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YOUR HEALTH & THE ENVIRONMENT

NEWS FROM THE UNIVERSITY OF ROCHESTER ENVIRONMENTAL HEALTH SCIENCES CENTER

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NEW RESEARCH POINTS TO MERCURY'S LONG-TERM EFFECTS

Methylmercury (MeHg) is a well-known neurotoxicant that can impact brain development, particularly in utero. A series of new studies from researchers at the University of Rochester Medical Center (URMC) indicate that exposure to MeHg may disrupt the early development of the connections between muscles and the brain, which could lead to motor control problems later in life.

MeHg enters in the environment in the form of industrial pollution and natural sources, settles in the oceans, and is eventually absorbed in plants and other small organisms like plankton. Mercury bio-accumulates as it moves up the food chain and eventually reaches humans in the form of fish consumption, which is a major food source in many parts of the world.

Much of our understanding of the impact of mercury exposure comes from major[1] 20th century industrial accidents in Japan and Iran, which poisoned thousands of people with high levels of mercury exposure. Many victims of these accidents exhibited a range of neurological symptoms similar to cerebral palsy, including muscle weakness and impaired motor control. While these accidents document the dangers of high levels of mercury, the long-term cumulative effects of exposure to smaller amounts are not well understood, especially during the important and vulnerable period of early development of the central nervous system.

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New Research Points to Mercury's Long-Term Effects

The new studies – which come from the lab of Matthew Rand, Ph.D., with the URMC Department of Environmental Medicine and appear in the journals Neurotoxicology and Teratology and Toxicological Sciences – begin to shed light on the mechanism by which mercury may damage developing muscles and motor control.

The new research was conducted in the fruit fly Drosophilia, a long-established and important research tool in neuroscience because it enables researchers to study the entire nervous system.The researchers – which included graduate students Ashley Peppriell and Jakob Gunderson – found that when fruit fly larva were exposed to MeHg it impacted the early formation flight muscles and ultimately impaired flight ability when the flies reached adulthood. The researchers identified a gene called Nlg1 that encodes a protein found in muscles that plays an important role in forming the connections between muscles and neurons, at what is known as the neuromuscular junction. The Nlg1 gene expression is altered when exposed to MeHg during the larva stage.

Matthew Rand, PhD

Jakob Gunderson, PhD (Left)
Ashley Peppriell, PhD (Right)

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New Research Points to Mercury's Long-Term Effects

“What we have to appreciate is that the musculoskeletal system is really sort of a continuation of the nervous system,” said Rand. “They're connected and neural impulses are responsible for the muscle contractions that move our body. These are integrated systems and when a fetus is forming, muscle tissue and neural tissue need to talk to each other to get wired up. These findings indicate that mercury exposure disrupts this process, with effects that may not appear until adulthood.”

The analysis of the risks versus benefits of fish consumption during pregnancy is complicated. Fish are a rich source of omega-3 fatty acids and other nutrients that are important in brain development. The U.S. Food and Drug Administration and the Environmental Protection Agency currently acknowledge the health benefits of nutrients in fish, but also recommend that pregnant people limit their fish consumption and avoid eating types of fish with higher concentrations of MeHg. However, decades of research involving mothers and children in Seychelles have muddled the scientific consensus. Seychelles is an island country in the Pacific Ocean where residents consume a wide variety of ocean fish, resulting in MeHg exposure that is about 10 times greater than in the populations of the U.S. and Europe.

The Seychelles Child Development Study is a partnership between the University of Rochester and the Seychelles Ministries of Health and Education, the Ulster University in Northern Ireland, and the Karolinska Institute in Sweden. Research from this study has shown that the fatty acids in fish enhance developmental and educational outcomes and may even help protect the developing brain from the harmful effects of mercury.

Researchers in the Rand lab are currently working to translate these new findings into animal models - in collaboration with the lab of EHSC faculty member Deborah Cory-Slechta, Ph.D. Rand is also collaborating with the Seychelles research team to see if muscle weakness, loss of motor skills, and other symptoms can be observed in the Seychelles’ mothers and their children – many of whom are now adults – that are a part of the study.

Adapted from an article written by Mark Michaud, University of Rochester, Associate Director of Communications

EHSC Researchers Explore Airborne Microplastics

In the past several years, concerns have grown over potential human exposures to microplastics in the environment. Much of the focus has been on exposure through food or drinking water, and some publications have claimed that airborne microplastics can be inhaled. However, there has been no rigorous characterization of the size and composition of airborne microplastic particles in the environment to see whether they are small enough to enter the lungs and potentially cause harm to health. Previous research on microplastics in the environment suggests that the plastic particles are of varied shapes and sizes, but in general are quite large (over 10 micrometers). If they become airborne, such particles could potentially deposit in the nose and cause irritation or could be swallowed, contributing to the overall body burden of microplastics. However, larger particles cannot get deep into the respiratory tract where they could potentially enter the bloodstream or cause damage to lung tissues. The question remains whether, what type, and what proportion of airborne microplastics are small enough to pose a concern for respiratory health.

Alison Elder, PhD

James McGrath, PhD

A team of researchers at the University of Rochester is exploring this question with support from the American Chemistry Council. Center members, Alison Elder, PhD (Environmental Medicine) and James McGrath (Biomedical Engineering), along with Wayne Knox, PhD (Optics) are working on answering two questions: 1) What is the size distribution of microplastics in the air? 2) What is their chemical composition?

Elder leads the first aim of this research, using the technology of the EHSC Inhalation Core to collect and characterize human respirable (<4 micrometers in aerodynamic diameter) microplastic particles in indoor air from a range of home and occupational settings. Based on the size distribution, the researchers will model where in the respiratory tract the microplastics particles would be expected to deposit. These findings will inform future studies of what types of health effects microplastic particles might have.

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EHSC Researchers Explore Airborne Microplastics

The second aim of this research uses a silicon nanomembrane technology developed in McGrath's lab. McGrath previously received an EHSC pilot grant to develop this technology for assessing the number and composition of microplastics in water (Madejski et al., 2020).The current project will characterize the types of polymers in the respirable particulate samples that could get into the gas exchange areas of the respiratory tract. Characterization of microplastics is complicated, and different methods are needed to identify which kinds of plastic polymers are in each particle.

One challenge in characterizing microplastic composition is that most filters that are used to collect particles for analysis are themselves made of plastic. McGrath developed nanomembranes that are made of silicon, not plastic, and are optically passive, allowing researchers to study the composition of plastic particles retrieved from Elder's respirable sampler. According to Elder, McGrath, "is the tie that binds, because he makes these filters that let us both collect the particles and identify them."

Knox is adapting techniques including confocal Raman spectroscopy and infrared spectroscopy to identify the organic chemical signatures of the plastic particles, as well as Nile Red staining to identify lipophilic compounds like plastics. These approaches have not been used previously for objects as small as the respirable microplastics collected on the filters. If the effort is successful, it will provide a foundation for future research on the potential health effects of the types of microplastic compounds found in environmental samples.

Madejski GR, Ahmad SD, Musgrave J, Flax J, Madejski JG, Rowley DA, et al. Silicon nanomembrane filtration and imaging for the evaluation of microplastic entrainment along a municipal water delivery route. Sustainability. 2020;12:14

EHSC Members Part of Effort to Create Atlas of Cells to Study Age-Related Diseases

Several University of Rochester EHSC members are part of a consortium of institutions recently awarded $31 million to build a molecular atlas of human senescent cells. These cells, which are not very well understood, are believed to contribute to a number of age-related diseases, including chronic lung disease, cardiovascular disease, dementia, and cancer caused by environmental stresses and factors.

Most cells throughout the body have the capacity to divide, multiply, and replace old cells. However, in response to certain stresses, some cells lose the ability to proliferate. These cells, called senescent cells, accumulate as we age and are believed to contribute to diseases later in life.

The University of Rochester arm of the study will be led by Irfan Rahman, Ph.D., (principal investigator, Environmental Medicine), Gloria Pryhuber, M.D. (Pediatrics), Vera Gorbunova, Ph.D. (Biology) who is co-director of the Rochester Aging Research Center, and Dongmei Li, Ph.D. (Public Health Sciences and the Clinical and Translational Science Institute).

Irfan Rahman, PhD

Gloria Pryhuber, MD

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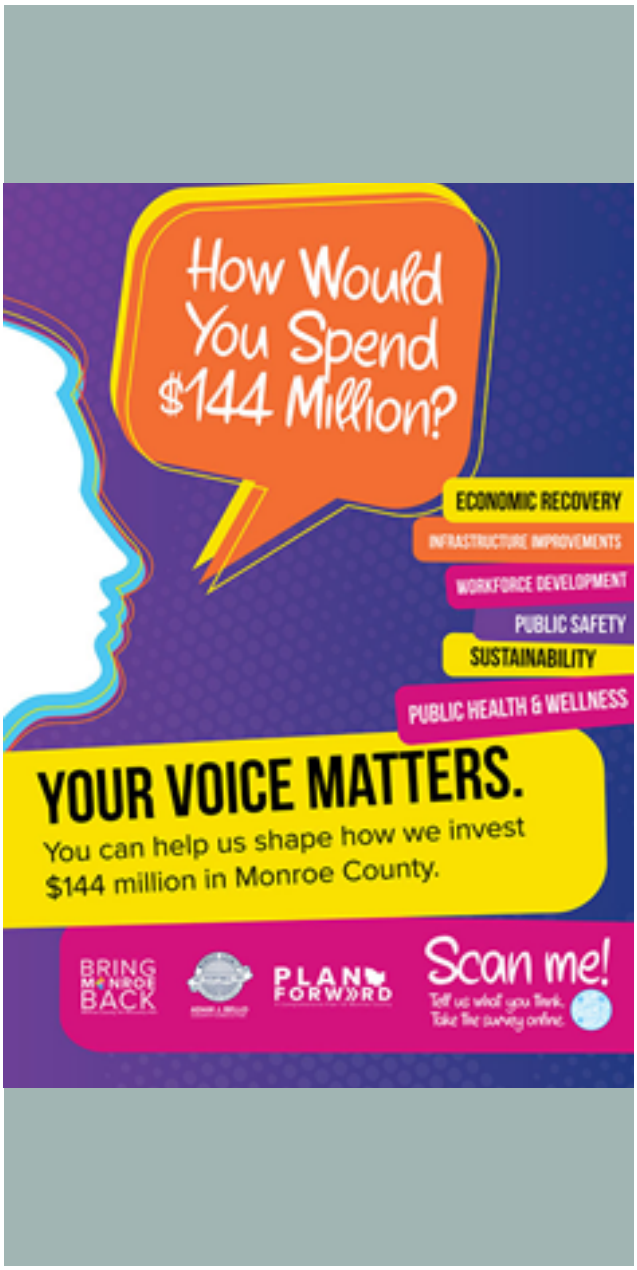
The project is part of a larger initiative called the Cellular Senescence Network (SenNet), a program established by the National Institutes of Health to build a cellular atlas to understand how and why senescent cells develop and to set the course for new therapies for age-related diseases. Rochester is part of the TriState SenNet Tissue Mapping Center, which is led by the University of Pittsburgh and also includes The Ohio State University and Carnegie Mellon University.

The TriState SenNet Tissue Mapping Center will contribute to this effort by studying senescence in heart and lung cells. The researchers will collect and map gene expression and protein composition, as well as metabolites in senescent cells from human tissue slices and in lab-grown mini-organs, or organoids. They will compare different types of senescent cells from across the lifespan to characterize biomarkers that can identify why and by what mechanism cells become senescent. This information could point to new therapies called senolytics that seek and destroy senescent cells involved in age-related diseases.

Modified from the article:
https://www.urmc.rochester.edu/education/graduate/news/ur-researchers-part-of-effort-to-create-atlas-of-c.aspx

EHSC Bi-Annual Community Advisory Board Meeting

The EHSC held its bi-annual Community Advisory Board Meeting on December 2. Pat Gooch, Senior Planner for Monroe County gave the keynote presentation on "Build Monroe Back and Plan Forward." He described the Bring Monroe Back campaign which is collecting feedback from Monroe County residents in order to gain insight on how to best use the $144 million funding that Monroe County received from the American Rescue Plan Act of 2021 (ARPA). This emergency relief funding will be used in several areas including public safety, public health and wellness, economic recovery, workforce development, infrastructure improvements, and sustainability. Monroe County residents can provide feedback to help identify areas of need.



To participate in the Bring Monroe Back campaign, go to the Monroe County, NY Recovery Plan website and take the survey: https://www.monroecounty.gov/bringmonroeback

Update on Vaping Education Efforts

Vaping Education Kit Presentation

The EHSC Community Engagement Core (CEC) Program Manager, Cait Fallone, M.A. presented to the American Lung Association's (ALA) Smoking and Health Action Coalition (SHAC) coalition meeting on October 25 to discuss the four new vaping education kits that were created in collaboration with Science Take-Out. Two of the kits focus on the impact of nicotine in vaping products while the other two kits highlight the effects of toxic chemicals found in e-juices and vaping devices. For more information on the Science Take-Out vaping education kits, please visit https://www.sciencetakeout.com/?s=vaping&post_type=product&dgwt_wcas=1

EHSC Member, Matthew McGraw, MD Vaping Webinar

Matthew McGraw, MD presented a webinar on "E-Cigarettes and Vaping" at the October 27 meeting of the Monroe County Medical Society.McGraw's presentation included data published by the American Academy of Pediatrics and the Surgeon General for counseling teens and parents on e-cigarette use and prevention as well as information for educating care providers on screening patients for e-cigarette use and referring them for appropriate counseling. He also spoke about the collaboration between the EHSC's CEC and Science Take-Out on their vaping education kits.

Matthew McGraw, MD

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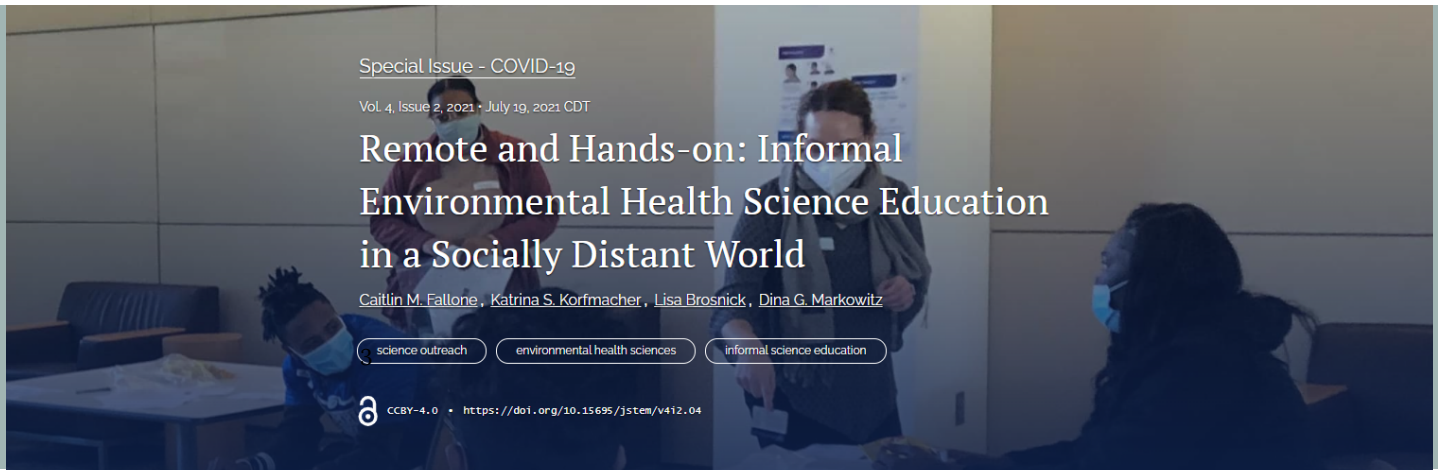
Vaping Activities Developed with NIEHS CEC Partners

The EHSC's CEC collaborated with CEC partners from The Center for Environmental Health and Susceptibility at the University of North Carolina at Chapel Hill, The Center for Exposures, Disease, Genomics, and Environment at the University of Washington, and The Environmental Health Sciences Research Center at the University of Iowa to develop vaping activities for middle and high school students. These online and hands-on activities include: 1) Investigating the Impact of E-Cigarettes on Airway Inflammation and Asthma, 2) Biomarker Simulation, 3) A Case of Severe Lung Illness, and 4) Escape the Vape Digital Breakout.

To view and utilize these activities, please visit https://ie.unc.edu/cpes/resources/vaping-and-respiratory-health-resources-for-educators/

CEC Publication About Remote Learning



EHSC Community Engagement Core staff Cait Fallone, MA, Katrina Korfmacher, PhD, and Dina Markowitz, PhD published an article in July 2021 entitled "Remote and Hands-On: Informal Environmental Health Science Education in a Socially Distant World". This article discusses the challenges of doing environmental health education and outreach during the COVID-19 pandemic and the success of using Science Take-Out kits for remote learning

Fallone, C. M., Korfmacher, K. S., Brosnick, L., & Markowitz, D. (2021). Remote and Hands-On: Informal Environmental Health Sciences Education in a Socially Distant World. Journal of STEM Outreach, 4(2), 1-8. doi.org/10.15695/jstem/v4i2.04

Researchers Awarded Grant to Combat Vaccine Hesitancy in Adolescents

Modified from the article originally posted: https://www.urmc.rochester.edu/education/graduate/news/researchers-awarded-grant-to-combat-vaccine-hesita.aspx

Center Member Dina Markowitz, Ph.D., recently received a supplemental award to her One Health Education project funded by the National Institute of General Medical Sciences (NIGMS) Science Education Partnership Award (SEPA). Markowitz is the director of the Life Sciences Learning Center (LSLC), which has received SEPA support since 1998. The LSLC, which is located within the Department of Environmental Medicine, offers outreach programs for Rochester students and community members, and gives them opportunities to participate in hands-on science activities. Since its inception, the LSLC has received more than $9 million in funding.

Dina Markowitz, PhD

Dani Alcéna-Stiner, PhD

While the current SEPA grant focuses on “One Health” – the connection between the health of humans, animals, and the environment, the new one-year supplement grant will extend those lessons to include COVID-19 and vaccination. This new project, Outreach for Youth Education on SARS-CoV-2 (O- YES!), was developed in collaboration with Danielle (Dani) Alcéna-Stiner, Ph.D., R.N., assistant professor at UR School of Nursing, who also serves as the assistant director of the LSLC. The O-YES project will address vaccine hesitancy and improve health literacy among middle and high school students.

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Researchers Awarded Grant to Combat Vaccine Hesitancy in Adolescents

> ***"There's a lot of confusion in the community about what RNA is, what mRNA is and how it works with the vaccines,"*** **Alcéna-Stiner said.** ***"And a lot of hesitancy about taking vaccines, because there's a misunderstanding about what that is and how to understand the science."***

"The driving force behind the project is this passion to start incorporating health literacy and behavior change into the educational material that we're offering for our outreach programs," said Alcéna-Stiner, co-investigator on the new project. The lessons and hands-on activities Alcéna-Stiner and Markowitz create will teach students about how COVID-19 spreads, how COVID testing works, what RNA is and how the vaccine works.

Alcéna-Stiner said the new grant will help youths find reliable information and help them make informed decisions about their health.

Rochester-area teachers, students, and health professionals, including nurses, physicians, and health educators, will be involved every step of the way as the project develops, beginning with assessments to find out what students already know about infectious diseases and how they learn about them.

Students will then help guide materials and lessons created, which will be both in English and Spanish, and provide feedback through focus groups. Students from rural areas surrounding Rochester and those within the city will be included in focus groups.

"We really are trying to get a nice representation of our Rochester community throughout the different groups that we're involving in the project," Alcéna-Stiner said. The team is also working with community liaisons to identify and share information with different groups within Rochester.

After testing the materials, Alcéna-Stiner and Markowitz will release the materials online so teachers across the country have resources to teach their students about health literacy.

EHSC Post-Doctoral Trainee Receives K-Award

Dr. Thivanka Muthumalage joined the Department of Environmental Medicine as a T32 postdoctoral trainee in 2017. He has been studying the toxicological effects of exposure to tobacco smoke, electronic nicotine delivery systems (ENDS), and other emerging vaping products to understand the respiratory and immunotoxicity of acute and chronic exposure to these products and their chemical constituents. Dr. Muthumalage was recently awarded a pathway to independence (K99/R00) grant by the NIEHS. His project studies the toxicological effects of ENDS-flavors (tobacco and menthol) under normal and pulmonary disease conditions, such as asthma and COPD. Dr. Muthumalage's research will determine the toxicological mechanisms of flavor and constituent exposure and the pathogenesis of lung diseases by e-cig flavor exposure under pre-existing respiratory conditions. He will also identify biomarkers of therapeutic targets. Dr. Muthumalage's career goals include obtaining an an assistant professor faculty position to continue his research on the disease processes of chronic tobacco smoke and e-cigarette flavors in disease susceptibility. Dr. Muthumalage is a member of the Society of Toxicology and the American Thoracic Society. He also plans to obtain DABT (Diplomate American Board of Toxicology) certification, which is a professional certification in the field of toxicology.

Thivanka Muthumalage, PhD

Seychelles Child Development Study Holds First Virtual Symposium

On December 9, the Seychelles Child Development Study (SCDS) organized its first virtual symposium that was attended by scientists, policy makers and other collaborators and stakeholders from Seychelles and internationally. The symposium consisted of six presentations by researchers from Seychelles, Rochester, Northern Ireland, and Sweden. Topics included the impact of COVID-19 on children in Seychelles, fish knowledge and consumption among Seychellois children, sustainable fish consumption, and recent findings and future directions of the SCDS. The presentations have been recorded and will be available on the study website.

Congratulations to our 2021 Toxicology PhD Graduates

Ashley Rackow, PhD
Postdoctoral Associate at URMC, Rochester, NY

Jakob Gunderson, PhD
Senior Scientific Associate, Charles Rivers laboratories, Horsham, PA

Ashley Fields, PhD
Toxicologist at FDA, Beltsville MD

Timothy Anderson, PhD
Federal Postdoctoral Fellow at the EPA, North Carolina

Timothy Smyth, PhD
Postdoctoral Trainee at UNC Chapel Hill

Ashley Peppriell, PhD
Toxicologist at ICF, Durham, NC

For Questions or Comments, Please Contact:

Cait Fallone, MA
Program Manager
Environmental Health Science Center
Community Engagement Core
(585) 275-3354
Cait_fallone@urmc.rochester.edu

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