNA Targets and found that slincR is enriched at the 5’ untranslated region (UTR) of the sox9b promoter in 48hpf DMSO and TCDD-exposed samples. To understand slincR’s role in TCDD-induced toxicity, we performed RNA-sequencing and gene ontology enrichment analysis and identified significant enrichment in processes related to skeletal and cartilage development in TCDD-exposed control morphants, and angiogenesis and vasculature development in TCDD-exposed slincR morphants. To further investigate slincR’s role, we measured cartilage of TCDD-exposed 72hpf zebrafish and found a significant difference in the craniofacial cartilage structure in slincR morphants compared to control morphants. Additionally, a blood hemorrhage screen showed TCDD-exposed slincR morphants at 48hpf had a lower proportion of hemorrhaging compared to TCDD-exposed control morphants. We also mined unpublished RNA-sequencing data from 16 PAHs and found 6 PAHs caused a significant increase in slincR expression, of which 3 are from EPA’s priority PAH list. Our results suggest that slincR regulates sox9b expression by binding to the 5’UTR of the sox9b promoter, contributes significantly to TCDD-induced jaw malformation and blood hemorrhaging, and is up-regulated by multiple PAHs. Understanding downstream transcriptional events that occur on AHR activation and play a role in toxicity pathways is necessary to accurately guide remediation strategies.

This research was supported by the SRP Grant P42 ES016465, NIEHS Core Center Grant P30 ES000210, and NIEHS Training Grant T32 ES007060.

D2-42. The AHR as a Driver of Tumor Aggression and as a Novel Immune Checkpoint Regulator

Elizabeth Stanford-Zulick (Northeastern University), Olga Novikov (Boston University School of Medicine), Zhongyan Wang (Boston University School of Public Health), Francisco Quintana (Brigham and Women's Hospital), David Sherr (Boston University School of Medicine, Boston University School of Public Health)

Environmental chemicals have been implicated in many cancers including oral, breast and brain carcinomas. Some of these chemicals are AHR ligands. The AHR has been implicated in the differentiation of stem cells and in immunosuppression inspiring, for us, the hypothesis that the AHR plays a role in both the formation of cancer stem-like cells and the suppression of tumor-specific immunity (immune checkpoints). To test this hypothesis, AHR activity in cancer cell lines was modulated with environmental and bacterial AHR ligands, AHR-specific inhibitors, or AHR-specific CRISPR-mediated knockdown and phenotypic, genomic and functional characteristics were evaluated. In addition, the effect of AHR inhibition on tumor immunity was determined. The data demonstrate that: 1) primary human oral squamous cell cancers (OSCC), triple negative breast cancers (TNBC), and glioblastomas (GBM) express elevated levels of nuclear AHR as compared to normal tissue, 2) AHR hyper-activation with several ligands, including environmental and bacterial ligands, significantly increase AHR activity and markers of cancer stem cells (CSCs), and accelerates cell migration, 4) AHR inhibition blocks the rapid migration of cancer stem cells and reduces cell chemoresistance, 5) the AHR regulates production of TDO-dependent, tryptophan-derived AHR ligands in an AHRÆTDOÆAHR ligandÆAHR amplification loop, 6) AHR knockdown inhibits tumor growth and increases overall survival in vivo and 7) AHR inhibition increases the number of tumor infiltrating CD8+ T cells and enhances tumor immunity. These data demonstrate that the AHR plays an important role in the development and progression of several cancers and that environmental or...
bacterial AHR ligands may exacerbate cancer by enhancing CSC development and AHR-mediated immune checkpoints. AHR inhibitors are now in preclinical evaluation prior to translation to the clinic.

D2-43. Infants’ dietary arsenic exposure during transition to solid food

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Infants who are exclusively breastfed have lower arsenic exposure than those who are formula fed, but as yet, little is known about exposure changes among weaning infants. Early life exposure to inorganic arsenic (i-As) may cause long-lasting health effects; therefore, we assessed exposure before and during weaning and investigated the association between solid food intake and infants’ urinary arsenic species concentrations. Following the recording of a comprehensive 3-days food diary, paired urine samples (pre and post introduction to solid foods) were collected and analyzed for arsenic speciation by ion chromatography (IC-ICP-MS) from 15 infants participating in the New Hampshire Birth Cohort Study. Infants had higher i-As (p = 0.035), monomethylarsonic acid (MMA) (p < 0.001), dimethylarsinic acid (DMA) (p = 0.002), and total urinary arsenic (sum of i-As + MMA + DMA (ΣAs), p = 0.004) during weaning to solid foods than while exclusively fed on a liquid diet including breast fed, formula fed, or mixture of breast milk and formula. Among weaning infants, increased urinary ΣAs concentration was pairwise-associated with rice cereal (rho = 0.90; p = 0.037), fruit (rho = 0.70; p = 0.035), and vegetable intake (rho = 0.85; p = 0.013). The observed increase in infants’ exposure to i-As, a highly toxic chemical form, related to the transition to solid foods suggests the need to minimize exposure during this critical period of development.

D2-44. Competitive metabolism of polycyclic aromatic hydrocarbons (PAHs) in rodent and human hepatic microsomes

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Humans are rarely exposed to a single polycyclic aromatic hydrocarbon (PAH) and, instead, are typically exposed to complex PAH mixtures from natural and anthropogenic sources. Since multiple PAHs can be substrates for various individual cytochrome P450 enzymes (e.g. CYP1A1, CYP1B1, etc.), exposure to PAH mixtures can cause metabolic competition, inhibiting PAH metabolism. Altered metabolism could have consequences for PAH clearance, bioactivation, and detoxification. The objective of this study was to quantify metabolic inhibition of PAHs using three different scenarios with mouse, rat, and human hepatic microsomes. First, the ability of parent PAHs to compete for metabolism in binary mixtures was quantified using benzo[a]pyrene (B[a]P) and dibenzo[def,p]chrysene (DBC). Second, the ability of parent PAHs to compete for metabolism with their major diol metabolite was quantified using B[a]P with benzo[a]pyrene-7,8-dihydrodiol (B[a]P diol) and DBC with dibenzo[def,p]chrysene-11,12 diol (DBC diol). Third, the ability of a real-world PAH
mixture (top 10 most abundant PAHs found in Portland Harbor Superfund Site) to compete for metabolism was quantified with B[a]P and DBC. Competitive metabolism was observed in all three scenarios using microsomes from all species tested. Inhibition constants were calculated, and in general, DBC was the most potent inhibitor tested. Species differences were observed with specific inhibition constants. For example, human metabolism was most sensitive to inhibition when B[a]P was used as the substrate, while mice were most sensitive when DBC was used as the substrate. This observation suggests that care should be taken when utilizing animal models to predict human hazard of PAH mixtures. Measured inhibition constants will be integrated into a physiologically based pharmacokinetic (PBPK) model to predict implications of observed competitive metabolism on internal dosimetry at relevant human PAH exposure conditions. Funded by NIEHS Grant No. P42 ES016465.

D2-45 HS. Metabolomics to Understand the Association between Arsenic Metabolism and Type 2 Diabetes: Preliminary Evidence from the Strong Heart Family Study

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Inorganic arsenic exposure is ubiquitous and both exposure and inter-individual differences in its metabolism have been associated with cardiometabolic risk. A more efficient arsenic metabolism profile (higher DMA%) has been associated with reduced risk for arsenic-related health outcomes. This profile, however, has also been associated with increased risk for metabolic outcomes, including diabetes. The mechanism behind these conflicting associations is unclear; we hypothesized the one-carbon metabolism (OCM) pathway may play a role. We evaluated the influence of OCM on the relationship between arsenic metabolism and diabetes using metabolomic data from an OCM-specific and P180 metabolite panel measured in plasma, arsenic metabolism measured in urine, and HOMA2-IR measured in fasting plasma. Samples were drawn from baseline visits (2001-2003) in 59 participants from the Strong Heart Family Study, a family-based cohort study comprised of American Indian men and women aged ≥14 years from Arizona, Oklahoma, and North/South Dakota. In crude analyses, an IQR increase in DMA% was associated with significantly lower HOMA2-IR (geometric mean ratio (GMR)=0.61 (95% CI: 0.46-0.82)). After adjustment for OCM-related metabolites (SAM, glutamate, lysophosphatidylcholine 18.2, and three phosphatidylcholines), the GMR was 1.02 (95% CI: 0.78-1.33). These preliminary results indicate that the association of higher DMA% with metabolic outcomes may be influenced by OCM status, either through confounding, reverse causality, or mediation. Findings will be shared with the Strong Heart Study community tribes and partners reinforcing their preliminary nature and the need for additional confirmation in larger longitudinal studies.

D2-46. Ethylene glycol monomethyl ether causes dose-dependent changes in testicular histopathology and in sperm small RNA populations in rat

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PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
Male reproductive toxicity poses a regulatory challenge in environmental, occupational, and pharmaceutical exposures due to the lack of simple robust analytical methods. Histopathological analysis has remained the gold standard for toxicity assessment where other read outs such as testosterone levels and WHO semen analyses are not well correlated or sensitive to testicular injury. RNA in sperm is reflective of the developmental process of the sperm, and changes in RNA composition could indicate toxic exposure. Ethylene glycol monomethyl ether (EGME) is a well-described testicular toxicant found at contaminated industrial sites and in consumer products such as paint. EGME induces cell death in a specific subset of germ cells (spermatocytes) at high doses. To find sensitive biomarkers at doses that do not cause overt toxicity, we performed a dose-response analysis of 5 daily exposures to 0, 50, 60 and 75 mg/kg in adult (275-350g) Fisher rats, and then examined 5 weeks later when the sensitive germ cell populations matured into sperm. Following 50 and 60 mg/kg EGME, we saw no differences in sperm motility, retained spermatid heads, or Sertoli cell vacuoles; however, the highest dose, 75 mg/kg, showed a significant decrease in sperm motility (21% vs. 69% in controls), and a significant increase in retained spermatid heads, and Sertoli cell vacuoles, 2-fold and 1.6-fold respectively. There was a significant linear correlation (decrease) between homogenization resistant spermatid head count per testis and dose EGME. The amount of small RNAs per sperm significantly increased with treatment, with the 75 mg/kg exposure group averaging 6.7-fold more small RNAs per sperm compared to controls. Analysis of small RNA-seq data is underway to identify specific sperm molecular biomarkers associated with EGME exposure.

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D2-47 HS. The trichloroethylene metabolite S-(1,2-dichlorovinyl)-L-cysteine (DCVC) stimulates apoptotic responses in a differentiated human placental cell model (BeWo)

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With 16 active Superfund sites, Puerto Rico grapples with risks for drinking water contamination. As part of the PROTECT Center effort to identify environmental contaminants that may contribute to Puerto Rico’s high rate of preterm birth, this study examines trichloroethylene (TCE) toxicity to placental cells. Syncytiotrophoblasts are the cells at the outermost layer of the fetal side of the placenta in direct contact with maternal blood and blood-borne toxicants. Although apoptosis of syncytiotrophoblasts is associated with several adverse pregnancy outcomes, little is known about environmental exposures as a cause of syncytiotrophoblast apoptosis. The TCE metabolite S-(1,2-dichlorovinyl)-L-cysteine (DCVC) is a strong candidate for inducing apoptosis in syncytiotrophoblasts because: (1) DCVC induces apoptosis in non-placental (kidney) cells; and (2) TCE exposure has been associated with adverse pregnancy outcomes. Using the BeWo cell line, cultured initially as cytotrophoblasts and induced to differentiate in vitro into syncytiotrophoblasts, this study investigated DCVC impacts on apoptosis biomarkers. Differentiation of BeWo cells was verified by increased mRNA expression of syncytin-1 and syncytin-2, biomarkers of syncytialization. Exposure to DCVC at 5-50 µM for 24 hours and at 5-20 µM for 48 hours stimulated apoptosis in syncytialized BeWo cells as inferred by decreased mRNA expression of bcl-2 and NF-κB, and an increased expression of galectin-3. These results provide molecular evidence of DCVC-stimulated apoptotic responses in a critical placental cell type. If similar effects occur in human placenta in vivo, TCE exposure could contribute to adverse pregnancy outcomes. These findings improve understanding of TCE hazards towards pregnancy and may aid key government and public health stakeholders in implementing approaches to decrease the occurrence of adverse pregnancy outcomes.
D2-48. Spatial data enrichment for historical analysis of non-occupational exposure to asbestos

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Background: There is increasing evidence of asbestos-related diseases among non-occupationally exposed individuals. Using the town of Ambler, Pennsylvania (PA), a community with substantial occupational and community exposure to asbestos, we aimed to characterize non-occupational exposure to asbestos and its resultant mortality within a spatial context. We are doing this with a novel approach carried out through an historic cohort study that spans 8 decades and retrospectively follows the population of 4,700 individuals who resided in Ambler in 1930.

Methods: Using historical Sanborn Fire Insurance Maps from 1930, we reconstructed a digital historical narrative of Ambler and surrounding boroughs. We leveraged the spatial capabilities of geographic information systems (GIS) to digitally map property boundaries and building outlines of each residence in Ambler. The data captured includes address and details on building construction materials along with square footage.

We then used publically available Census records to identify the 4,700 individuals living in Ambler in 1930. We extracted each individuals’ name, residence address, gender, race, occupation and industry. Occupational exposure was based on an individual’s occupation and listed industry. Paraoccupational exposure based on having the same address as an individual with occupational exposure. We then spatially enabled these Census records by linking the data with the existing digital map of our study area, thereby deriving a proxy of each individuals’ socioeconomic status (SES).

Results and Next Steps: The 1,669 property boundaries in Ambler were digitally drawn using a combination of heads-up digitizing and modification of present day parcel and building boundaries. With the resulting linked dataset, we are conducting a survival analysis estimating how occupational asbestos exposure, paraoccupational exposure, and SES impact mortality.

Research Translation: Findings are being discussed with our Community Advisory Group members to aid interpretation.

D2-49 ESE. N-isopropylacrylamide-Based Thermal Responsive Hydrogels for Organic Pollutants Removal from Water

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Thermally responsive hydrogels are attractive materials for removing contaminants from water, due to their high adsorption capacities and swelling response to temperature change. N-isopropylacrylamide (NIPAAm) based polymers are the most widely studied thermo-responsive polymers, which undergoes reversible phase transition at its lower critical solution temperature (LCST) around 32°C. Recently, our group has developed several novel NIPAAm-based hydrogels that were synthesized with novel polyphenolic crosslinkers, which can provide selective binding affinities toward aromatic/hydrophobic pollutants through pi-pi stacking interaction. The temperature dependent swelling behavior and their capabilities to remove model pollutants were characterized. Pollutant binding studies were conducted at low temperature (10°C) and elevated temperature (50°C) to test

PLEASE NOTE: Student posters designated w/HS (Health Science) or ESE (Environmental Science & Engineering)
the impact of temperature on the binding affinity. In addition, binding kinetics and the effect of crosslinker content in hydrogel were examined. It was demonstrated that the thermos-responsive nature of the NIPAAm-based polymers can be used to modulate the binding activity of a pollutant. Specifically, these hydrogels exhibit hydrophobicity above the LCST of NIPAAm, which enhances the binding affinity for many organic pollutants.

D2-50. Distinct arsenic metabolites following seaweed consumption in humans

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Seaweeds have become widely available for human consumption, and contain high levels of arsenosugars, which are organic arsenic compounds that can be metabolized by humans. By combining a market basket assessment with an experimental feeding trial, we assessed exposure to arsenic in seaweed consumers, including both the arsenic compounds consumed and the metabolized forms of arsenic excreted in urine. High variability in arsenic excretion was observed between individuals and between seaweed types, suggesting individual metabolism plays an important role in exposure. Arsenic metabolite species that are unique to arsenosugar breakdown may help identify intake of seaweed arsenic in population studies. Information on exposure, speciation and toxicokinetics of arsenic in seafood, including seaweed, was translated to scientists and regulators through a synthesis paper spearheaded by the Collaborative on Food with Arsenic and associated Risk and Regulation (C-FARR). Dartmouth SRP’s website, Arsenic and You, provides information, aimed at a general audience, on arsenic exposure from different food sources including marine based foods.

D2-51 ESE. Spatial Distribution of HOCs on the Palos Verdes Shelf Superfund Site

Allison Taylor, Jie Wang, Daniel Schlenk, and Jay Gan (Department of Environmental Sciences, University of California, Riverside, CA)

Hydrophobic organic contaminants (HOCs), such as DDTs, PCBs, and currently used pesticides contaminate soils and sediments all over the world. As they are hydrophobic in nature, these compounds are resistant to both chemical and physical degradation while also having a strong affinity for soil or sediment particles and organic matter.1 Often, this contamination is due to the historic or current use and manufacturing of these compounds. For HOCs like DDT and PCBs, their use was banned in the 1970s, however their residues remain in the sediment and continue to be a health hazard to ocean organisms and humans that eat fish caught from this area.2 There are also several current use pesticides, such as fipronils and pyrethroids, which have been detected in sediment from the shelf during preliminary experiments, indicating that these contaminants may have been deposited onto the shelf via urban waterways. In this study, we assessed the spatial distribution of HOCs on the Palos Verdes Shelf Superfund Site. This study aims to assess the extent of the contamination of waterways that lead to the ocean by pesticides and other HOCs. Future projects aim to assess the bioavailability of these contaminants in order to determine their risk to both organisms living on the shelf and possible routes of human exposure. The results of this study will be reported to the federal
and state Environmental Protection Agencies for use in environmental risk assessments in order to assess the impacts of these contaminants on ecosystem and human health.

D2-52. Research is Ceremony: Integrating an Indigenous Perspective into Environmental Health Research: The Namaus (All Things Fish) Project

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To understand the meaning of fishing and its relationship to cultural ways of knowing and the potential impact of environmental pollution (mercury, PCBs) on fishing and fish consumption among Narragansett Tribal members.

Background. Cultural and economic factors are important determinants of health; in particular, fish consumption among indigenous populations. Continuing tribal fishing traditions in communities where fishing is critically linked to cultural identity has the potential to place tribal members at increased risk for health impacts from environmental contaminants.


Methodology. Inductive qualitative descriptive study encompassing seven Talking Circles. Narragansett tribal men (18-49), women (18-49), elders (aged 50 and older), and present and past tribal leaders who volunteered and consented to participate. Groups continued until data saturation. Audio and videotapes transcribed verbatim with member checking. Themes categorized using N-vivo 11+.


Implications. The increased knowledge of the meaning of fish, fishing, past and current practices and cultural factors influencing these practices was used to inform The Namaus Project. Study provided insight for translating research into practice and policy within the context of an Indigenous knowledge framework. Plan to incorporate tribal art that describes the relationship that tribe and its members have with the ponds and the fish who live in the ponds. Results in building capacity of the Narragansett Tribal government and its members for informed decision-making and participation in Tribal environmental health policy and regulatory formulation.


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D2-53. Metabolic correlates in meconium sterols of maternal PBDE exposure

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Meconium is the first stool of a newborn that passes in the first few days after birth but begins accumulation around the 13th week of gestation. Thereby, it provides a unique window into gestational metabolism. We previously quantified the sex steroid content of meconium from a longitudinal pregnancy cohort using a liquid chromatography-high resolution mass spectrometry method that also provided coverage of meconium sterols. Using linkage to the targeted exposure quantification of polybrominated diphenyl ethers (PBDEs) in maternal serum from the same mother-child dyads, we investigated the potential metabolic correlates of maternal PBDE exposure in meconium. Sparse partial least squares (SPLS) was used to identify a subset of biomarker features that are predictive of multivariate PBDE exposure. Analysis was performed on a log-log scale and feature selection was performed both stratified on sex and on the complete sample. The number of components for (1 in male, female and combined analysis) and sparsity tuning parameters was selected using cross validation. The robustness of the selected features was evaluated by comparing the results to features selected using elastic net regularization for PBDE28, PBDE99 and PBDE153, distinguishing a smaller subset of features selected by both SPLS and elastic net. This method is useful for querying the potential metabolic impacts of any exposure on gestational metabolism in a hypothesis testing and hypothesis generating approach. The wider impact of this research is that it can provide a way to maximize the useful information garnered from targeted analysis of precious biospecimens from stakeholders.

D2-54. Transgenerational inheritance of neurobehavioral and physiological deficits from developmental exposure to benzo[a]pyrene in zebrafish

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Benzo[a]pyrene (B[a]P) is a well-known genotoxic polycyclic aromatic compound whose toxicity is dependent on signaling via the aryl hydrocarbon receptor (AHR). It is unclear to what extent detrimental effects of B[a]P exposures might impact future generations and whether transgenerational effects might be AHR-dependent. This study examined the effects of developmental B[a]P exposure on 3 generations of zebrafish. Zebrafish embryos were exposed from 6 — 120 hours post fertilization (hpf) to 5 and 10 µM B[a]P and raised in chemical-free water until adulthood (F0). Two generations were raised from F0 fish to evaluate transgenerational inheritance. Morphological, physiological and neurobehavioral parameters were measured at two life stages. Juveniles of the F0 and F2 exhibited hyper locomotor activity, decreased heartbeat and mitochondrial function. B[a]P exposure during development resulted in decreased global DNA methylation levels and generally reduced expression
of DNA methyltransferases in wild type zebrafish, with the latter effect largely reversed in an AHR2-null background. Adults from the F0 B[a]P exposed lineage displayed social anxiety-like behavior. Adults in the F2 transgenerational manifested gender-specific increased body mass index (BMI), increased oxygen consumption and hyper-avoidance behavior. Exposure to benzo[a]pyrene during development resulted in transgenerational inheritance of neurobehavioral and physiological deficiencies. Indirect evidence suggested the potential for an AHR2-dependent epigenetic route. Collectively, these data provide insight to stakeholders regarding the potential transgenerational effects elicited from an acute exposure during development and the need to continue research in this area to understand the mechanism that is being impacted to cause this effect.

D2-55. The application of monoclonal antibody-based biosensor analysis for the rapid assessment of PAH distribution, fate and toxicity at contaminated sites

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Lipophilic contaminants such as polycyclic aromatic hydrocarbons (PAH) accumulate in sediments and biota, posing a significant human health risk. A biosensor was developed to quantify PAH to sub-ppb concentrations in small volume (1-5 mL) aqueous samples at spatial and temporal scales not possible by GC-MS methods (Li et al., 2016). The biosensor analysis allowed rapid evaluation of the mechanisms controlling PAH transport at contaminated sediment sites saving costs over traditional methods. Dissolved PAH concentrations were measured in porewater samples to evaluate small-scale temporal changes in PAH concentration and flux at contaminated sites. Biosensor measured PAH in porewater was highly correlated to GC-MS analysis in split samples and was also correlated to benthic amphipod toxicity at field sites (Hartzel et al., 2017). PAH concentrations in porewater were better predictors of toxicity than the whole sediment PAH concentrations (Hartzel et al., In review) that are currently used for regulatory evaluation of remediation effectiveness. Results from this research were provided to environmental managers to help guide the most effective future remediation strategies at contaminated sites. Future remediation plans that involve sediment removal and/or capping will need to address controlling the PAH flux as well as total sediment concentrations. The new technologies allow this assessment to be accomplished more rapidly and economically than traditional methods. Data can be provided to environmental engineers soon after field collection to help define PAH transport at contaminated sediment sites to guide remediation plans or to evaluate remediation efficacy. New work is evaluating our SRP developed biosensor as an effective tool for monitoring PAH during oil spills to define sub-surface oil distribution in near real-time.

D2-56. Diabetogenic Risk in Young Adults with Lifecourse Exposure to Perfluoroalkyl Substances.

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3 Department of Environmental Medicine, Institute of Public Health, University of Southern Denmark, Odense, Denmark*  Compelling evidence from animal studies show diabetogenic effects induced by developmental exposure to perfluoroalkyl substances (PFASs), but human evidence is limited and
inconclusive. Given the frequent presence of PFASs as drinking water contaminants from toxic waste, we evaluated the associations between early-life PFAS exposures and subsequent diabetogenic risk in 636 young adults from a cohort born in 1986/7 in the Faroe Islands, where elevated PFAS exposures occur. Concentrations of major PFASs (PFOS, PFOA, PFHXs, PFDA and PFNA) were measured in cord whole blood and serum at participants' ages 7, 14, 22, and 28 years. We derived clinical indices of insulin sensitivity (e.g., homeostatic model assessment of insulin resistance [HOMAIR], Matsuda insulin sensitivity index [ISI]) and insulin resistance (e.g., corrected insulin response [CIR], insulinogenic index [IGI]) based on 2-hour (75g) oral glucose tolerance tests performed at age 28 years. PFOS was the PFAS most highly detected, and its concentrations in cord blood were associated with lower ISI (95%CI: -5% [-11, 2]) and higher HOMAIR (4% [-4,12]), CIR (14%; [4, 25]) and IGI (17% [6, 30], with some associations being stronger in women compared to men (P-sex interaction <0.10 for CIR and IGI). Associations in the same direction but of smaller magnitude were seen for PFOS concentrations measured at later developmental stages, and for other PFASs. Our findings overall suggest that life-course exposure to PFASs and especially exposure prenatally is associated with clinical markers of insulin resistance and impaired pancreatic beta-cell function in healthy young adults. These findings support the need to prevent release of PFASs from toxic waste and to protect populations against early-life exposures. These issues are being pursued in the SRP-supported STEEP center (1P42ES027706-01).

D2-57. Reductive dissolution of iron oxides by advected methane as a new driver of arsenic release to groundwater

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Advection of dissolved organic carbon (DOC) in groundwater is widely considered a leading cause of reductive dissolution of ferric oxides and the release of dissolved arsenic (As) downstream of Superfund sites and anaerobic aquifers across South and Southeast Asia. We present new evidence from both NSF- and SRP-sponsored field studies that methane (CH4) rather than DOC could be the main electron donor driving the release of As to groundwater in aquifers that were previously low in As. Along a portion of a well-studied transect of wells installed within a >10 kyr old aquifer in Vietnam, we observe a sharp increase in CH4 concentration from <1 to 1000 umol/kg towards an advected contamination front marked by a reduction of Fe oxides in aquifer sands and an increase in As concentrations from 1 to 500 ug/L in groundwater (1). The isotopic composition of dissolved inorganic carbon across towards front shifts from -18 to -12 o/oo in d13C. These patterns combined suggest that oxidation of advected CH4 by Fe(III) oxides causing, in turn, a release of As to groundwater. The increase in DOC concentrations towards the same front from 100 to 200 umol/kg is more muted and unlikely to play a major role. In Bangladesh, we have recently documented concentrations of As as high as 100 ug/L in >150 m deep, >10 kyr-old aquifers paired with elevated CH4 concentrations of 100 umol/kg. The unexpectedly high-As wells were all confirmed to be properly installed with a downhole camera and repeated profiling of a salt spike (2). We expect to present also new direct evidence of CH4 oxidation during incubations of fresh aquifer sands from Vietnam with 14C-labelled methane.
D2-58. Fipronil immunoassay: from conception to broad application.

Natalia Vasylieva¹, Bogdan Barnych², Debin Wang¹, Bruce D. Hammock¹.

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Phenylpyrazole insecticides such as fipronil have been used as replacements for organophosphates. The wide application of fipronil raises concern about environmental contamination and risk for fish, birds, bees and other non-targeted beings. To mitigate ecological risks routine environmental monitoring could help in timely detection of environmental contamination thus preventing at-risk species from exposure. Two sensitive, rapid tests based on antibodies with sensitivities of 0.58±0.06 and 2.6±0.4 ng/mL were developed.

In addition to environmental monitoring, occupational medical surveillance is highly desirable in manufacturing facilities where exposure to chemical is significant. Identification of urinary metabolites of fipronil may allow development of affordable, cheap and rapid procedures for human exposure evaluation. Therefore, we developed a fast and easy approach for synthesis of hydroxy-fipronil, a potential urinary metabolite of fipronil. This standard was used to develop a sensitive analytical LC-MS/MS method with a limit of quantification of 0.4 ng/mL. Fipronil sulfone and hydroxy-fipronil were quantified in urine samples from fipronil treated rats. Fipronil sulfone concentration centered around 20 ng/mL, while the concentration of hydroxy-fipronil was dose-dependent ranging in 10-10000 ng/mL, therefore being a more sensitive marker of fipronil exposure. Immunoassays developed to fipronil also showed cross-reactivity to hydroxy-fipronil. We showed that immunoassay can measure fipronil and its metabolites in samples at levels relevant for human exposure monitoring.

With current fipronil crisis in Europe, both the reagents for the immunoassay and a standard for hydroxy-fipronil are in high demand among international profit and non-profit organizations. The reagents are being applied for commercial kits and rapid tests production, instrumental analytical methods development and for monitoring of food and environmental samples. Fipronil immunoassay is also currently used by USGS for field studies.

D2-59. VHH antibodies and Phage displayed peptides: emerging reagents for the analysis of environmental chemicals.

Natalia Vasylieva, Dongyang Li, Bogdan Barnych, Xiping Cui, Kai Wang, Bruce D. Hammock (Department of Entomology and Nematology, and UCD Comprehensive Cancer Center, University of California Davis, Davis, California 95616, United States.)

Bio-recognition elements are the key to affinity based bioanalytical technology. Nanobodies or peptides obtained from phage display technology have drawn much attention in recent years due to their promising advantages in gene engineering. Camelid single domain antibodies (sdAb, nanobody or VHH) are increasingly popular due to their small size, high stability, ease of genetic manipulation, and ability for continuous manufacture. We have shown their use has resulted in assays for pesticide metabolites and industrial chemicals that are comparable to polyclonal or monoclonal antibody-based assays. Phage displayed peptides derived from random peptide libraries can be used to increase the sensitivity of competitive assays by using them as coating antigens in heterologous competitive assays that are more sensitive than their homologous counterpart. Also, phage displayed peptides can be found that bind the complex of antibody and pesticide, thus uniquely creating a sandwich method for a small molecule. Several examples of nanobody and peptide-based assays for small molecules and proteins are presented.
D2-60. Biogeochemical approaches for the reduction of the dangerous features of asbestos

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The currently available technologies applied to obtain secondary raw materials from asbestos waste are known to be expensive, energy-consuming and to use additional hazardous materials to destroy the native asbestos fibers. These technologies include but are not limited to high temperatures, acid/base dissolution or microwave radiation.

The incomplete mineralogical knowledge of these materials, however, constrains our ability to optimize energy and cost efficiency for the recycling of asbestos-containing wastes.

As demonstrated in recent years, a multidisciplinary approach to the research of asbestos-related diseases has shed light on several aspects involved in the carcinogenic mechanisms that follow asbestos exposure.

Importantly, these multidisciplinary approaches suggest that characterizations of the mineralogical and crystallochemical state of asbestos fibers must include descriptions of the evolution of notable features within any studied process.

Considering this pivotal aspect, we are proposing to transform asbestos waste into a secondary raw material using chemolithoautotrophic bacteria and to mutually improve the quality of the evidence collected from microbiological and mineralogical points of view.

Through these microbe-mineral reactions, we aim to evaluate which mineral features are likely to be modified by the biological activity and to which extent. Studying chemosynthetic bacteria paired with serpentine (e.g. chrysotile) as well as amphibole (e.g. actinolite, crocidolite) asbestos, will involve the nanoscale description of asbestos features potentially sensitive to the bacterial “alteration” as well as variability of morphological changes according to the different microbe-mineral pairs.

Particular nanoscale features include Fe2+, Fe3+ and Si states as these are the main targets of biological extraction processes we will be evaluating.

D2-61 ESE. Engineering Fungal-Bacterial Biofilms derived from PAH-contaminated Estuarine Sites

Savannah J. Volkoff and Claudia K. Gunsch, PhD (Duke University, Durham, NC)

Polycyclic Aromatic Hydrocarbons (PAHs) are ubiquitous environmental contaminants, that enter the environment via natural and industrial processes. In sediments, PAH-degradation can occur via microbial catabolic processes, however efficient biodegradation is particularly difficult to achieve because of the hydrophobic properties of PAHs which limit their bioavailability. Engineered bioremediation strategies can be designed to harness microbial capabilities, which are often more effective and economical approaches for removing complex contaminants, than physical removal processes. In sediment, bacteria and fungi complexed within biofilms may be good targets for bioremediation of PAHs because of their cooperative behaviors and resilience to changing environmental conditions.

The focus of this project is the Elizabeth River, VA that hosts three different locations with historic PAH-contamination from former creosote processing facilities. Three sites along the river and one site in the James River, which feature a gradient from high to low PAH-contamination, were selected as study sites. Microbes were isolated from sediment using 3D-printed passive sampling devices and
various selective culture media. Microbes were identified and then tested for their PAH-degrading potential. Fungal and bacterial biofilms were engineered in the laboratory and will be undergoing spatial evaluation in terms of microbial architecture and organization, as well as evaluation of their PAH-degrading capabilities.

Results regarding the impact of PAH-degradation by these sediment biofilm communities will be shared with the Elizabeth River Project/Sediment Remediation Project (ERPSRP) committee, which is a group of non-project organizations, researchers, and remediation managers for the Elizabeth River sites.

D2-62 ESE. Understanding the role of Fe/Pd nanoparticles in functionalized membrane systems for PCB degradation

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Lindell Ormsbee,

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Polychlorinated biphenyls (PCBs) were listed as top 5 in the ASTDR 2017 substance priority list due to their high toxicity, extremely persistence and prevalence in the environment. To treat PCBs, polymeric membrane platforms, with in-situ immobilization of iron/palladium nanoparticles, were designed. Our previous studies showed over 96% degradation of 3,3′,4,4′,5-pentachlorobiphenyl (PCB 126) was achieved at a residence time of 14.7 seconds in the membrane pores [1]. Particle size was found to be uniform inside membrane pores at different depths (particle size: 16.7±0.7 nm) but slightly smaller than those nanoparticles located on the surface (19.4±3.2 nm) by using focused ion beam. The atomic ratio (detected by using EDS) of iron and fluorine at different depths reflect the iron distribution inside the membrane pores. The membrane was also tested for reactivity after four degradation cycles with regeneration between each cycle. The increase of surface particle size of 22% resulted in a decrease of 9.7% PCB conversion for the 4 hr reaction time.

Furthermore, the composition of iron/palladium particles as well as the oxidation were investigated in PCB degradation performance by testing the production of hydrogen. The production was test with zero-valent iron, iron oxide and palladium coated iron (in different coverage) by using GC-TDS. Corresponding XRD, XPS, TEM studies were conducted in bulk and single particles. The PCB dechlorination results were consistent with the hydrogen production data for palladium coated iron samples. This research is supported by the NIEHS-SRP grant P42ES007380.

D2-63 HS. Genetic and conditional stimulation of adult neurogenesis rescues cadmium impairments of hippocampus-dependent memory and olfactory memory in mice

Hao Wang, Zhengui Xia (Toxicology Program, Department of Environmental and Occupational Health Science, University of Washington, Seattle, WA.)

Cadmium (Cd) is a heavy metal of high interest to the Superfund Initiative. Cd is a potential neurotoxicant and its exposure is reported to be associated with impairments of cognition and olfaction in humans1-4. However, the underlying mechanism of its neurotoxicity is still not clear. Adult neurogenesis occurs in the subventricular zone (SVZ) along the lateral ventricles and the subgranular zone (SGZ) of the dentate gyrus in adult mammalian brains5. It plays an important role for hippocampus-dependent memory and olfaction5. The effect of neurotoxicants on adult neurogenesis...
is just beginning to be elucidated. The goal of our study is to investigate the effects of Cd on cognition and olfaction with a focus on its effects on adult neurogenesis. We recently reported that exposure of low-level Cd impairs hippocampus-dependent spatial working memory and olfactory memory in young adult mice. Furthermore, cadmium inhibits adult neurogenesis in primary cultured adult neural stem/progenitor cells. Our most recent data showed that enhancing adult neurogenesis through genetic manipulation partially rescues Cd-induced impairments of spatial working memory and olfactory memory in mice. These data suggest that inhibition of adult neurogenesis plays a critical role in Cd impairment of hippocampus-dependent memory and olfactory memory. This study provides new insights concerning the underlying mechanisms of Cd neurotoxicity, and partially fulfill UW SRP’s mission of mechanistic-based toxicology studies on neurotoxic heavy metals.

D2-64 HS. Development of Broad-Acting Entero-sorbents for the Mitigation of Superfund Chemicals and Mixtures during Emergencies and Natural Disasters
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People and animals can be unintentionally exposed to complex mixtures of hazardous chemicals following natural and man-made disasters. A major challenge associated with these emergencies at sites of impact is the protection of: 1) vulnerable communities and neighborhoods, 2) first responders, and 3) those involved in management and cleanup. Of immediate concern is the associated mobilization and re-distribution of contaminated sediment and soil and its impact on the municipal water supply and food being consumed, increasing the risk of exposures to hazardous substances. Thus, to minimize human and animal exposures to complex chemical mixtures during disaster events, our laboratory has amended calcium and sodium montmorillonite clays with the nutrients, L-carnitine and choline at 100% cation exchange capacity. Based on equilibrium isothermal analysis, we have demonstrated an increased binding capacity (Qmax) by 300% for benzo[a]pyrene (BaP) and selected hydrophobic pesticides compared to the parent clays. This effect is possibly due to enhanced exposure of organophilic siloxane surfaces within the interlayer of amended clays. In further studies, a processed sorbent material (PSM) was shown to tightly bind multiple environmental compounds including pentachlorophenol (PCP), BaP and pesticides such as lindane, with Qmax of 0.21, 0.1 and 0.53 mol/kg, respectively. Also, cultures of adult hydra were used as an in vivo toxicity indicator to confirm the ability of sorbents to protect against individual chemicals and chemical mixtures. Computational quantum chemistry models and isotherms are being used to estimate the thermodynamics of surface-chemical interactions and potential mechanisms of binding. We anticipate that optimal sorbents developed from this project can eventually be delivered in food, condiments and flavored water, or administered by sachet or capsule during emergencies and natural disasters (Supported by NIEHS SRP 02-413421-00002).

D2-65 ESE. solation of nanobodies to small molecules: are camels a better choice?
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Since the unique functional heavy chain antibodies (HCAbs) have been discovered in the serum of camels\textsuperscript{1}, their variable domain (VHHs) has shown a great promise in a number of applications\textsuperscript{2}. However, they have been rarely used for pesticide monitoring in environmental samples due to difficulties in isolating positive clones. Success in obtaining of the VHHs against small molecules is related to several critical factors including hapten design, effective immune response, complete amplification of VHH encoding genes and biopanning strategy\textsuperscript{3}. Currently, only llama and alpaca are the most commonly used animals for nanobody generation. However, camel sera possess four allotypes of HCAbs in much higher levels (50-80\% vs 10-25\%)\textsuperscript{4}. Therefore, we hypothesize that camels may be a much better source of nanobodies.

In our research, camels were immunized with immunogens of insecticides fipronil and triazophos. A novel reverse primer specific to allotype IgG\textsubscript{3a} was designed and diversity of the phage displayed VHH library was expanded significantly ($1.0 \times 10^8$ cfu/mL). Several VHHs were isolated to develop immunoassays. The sensitivities of fipronil and triazophos were 4.2 and 6.6 ng mL\textsuperscript{-1} (IC\textsubscript{50}), respectively.

Over 60\% of identified positive clones were derived from IgG\textsubscript{3a}. Therefore, it is possible that IgG\textsubscript{3a} is the most important for the VHH generation among all the allotypes. This result may guide us to generate VHHs for small molecules with higher efficiency. Interestingly, a new nucleotide sequence of hinge region that has never been reported previously was observed. The long hinge indicates it is originated from the subclass IgG\textsubscript{25}. This finding allows design of additional new primers, ultimately increasing the diversity of the resulting library and further increasing probability of isolation of nanobodies to small molecules.

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**D2-66. PCB126 Induces Monocyte/Macrophage Polarization and Inflammation**

Chunyan Wang, Michael C. Petriello, Bernhard Hennig

Polychlorinated biphenyls (PCBs) are persistent organic pollutants which can contribute to a range of adverse health effects, including inflammatory diseases such as atherosclerosis, which involve macrophages. Although many cells are involved in the initiation and progression of atherosclerosis, macrophages play a key role in the overall inflammatory response and lipid deposition. We hypothesize that dioxin-like PCBs can contribute to monocyte/macrophage polarization and macrophage inflammation. To test this hypothesis, monocytes (THP-1) were differentiated to macrophages, and subsequently exposed to PCB 126. Inflammatory cytokines and genes associated with oxidative stress (e.g., Nrf2 signaling) were studied. Exposure to PCB 126 increased the expression of inflammatory cytokines, such as TNF-\textsubscript{\alpha}, IL-1\textsubscript{\beta} and IL-6, suggesting polarization to the M1 phenotype. In addition, the monocyte chemoattractant protein-1 (MCP-1) was expressed in PCB-activated macrophages, suggesting induction of chemokines which regulate immune cell recruitment and migration and infiltration of monocytes/macrophages into vascular tissues. Furthermore, nuclear factor (erythroid-derived 2)-like 2 (Nrf2) and down-stream genes, such as glutathione S-transferase (GST) and NAD(P)H quinone oxidoreductase 1 (NQO1), were induced following PCB exposure, indicating induction of xenobiotic-linked defensive mechanisms. Our data demonstrate the involvement of PCB 126 in monocyte/macrophage polarization and inflammation, suggesting another important role of dioxin-like PCBs in the pathology of atherosclerosis. These data have translational implications, suggesting that a compromised immune system and inflammation can modulate vulnerability to environmental insults. (Supported in part by NIEHS/NIH grant P42ES007380)
D2-67. Absolute quantification of plasma fibulin-3 as a biomarker for asbestos exposure by immunoprecipitation-high resolution mass spectrometry

QingQing Wang, Liwei Weng, Clementina Mesaros, Ian A. Blair (University of Pennsylvania)

Asbestos exposure is known to cause lung cancer and mesothelioma. The exceptionally long latency periods of most asbestos-related diseases have hampered its preventative treatment. New biomarkers are needed to detect asbestos exposure at an earlier stage and to individualize treatment. Fiblin-3 was recently reported as a new potential biomarker for pleural malignant mesothelioma. However, controversy results were reported due to unsatisfactory bioanalytical methodology or biological variability. In this study, we developed an immunoprecipitation approach coupled with nanoLC-high resolution mass spectrometry (NanoLC-HRMS) method for quantifying fibulin-3 in human plasma as a biomarker for asbestos exposure and evaluated its prognostic value.

Sheep Anti-fibulin-3 polyclonal antibody was selected out of five antibodies as it provides the highest specificity and pull-down efficiency. Dimethyl pimelimidate (DMP) was used to cross-link the antibody to protein A/G beads which enable fewer antibody contamination and less matrix effect on MS. Recombinant fibulin-3 was expressed from HEK293 cells using stable isotope labeling by amino acids in cell culture (SILAC) strategy, then it was spiked into plasma samples at initial step of sample preparation as an internal standard. Parallel reaction monitoring (PRM) was used on Q Exactive HF (Thermo) for providing high selectivity and high sensitivity. Absolute quantification was based on the ratio of endogenous protein and SILAC-labeled protein. The low limit of quantification of current method reaches to attomole level in human plasma. This improved sensitivity and specificity was obtained by antibody-based immunoprecipitation step, as well as the use of HRMS under PRM mode. The enhanced sensitivity and specificity offered by the current method will allow for a more complete analysis of fibulin-3 and fibulin family, shedding light on previously unknown mechanisms of asbestos exposure.

D2-68 HS. Arsenic Detoxification in Plant Roots: Identifying Arsenic Effluxers

Todd Warczak, Heng-Hsuan Chu, and Mary Lou Guerinot (Department of Biological Sciences, Dartmouth College, Hanover, NH)

Arsenic is a non-threshold carcinogen that enters our food chain via plant roots. Unfortunately, the world’s 2nd most important staple crop, rice, accumulates high amounts of this toxic metalloid in the grain compared to other crops. Recent studies show epidermal root cells of rice and Arabidopsis thaliana actively efflux intracellular arsenic back into the soil, although the effluxer(s) responsible remains elusive. To identify the gene(s) responsible for this efflux, we have used microarray data from whole roots of rice and A. thaliana plants exposed to arsenic, searching for differentially expressed genes coding for potential metal transport proteins that localize to the plasma membrane. Microarray data from whole-root RNA, however, cannot reveal cell-type specific expression patterns. Therefore, we utilized Fluorescently-Activated-Cell-Sorting (FACS) together with RNA-sequencing (RNA-seq) to generate genome-wide expression maps for epidermal, cortex, and endodermal cell types of A. thaliana roots exposed to arsenic. In addition, we are screening 526 Multi-Parent Advanced Generation Integrated Cross (MAGIC) A. thaliana lines for variation in arsenic tolerance caused by the genomic variation in this population. Analysis of the variation has produced quantitative trait loci (QTL) responsible for arsenic tolerance. These QTL, together with the cell-type specific expression data, provide two distinct, high resolution data-sets capable of identifying not only genes responsible for arsenic efflux back to the soil, but other means of arsenic detoxification in plant roots beyond efflux. Once root arsenic efflux is characterized, breeders and crop scientists can...
optimize the native plant mechanisms to develop rice cultivars that return more arsenic back to soil, preventing the toxic metalloid from accumulating in the edible grain. This work is supported by the National Institute of Environmental Health Sciences (NIEHS) Superfund Research Program (SRP).

D2-69. Water Arsenic Exposure and Intellectual Function in Adolescence in Arai hazar, Bangladesh

Gail A. Wasserman, Xinhua Liu, Faruque Parvez, Pam Factor-Litvak, Nancy J. Lolacono, Hasan Shahriar, Taruqul Islam, Elizabeth A. Gibson, Marianthi-Anna Kiourmouzoglou, Tiffany Sanchez, Jennie K. Kline, Alexander van Geen, Joseph H. Graziano

Columbia University Arsenic Project Office, Dhaka, Bangladesh and Mailman School of Public Health, Columbia University, NY, NY

Exposure to inorganic arsenic (As) from drinking water is associated with modest deficits in intellectual function in young children; it is unclear whether deficits persist into adolescence, when key brain functions are more fully developed.

Objectives: We sought to determine the degree to which adolescent intelligence was associated with As exposure, and the contributory roles of exposures to lead, cadmium, manganese and selenium.

Methods: We recruited 726 14-16 year olds whose mothers are participants in the Bangladesh Health Effects of Arsenic Longitudinal Study (HEALS), and whose household well water As levels, which varied widely, were well characterized. Using a culturally modified version of the WISC-IV, we examined raw Full Scale scores, and Verbal Comprehension, Perceptual Reasoning, Working Memory and Processing Speed Indices. Blood levels of As (BAs), Mn, Pb, Cd and Se were assessed, as was creatinine-adjusted urinary As (UAs/Cr).

Results: Multiple linear regression analyses revealed that BAs was significantly negatively associated with all WISC-IV scores except for Perceptual Reasoning. With UAs/Cr as the exposure variable, we observed significant negative associations for all WISC-IV scores. Except for Se, blood levels of other metals, were also associated with lower WISC-IV scores. Confirmatory analyses using Bayesian Kernel Machine Regression, which identifies important mixture members, supported these findings; the primary contributor of the mixture was BAs, followed by BCd.

Conclusions: Our data indicate that the adverse consequences of As exposure on neurodevelopment in young children also appear later in life. They also implicate Cd as a neurotoxic element that deserves more attention.

D2-70. Accurate Quantification of Serum Protein Mesothelioma Biomarkers

Liwei Weng1,2,3, Clementina Mesaros1,2,3, Ian A. Blair1,2,3

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Pronounced asbestos exposure in the community of Ambler, PA results in high prevalence of asbestos-related diseases including malignant mesothelioma (MM). The exceptionally long latency periods of MM have hampered preventative and precautionary steps. Therefore, reliable biomarker capable of assessing the development of the disease is in urgent need. A recent report reveals that the serum levels of acetylated high mobility group box-1 (HMGB1) are elevated in MM patients. HMGB1 is a non-histone chromatin protein that normally locates in the nucleus. However, during cell
necrosis due to asbestos fibers, HMGB1 undergoes acetylation followed by translocation from the nucleus to the cytoplasm, and then secreted to extracellular space, where it binds to and activates pro-inflammatory mediators. Given the role it plays in inflammatory processes, HMGB1 holds promise as a biomarker of mesothelioma and asbestos exposure.

Herein, we developed a stable isotope dilution HPLC-MS method to accurately quantify the acetylated HMGB1 levels in serum. Stable isotopically labeled HMGB1 was added as the internal standard at the initial step of the sample preparation. After acetylated HMGB1 was first enriched using an anti-acetylation antibody, gel electrophoresis was introduced to further remove the background binding on the antibody. Proteinase AspN or Glu-C was applied to digest acetylated HMGB1 in gel. Absolute quantification was achieved by analyzing the ratio of the peptides from endogenous form and ISTD. The serum acetylated HMGB1 levels in mesothelioma patients were compared with healthy controls and with individuals heavily exposed to asbestos. The accuracy and sensitivity of this assay provides a thorough quantification method for acetylated HMGB1 and further identifies if the acetylated form is a promising biomarker for mesothelioma patients.

D2-71. Asbestos manufacturing locations and geographic clustering of mesothelioma among residents of Pennsylvania

Douglas Wiebe, PhD, Michelle Ross, PhD, Christopher Morrison, PhD, Edward Emmett, MD, Anil Vachani, MD, Charles Branas, PhD, Frances Barg, PhD (University of Pennsylvania)

Context: Ambler, PA is one of the largest asbestos waste sites in the U.S. Community and occupational exposure to asbestos occurred in Ambler from the 1800s to the 1980s. Known health effects of asbestos exposure observed at high exposure levels in work settings raise the possibility of effects from community exposure and may lead to clustering of mesothelioma cases.

Methods: Mesothelioma patient data from the Pennsylvania Cancer Registry (PCR) were obtained and geocoded to residential addresses for the entire state for 1993-2013. Census tract mesothelioma rates were calculated, and the results were evaluated for spatial autocorrelation and clustering.

Results: 3,875 mesothelioma cases were identified, with a median age at diagnosis of 74 years. The majority were male, white and non-Hispanic. Moran’s I statistic and LISA revealed the presence of spatial autocorrelation in the Ambler area. Clusters in multiple parts of the state were identified using the Besag-Newell method. In addition, both the Besag and Newell and the Kulldorff method identified clusters in the Ambler area.

Conclusions: There is preliminary evidence that cases of mesothelioma are clustered in distinct locations in Pennsylvania. Next steps are underway to account for complexities including the long induction period, residential mobility, deaths from related conditions, and the modifiable areal unit problem. This will help to understand the risks of community level exposure to asbestos.

Research Translation: The findings are being discussed with our Community Advisory Group members to aid interpretation and raise awareness.

D2-72. Activity-Based Protein Profiling Enables Quantitative Characterization and Measurement of Exposure Response by Mammalian Glutathione S-Transferases

Aaron Wright, Ethan Stoddard, Justin Teeguarden, Jordan N. Smith
All authors have the same affiliation as the presenting author.

Glutathione S-transferases (GSTs) compose a highly diverse group of phase II drug metabolizing enzymes that catalyze the conjugation of glutathione to various electrophilic endo- and xeno-biotics.
GST activity is dependent upon the activity of two distinct “G”• and “H”• active sites. The “G”• site of GSTs binds glutathione in such a way that the cysteine thiol is directed toward the substrate-binding “H”• site. Although there are commercial assays used to detect changes in total GST activity, the ability to detect changes in the activity of specific GST isoforms does not exist. For this reason, we developed two probes to track isoform-specific GST activity. The first probe, GSTABP-G, is a glutathione-based photoaffinity probe designed to target the glutathione-binding “G”• site. The second probe, GSTABP-H, is based on the known irreversible GST inhibitor 2,3-dichloro-1,4-naphthoquinone and was designed to target GST “H”• sites. Active site specificity of these probes was validated using a series of competition experiments in murine liver lysate as well as a determination of the active site amino acid residues irreversibly bound by GSTABP-H. We demonstrate organ-specific GST enzyme activities, and we show that oxidative stress induced by a high fat, obesogenic, diet induces intestinal GST activity. Our approach provides an enzyme-specific characterization of the role of GSTs in phase II metabolism, and their response to exposures. This work translates to community exposures due to myriad effectors, including diet and chemicals such as polyaromatic hydrocarbons.

D2-73. Liquid Chromatography- High Resolution Mass Spectrometry for Combined Targeted Phthalate/Untargeted Metabolomics of Complex Biospecimens

Jimmy Xu (AJ Drexel Autism Institute, Drexel University); Sophie Trefely (AJ Drexel Autism Institute, Drexel University); Jason Goodspeed (AJ Drexel Autism Institute, Drexel University); Qingqing Wang (University of Pennsylvania); Jennifer Adibi (University of Pittsburgh); Nathaniel W Snyder (AJ Drexel Autism Institute, Drexel University)

Phthalates are high-volume production chemicals used in plastics and ubiquitous environmental contaminants with a high bioburden of exposure in the United States. Quantification of phthalate exposure is currently performed by targeted analysis of their biologically derived metabolites. We developed and optimized a method that would allow simultaneous quantification of a diverse set of phthalate exposure biomarkers using an adaptation of the standard approach. In addition to phthalate quantification, this method utilized liquid chromatography-high resolution mass spectrometry (LC-HRMS) to capture a wider snapshot of the metabolome from the same sample and same analytical run. We then applied this method to quantification of phthalates in commonly used biospecimens (urine, blood) as well as less common matrices (meconium and placenta). Metabolomics analysis on exposure/metabolome correlations led to an interesting differential abundance of major metabolites quantified in the same analytical run. Further use of this method for phthalate quantification may reveal metabolic correlates and potentially metabolic exposure responses to differential phthalate exposure. This will translate into a better understanding of how phthalate exposure might influence prenatal metabolism, the health effects of early life exposures, and potentially ameliorative steps to reduce exposure response.

D2-74. Residential Proximity to Green Vegetation is Negatively Associated with Exposure to Volatile Organic Compounds

Ray Yeager¹, Daniel Riggs¹, Natasha DeJarnett², Daniel Conklin¹, Pawel Lorkiewicz¹, Zhenzhi Xie¹, Shesh Rai¹, David Hoetker¹, Shahid Baba¹, Aruni Bhatnagar¹

Cardiology¹, American Public Health Association²

Neighborhood vegetation has been shown to ameliorate exposure to airborne particulate matter in urban locations. However, it is unclear whether residential-area greenness reduces exposure to specific Volatile Organic Compounds (VOCs), a class of air pollutants with wide ranging impacts on
human health. Using urine samples collected from study participants, we tested associations between residential greenness and exposure to harmful VOCs. The peak, cumulative, contemporaneous, and spatial variation of residential greenness exposure was quantified for 237 non-smoking participants at multiple spatial radii via satellite-derived Normalized Difference Vegetation Index (NDVI). Generalized linear models were used to determine associations between greenness and urinary metabolites of 18 harmful anthropogenic VOCs in a cross-sectional analysis while adjusting for demographic, clinical, and environmental covariates. In adjusted models, a 0.1 increase in contemporaneous NDVI within a 250m radius was negatively associated with urinary metabolites of 1,3-butadiene, acetaldehyde, acrylonitrile, benzene, tetrachloroethylene, trichloroethylene, and xylene (-4.7 to -15.4% change). Associations between peak greenness and overall VOC exposure, based on primary PCA classification, were significant at 25m, 50m, 100m, 200m, and 300m radii, with a 22% change per 0.1 unit difference in NDVI. Greenness variability was also significantly associated with urinary VOC metabolites with a 40% change per variability IQR within 200m. These results suggest that residential vegetation, particularly within 200m of homes, is associated with lower exposure to anthropogenic VOCs. These findings are translatable into public health action by informing planned and ongoing urban greening strategies.

D2-75 ESE. Environmental Tracking in Northern Plains Indigenous Communities: A Citizen Science Approach to Locate and Prevent Metal Exposures

Joseph Yracheta, MS, Anne Nigra, MS, Guthrie Ducheneaux, Carlyle Ducheneaux, Marcia O’Leary, RN, Steve Childrud, PhD, Benjamin Bostick, PhD, Ana Navas-Acien, PhD

Many tribal groups were confined to areas of poor agricultural or grazing land. We now know many of these lands are poor because of the unique surface and subsurface geology of these reservations. Consequently, American Indian and Alaska Native communities are sites at risk for heavy metal exposures both naturally occurring and from the unregulated mining. In North and South Dakota, people have long been at risk from these same geologic sequelae via contaminated ground water used both for households and livestock. Current mining trends for oil & rare earth minerals continue to put these communities at risk. Though sovereign, many tribal groups cannot properly benefit or protect themselves from mining operations within or adjacent to their borders. In the absence of funding or political will, it is difficult to document these industrial or natural exposures in tribal communities. Data from the Strong Heart, however, indicates that the Northern Plains Indigenous communities are exposed to multiple metals at higher levels than other US communities. Here we begin to collect data on natural and man-made metal exposures through conventional and app-based data collection methods. We have developed a Citizen Science app (CS) for refuse disposal tracking. We have started a CS soil collection project to inform tribal natural resources and environmental agencies. We can combine these environmental data with human immune patterns (cytokines, chemokines, adipokines) and Omics data paired with 20-30 years of Strong Heart Study data to forensically track the distribution, timing and long term effects of metal exposures. We hope that environmental tracking sheds light on how to design prevention interventions to eliminate veiled natural, man-made and/or illegal exposures.

D2-76. Do temperature and precipitation affect the preterm birth rate in Puerto Rico?

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The preterm birth (PTB) rate for singletons born in the tropical Caribbean island Puerto Rico increased from 11.3% in 1994, which was comparable to rates in the U.S., to as high as 18.3% in 2006 before decreasing to 15.5% in 2012. Weather changes have been linked to human health, thus we hypothesize that the increase and decrease in PTB rates may be influenced by climate factors such as ambient temperature and precipitation. While the effect of ambient temperature on PTB has been explored extensively, the association between precipitation and PTB is largely overlooked. We quantitatively evaluated the influence of climate conditions on the changes of PTB rates in Puerto Rico. We compiled child birth data from the National Center for Health Statistics and climate data from the National Oceanic and Atmospheric Administration from 1994 to 2012, and applied a distributed lag non-linear model (DLNM) to explore the association between climate factors and singleton PTB rates in Puerto Rico. We found that high temperature frequencies in terms of days warmer than 32 °C in a month, has a protective effect on PTB rate. In contrast, the intensity and frequency of precipitation extremes increase the risk of PTB, where the overall relative risk of 95% precipitation intensities for a 4-month lag can be up to 1.25 in reference to the median values. While the climate factors do not explain the marked increase and decrease in PTB rate, we emphasized the negative effects on PTB from climate extremes particularly precipitation in Puerto Rico.

D2-77. Occurrence and Fate of Chemicals of Emerging Concern (CECs) and Their Interactions with Microbiota in Urban Water Cycles
Yongli Zhang a*, Vittoria Veltri a, Kishore Gopalakrishnan a

Department of Civil and Environmental Engineering, Wayne State University

The widespread presence of chemicals of emerging concern (CECs) is a pressing challenge to ecological and human health. Many CECs are included in the priority list of EPA/ATSDR. Although a number of studies have been conducted to investigate their impact on ecological and human health, their interactions with microbiota in urban water cycles and the consequential impact are not well studied or known. This research aims at addressing this knowledge gap by investigating the occurrence and fate of CECs, as particularly pertaining to endocrine disrupting compounds and microplastic, and their interactions with microbiota in urban water cycles from source to tap water.

One endocrine disrupting compound (4-nonylphenol) and one type of microplastic (polyethylene microplastic beads, the most common plastic) were included in this study. Their interactions with bacterial proliferation, microbial community, biofilm formation, and bacterial resistance to disinfection, as well as their removal efficiency in water treatment processes, were investigated. Results suggest that the presence of 4-nonylphenol and microplastic beads can significantly enhance bacterial proliferation and bacterial resistance to disinfection. In addition, microplastic is a distinct substrate and habitat for biofilm formation and may be a carrier for the transport of unique bacterial assemblages in urban water cycles. At the same time, biofilms are able to breakdown microplastic to smaller fragments, posing significant challenges for the monitoring and detection of microplastic and potential risks for ecological and human health.

This work has been conducted in collaboration with Great Lakes Water Authority’s Water Utilities. The results obtained from this study will contribute to scientific advancement and will be translated to practical applications for water utilities for improved and targeted control/prevention strategies of CECs.
Electro-Fenton reaction: Performance under high groundwater flow conditions

Yuwei Zhao, Ljiljana Rajic, Shirin Hojabri, Akram N. Alshawabkeh

Electrochemical systems can be used to induce Fenton reaction in situ: hydrogen peroxide (H2O2) forms through the catalyzed reaction between electro-generated oxygen and hydrogen and further activates to hydroxyl radicals (·OH) via reaction with ferrous iron (Fe(II)). Evaluation of parameters that influence these reactions in plug flow electrochemical reactors is of great importance for in-well groundwater treatment. In this study, we evaluate the influence of the flow rate and current intensity on the rate of H2O2 generation and pH variations within the reactor; we measured the accumulated production of H2O2 and pH at sampling ports located between the electrodes in the plug flow electrochemical reactor. The acidic pH conditions needed to support (Electro-)Fenton reaction, create and maintain during the treatment even under 200 mL/min. Under each constant flow rate tested, the accumulated production of H2O2 after 2 hours significantly increases with the current intensity (from 60 mA to 250 mA). However, under the constant current (for example: 200 mA), by increasing the flow from 3 mL/min to 80 mL/min, the H2O2 production decreases from 2.5 mg/L to 0.1 mg/L. By testing the dissolved oxygen (DO) at each sampling port, a significant increase in DO concentration occurs after the anode while depletion after cathode/Pd catalyst indicates direct and indirect O2 reduction. The consumed DO by cathode/Pd catalyst was negligibly affected by the current change while increase in the flow decreased both available DO after anode and its consumption at the cathode/Pd catalyst. Since groundwater flow rates can vary significantly, it is of great importance to better understand its effects on the conditions needed for (Electro-)Fenton reaction and support the performance under different flow rates during in situ implementation.

2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)-mediated activation of Aryl Hydrocarbon Receptor (AHR) in the Impairment of Immunoglobulin Secretion involving the increase of Lymphocyte Specific Tyrosine Kinase (LCK) by Human Primary B Cells

Jiajun Zhou1,3, Joseph Henriquz2,3, Robert Crawford3, Norbert Kaminski2,3

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AHR activation by the high affinity ligand, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), is widely established to suppress the immunoglobulin M (IgM) response in virtually every animal species tested, and extensively investigated in various mouse models. In mice, activation of AHR is known to impair B cell to plasma cell differentiation and IgM synthesis. In contrast to mouse B cells, activation of AHR in human primary B cells impairs immunoglobulin secretion in the absence of suppressing IgM synthesis. In recent studies, we have identified the putative involvement of LCK in impaired immunoglobulin secretion by human B cells. LCK is a well-characterized tyrosine kinase that phosphorylates known critical signaling proteins involved in vesicular secretion by T cells. Specifically, phosphorylation of tyrosine residue 505 inhibits the activity of LCK. By contrast, little is known concerning the role of LCK in human primary B cells. For the first time, our studies show that activation of the AHR by TCDD upregulates LCK protein expression, which then leads to an impairment of IgM secretion. Treatment with a LCK specific inhibitor restores IgM secretion by human primary B cells. Additionally, the presence of AHR antagonist reverses the AHR-mediated increase of LCK and the impairment of IgM secretion. We also observe a significant increase in phosphorylation of Tyr-505 LCK with TCDD treatment, indicating that AHR activation increases the level of inhibitory LCK. Taken together, our studies revealed a novel and species-dependent mechanism involving the AHR-mediated impairment of IgM secretion and an increase in total as well as inhibitory LCK in human but not mouse primary B cells. (Supported in part by NIH ES002520 and ES004911)
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