

2019 ANNUAL REPORT



IIT @MSU

INSTITUTE FOR INTEGRATIVE TOXICOLOGY

MICHIGAN STATE
UNIVERSITY

IIT ANNUAL REPORT 2019

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A **TRADITION** of EXCELLENCE

The Michigan State University Institute for Integrative Toxicology (IIT) is a multidisciplinary academic unit that supports and coordinates research and graduate education activities for faculty interested in various aspects of **toxicology**. The Institute is a **successor** to the Institute for Environmental Toxicology and the Center for Environmental Toxicology, the latter founded in 1978. While the name of the unit has changed over the years to denote changes in the **leadership** and academic position, the mission has been the same. For over 40 years, toxicology at Michigan State has provided **excellence** in training graduate students, facilitating research, and providing service to the State of Michigan when needed. The successes generated in these endeavors have resulted in **recognition** of Michigan State as a leader in academic toxicology.

The Center for Environmental Toxicology was initiated primarily to **assist** the State of Michigan with environmental contamination issues such as those arising from the PBB (polybrominated biphenyls) incident in the early 1970s. That unfortunate event was initiated by the accidental

contamination of feed for dairy cattle with PBBs. These dioxin-like chemicals and dioxin itself remain a major topic of research at Michigan State University.

Several years after the founding of the Center for Environmental Toxicology, a dual-major Ph.D. program in environmental toxicology was offered in conjunction with several cooperating departments. The characteristics of the program were **unique** at that time as students were required to complete the Ph.D. requirements of a department of their choice in addition to the didactic requirements and toxicology research specified by the Center. The **quality** of this cross programmatic effort was recognized by the National Institutes of Health in 1989 with the award of a Training Grant from the National Institute for Environmental Health Sciences. This grant has been competitively renewed ever since, providing over 30 years of continuous funding. Graduates of MSU's toxicology program number over 200 and can be found in academia, industry, and governmental positions. ♡

MESSAGE from the DIRECTOR



Now in our 41st year, the Institute for Integrative Toxicology had many successes in 2019.

Our most exciting news of the year - the graduate program in Environmental and Integrative Toxicological Sciences (EITS) has distinguished itself once again with the renewal of its National Institute of Environmental Health Sciences (NIEHS) Training Grant. Our training grant has been continuously funded since 1989, with the latest renewal, effective July 1, 2019, providing a further five years of funding. The training grant provides stipend support for 7 predoctoral and 2 postdoctoral students affiliated with our institute and is an invaluable tool in recruitment of students to our nationally recognized program. This successful effort was led by our Graduate Director, John LaPres with assistance from Bob Roth and our support staff, Amy Swagart and Kasey Baldwin, who had the Herculean task of collecting information on present and past trainees across 16 graduate programs.

Our affiliated faculty count has now grown to seventy-six experts who conduct toxicology-related research spanning investigations of environmental (air, water, soil), occupational, food-borne and pharmaceutical agents. This year the IIT welcomed Drs. Jinpeng Li, Neera Tewari-Singh and Leon Brun-

er to our faculty. We also celebrated the retirement of Drs. Jay Goodman, James Sikarskie and Matthew Zwiernik. Each have made significant contributions over the years to the success of the Institute.

This year I also accepted the position of director for the Center for Research on Ingredient Safety (CRIS). As one of the centers under the IIT umbrella, I have been involved in the creation of CRIS from its formation. I am delighted to lead this center and will continue to hold a dual role as the CRIS director and the director of the IIT. We move into 2020 with a full research agenda and goals to continue increasing the momentum we began in 2019.

Lastly, I am proud to share that our newly refreshed website is now mobile-friendly with a clean, modern design. New features include a news section, an events section and a faculty directory searchable by research interest and department/program affiliation. We are now able to feature news and events of our faculty and students on our website for our toxicology community in which to share and participate.

We look forward to 2020, with a clear vision for success and growth in the year to come.

A handwritten signature in blue ink that reads "Norbert E. Kaminski".

Norbert E. Kaminski, Ph.D., IIT Director

2019 IIT HIGHLIGHTS

This year's highlights showcase the accomplishments of not only the IIT, but also of the faculty and trainees involved in continuing to expand the quality and leadership of Michigan State University in academic toxicology.

IIT Affiliates Successful at 58th SOT Meeting in Baltimore

Students and faculty of the MSU Institute for Integrative Toxicology were excited to attend and present at this year's 58th annual Society of Toxicology (SOT) meeting held in Baltimore, Maryland.

The SOT annual meeting is the largest toxicology meeting and exhibition in

the world, with more than 80 scientific sessions and 2,100 abstract presentations. This year's meeting was held at the Baltimore Convention Center from March 10-14, 2019.

The following students and faculty affiliated with IIT received recognition: **Robert Freeborn, Jeremy Gingrich, Jiajun "Brian" Zhou, Lance Blevins, Yining Jin, Rance Nault, Asmita Pant, Lauren Hardy, Maria Poidomani, Dr. Sudin Bhattacharya, Dr. William Atchison, and Dr. Jinpeng Li.**

The highlight of the week was the IIT Alumni and Friends Reception held on Tuesday, March 12, for all current and former students, postdocs, faculty and friends of Michigan State University. The evening reception was a welcome opportunity to catch up with old acquaintances and meet with new friends. The IIT looks forward to the next SOT Meeting in Anaheim, California, in March 2020. 🍷



Left: Dr. Rance Nault accepts his John Doull Risk Assessment Award from the Risk Assessment Specialty Section.



Right: Cheryl Rockwell (center) with her lab trainees who took home several awards.

Kaminski Named CRIS Director in 2019



Dr. Norbert Kaminski, will also serve as the director of the Center for Research on Ingredient Safety (CRIS) at MSU. His appointment comes after successfully serving as the center's interim director.

"Norb's leadership has proven

invaluable, and we are confident that he will continue to elevate the center through his innovate research and dedication to sharing the latest science," said Doug Buhler, assistant vice president of Research and Innovation at MSU and director of AgBioResearch, the administrative home for CRIS.

CRIS is an independent, academic, science-based center that serves as a reliable and unbiased source for information on the safe use of chemical ingredients in consumer-packaged goods, including foods, beverages, cosmetics, and household consumer products. CRIS implements a multi-prong approach of research, education, and outreach allowing consumers, manufacturers, and poli-

cymakers to make evidence-informed decisions.

Kaminski will continue to focus on CRIS's core mission to educate the next generation of food scientists, conduct research, and provide insight on the safety of ingredients in food and consumer products to the greater community through outreach and risk communication.

"Norb brings his network, extensive knowledge, and proven record of scholarship and mentorship to CRIS, and we are thrilled he will continue to serve as CRIS director," said Ron Hendrick, Dean of the College of Agriculture and Natural Resources at MSU. 🍷

IIT Hosts Seminar Series for Faculty and Students

The IIT was thrilled to host six fantastic speakers in 2019 as part of the IIT Seminar Series:

- » **Dr. Matthew Campen**, University of New Mexico, spoke on, “*Circulating Molecular Shrapnel: Identifying links between inhaled toxicants and neurological outcomes*,” on January 11, 2019.
- » **Dr. Rita Strakovsky**, Michigan State University, spoke on, “*Gestational Exposure to Parabens and Fetal Growth*,” on February 8, 2019.
- » **Dr. Michael Honeycutt**, Texas Commission on Environmental Quality, spoke on, “*Regulating Air Quality - Nothing Simple is Ever Easy: A Case Study with Ozone*,” on April 12, 2019.

- » **Dr. Patricia Hunt**, Washington State University, spoke on, “*Making Errors While Making Gametes*,” on May 6, 2019.
- » **Dr. Tracie Baker**, Wayne State University, spoke on, “*Circulating Molecular Shrapnel: Identifying Links Between Inhaled Toxicants and Neurological Outcomes*,” on September 10, 2019.
- » **Dr. Patrick Allard**, University of California Los Angeles, spoke on, “*Epigenetic Mechanisms of Inheritance of Environmental Exposures*,” on October 8, 2019.

The IIT is looking forward to hosting four more prestigious speakers this spring:

- » **Dr. Bernard Goldstein**, University of Pittsburgh, will speak on, “*Challenges to Science: Changes to EPA’s*

Advisory Processes and the EU’s Use of the Precautionary Principle to Ban Agricultural Imports,” on January 14, 2020.

- » **Dr. Mark Harris**, ToxStrategies, will speak on, “*Consulting - Another Path for a Toxicologist*,” on February 11, 2020.
- » **Dr. Teresa WM Fan**, University of Kentucky, will speak on, “*Mapping Human Tumor Metabolism In Vivo and in Preclinical Models Using Stable Isotope - Resolved Metabolomics (SIRM)*,” on April 14, 2020.
- » **Dr. Donna Zhang**, University of Arizona, will speak on, “*NRF2 in Environmental Response and Disease Intervention*,” on May 12, 2020.

Hope to see you this spring for learning and networking! 🍷

2019 Annual Research Evening at Kellogg Center

The Institute for Integrative Toxicology’s Annual Research Evening showcased trainees in the Environmental and Integrative Toxicological Sciences Graduate Training program and their accomplishments. This year’s event took place at the MSU Kellogg Center and included student posters and platform presentations. Three EITS graduate students presented the platform presentations:

Tyler Firkus, training in the lab of Dr. Cheryl Murphy, spoke on, “*The Sublethal Effects of Sea Lamprey Parasitism on Lake Trout Reproduction and Growth*.” Firkus is a doctoral student in the Department of Fisheries and Wildlife and has focused his graduate research on assessing the influence of stressors on fish reproductive physiology, immune function, and growth. He is also interested in assessing how perturbations at the molecular, organ, and individual level have consequences for populations as well as the interface between chemical

and non-chemical stressors.

Sean Nguyen, training in the lab of Dr. Margaret Petroff, spoke on, “*Placental Extracellular Vesicles in Murine Pregnancy*.” Nguyen is a doctoral student in the Cell and Molecular Biology Program and has focused his graduate research on placental extracellular vesicles (pEVs) and their function during pregnancy. He is specifically interested in the cellular targets of pEVs in vivo as well as understanding the mechanisms by which they localize to maternal tissues in pregnancy.



Di Zhang, training in the lab of Dr. Karen Liby, spoke on, “*Identification of an Unfavorable Immune Signature in Advanced Lung Tumors from Nrf2-Deficient Mice*.” Zhang is a doctoral student in the Department of Pharmacology and Toxicology and has focused her graduate research on investigating the role of the Nrf2 pathway in cancer. Inhibition of the Nrf2-Keap1 pathway has become an attractive target for lung cancer treatment, since mutations in the *NFE2L2* gene (encodes Nrf2), which are associated with chemoresistance and poor survival,

have been found in lung cancer patients. However, there are no specific and potent Nrf2 inhibitors currently available. Zhang has identified a novel Nrf2 pathway inhibitor through a high throughput drug screen. She is currently working on further validating this novel compound and investigating how it inhibits the Nrf2 pathway.

To those who attended, thank you for joining us for this special evening of celebration, camaraderie, and learning! 🍷

EITS TRAINING PROGRAM

An overview of the current EITS training program and review of 2019 activities.

The Environmental and Integrative Toxicological Sciences (EITS) graduate program continues to be one of the premier toxicology training programs in the U.S. This MSU training program administered by the IIT is a “dual major” format that emphasizes excellent basic science training from one of our 17 partnering graduate programs coupled with didactic and research training in toxicology by MSU IIT-affiliated faculty. Currently, 30 doctoral students are enrolled in the EITS program, distributed among several of our partnering PhD programs. Twenty-three of these students are in the Biomedical Track, six in the Environmental Track, and one student has entered the new Food Toxicology and Ingredient Safety Track. Many of our current students received awards at the 2019 Annual Meeting of the Society of Toxicology (SOT) or from other organizations. Our students continue to demonstrate good citizenship by volunteering to serve on Society committees at the regional and national levels as well as within MSU. Students who graduated in the past year have accepted postdoctoral positions at various academic institutions in the U.S. and other countries or began careers at some of the largest corporations in the country.

The National Institute of Environmental Health Sciences (NIEHS) Training Grant, that the IIT has received with continuous funding since 1989, was renewed once again this year. The latest renewal, effective July 1, 2019, will provide funding for the next five years. The training grant offers stipend support for 7 predoctoral and 2 postdoctoral fellows each year. Universities compete nationally for training grant support from NIEHS. The longstanding support by NIH of the MSU-IIT is a testament to the excellence that the EITS program has maintained over three decades in training graduate students and postdoctoral fellows, many of whom have become leaders in the field of toxicology. 🌱

EITS GRADUATES 2019



Taylor Dunivin
Microbiology & Molecular Genetics
Mentor, Ashley Shade

The Distribution and Dynamics of Resistance Genes in Soil Microbiomes



Feng Gao
Plant, Soil & Microbial Sciences
Mentor, Stephen Boyd

Computational Methods for Understanding Environmental Processes, Risk and Toxicity



Mike Rizzo
Cell & Molecular Biology
Mentor, Norbert Kaminski

Δ9-Tetrahydrocannabinol Suppresses Human Monocyte Activation and Monocyte-Mediated Astrocyte Inflammation: Implications for HIV-Associated Neuroinflammation



Katherine Roth
Cell & Molecular Biology
Mentor, Bryan Copple

Regulation and Function of Macrophages During Acute Liver Injury and Acute Liver Failure



Vickie Ruggiero
Comparative Medicine & Integrative Biology
Mentor, Paul Bartlett

Field Studies on the Control of Bovine Leukemia Virus in Dairy Cows



Jiajun (Brian) Zhou
Microbiology & Molecular Genetics
Mentor, Norbert Kaminski

The Role of LCK and PD-1 in TCDD-mediated Suppression of the IgM Response by Human CD5+ Innate-like B Cells

GRADUATE SPOTLIGHTS

EITS graduates are sought for careers in industry, government and academia. They leave the program with extensive research training in a specific basic science discipline as well as in toxicology, preparing them to interact with multidisciplinary teams focused on the goal of solving current and preventing future threats to human, animal and environmental health. Below we feature four alumni and their paths after graduation from the EITS program.



Weimin Chen

Research Investigator II, Department of Immuno-and Molecular Toxicology (I-MTox), Bristol-Meyers Squibb

At a glance:

Department: Microbiology & Molecular Genetics

Mentor: Norbert Kaminski

Dissertation: “Modulation of HIV gp120 Antigen-Specific Immune Responses by Delta9-Tetrahydrocannabinol and Cannabinoid Receptors 1 and 2 In Vitro and In Vivo”

Defended: Feb 2014

Significant Achievements During Graduate School:

- » 2013: Vera W. Hudson and Elizabeth K. Weisburger Scholarship Fund Student Award presented by Women in Toxicology Special Interest Group of Society of Toxicology
- » 2013: Jean Lu Student Scholarship Award presented by American Association of Chinese in Toxicology Special Interest Group of Society of Toxicology
- » 2012: Charles River Best Abstract Award by American Association of Chinese in Toxicology Special Interest Group of Society of Toxicology

With a fascination for science experiments as a child and a developing love of learning, Weimin Chen used her passion and interest for science to propel her towards a career in the scientific field. After earning her Bachelors of Science in Biological Sciences at Nankai University in Tianjin, China, Chen came to the U.S. and studied Agronomy (Environmental Microbiology) at Purdue University and earned her Masters. She was then recruited by the MSU Microbiology and Molecular Genetics Graduate Program. During this time, Chen trained with Dr. Norbert Kaminski and completed her dissertation, “*Modulation of HIV gp120 Antigen-Specific Immune Responses by Delta9-Tetrahydrocannabinol and Cannabinoid Receptors 1 and 2 In Vitro and In Vivo.*”

Today Chen is a Research Investigator II in the Department of Immuno-and Molecular Toxicology (I-MTox) at Bristol-Meyers Squibb under the Drug Safety Evaluation group. Her work supports preclinical drug safety assessment for small and large molecules in various therapeutic areas, including immunology, immuno-oncology, and fibrosis. With the emerging immunotherapies for treating cancers or autoimmune diseases, understanding how these immunomodulators work preclinically is an essential process during drug discovery and development and is critical in enabling clinical trials. She serves

as a project representative and a study director/monitor. Chen’s responsibilities include designing toxicology studies in animal species and in vitro for the scientific and toxicologic evaluation of selected drug candidates, developing mechanistic approaches to address toxicity issues that arise, particularly those associated with immune systems, and integrating available pharmacological, biochemical, toxicological, immunological, clinical, statistical, toxicokinetic, and pathologic data into study reports for regulatory submissions.

As part of the I-MTox group at BMS, Chen has been able to gain a lot of experience in supporting preclinical drug safety assessments for numerous programs across multiple therapeutic areas over the past five years.

Chen found her time as an EITS student invaluable to her career today, “The EITS program not only prepared me with a solid and broad knowledge base in toxicology, but also taught me many essential skill sets, including independent and critical thinking, problem solving, public speaking, scientific writing, being a team player, and perseverance, to name a few.” Chen believes these skills were all critical and beneficial for her later career development. “I truly value all the training I received as an EITS student.”



- » 2011: Society of Toxicology Graduate Student Travel Support Award to attend the Society of Toxicology 50th Anniversary Annual Meeting in Washington, DC
- » 2010 Ron and Sharon Rogalski Fellowship for Food Safety and Toxicology Research at MSU



Taylor Dunivin

AAAS Congressional Science and Technology Policy Fellow, U.S. Senate Committee on Agriculture, Nutrition and Forestry

At a glance:

Department: Microbiology and Molecular Genetics

Mentor: Ashely Shade

Dissertation: “The Distribution and Dynamics of Resistance Genes in Soil Microbiomes”

Defended: June 2019

Significant Achievements During Graduate School:

- » 2019: Christine Mirzayan Science and Technology Policy Fellowship, National Academies of Sciences, Engineering, and Medicine
- » 2019: Dissertation Completion Fellowship, College of Natural Science
- » 2015 – 2019: Broadening Experiences in Scientific Training Scholar, National Institutes of Health
- » 2018: Russell B. DuVall Fall Fellowship Award, Michigan State University
- » 2018: Science and Society at State Scholar, Michigan State University
- » 2018: Toxicology Travel Award, Institute for Integrative Toxicology
- » 2017: Rogowski Fellowship for Food Safety and Toxicology, Department of Microbiology and Molecular Genetics
- » 2016: Rogowski Fellowship for Food Safety and Toxicology, Department of Microbiology and Molecular Genetics

An undiagnosable childhood illness, that was eventually linked to high levels of arsenic led Taylor Dunivin to study toxicology, environmental health and the policy surrounding those fields. Realizing how much there was to discover about how environmental exposures can impact human health, Dunivin chose to first study at the University of Michigan where she earned her Bachelor of Science degree in Biology with a minor in Environmental Science. Dunivin then came to MSU to earn her Ph.D. in Microbiology and Molecular Genetics with a dual major in Environmental Toxicology. Dunivin trained with Dr. Ashley Shade and completed her dissertation, “*The Distribution and Dynamics of Resistance Genes in Soil Microbiomes.*”

Prior to completing her graduate degree, Dunivin was chosen as a Mirzayan Science and Technology Policy Fellow at the National Academies of Sciences where she worked with the Board on Chemical Sciences and Technology to launch the Environmental Health Matters Initiative. Dunivin helped prepare background materials on environmental health topics including plastics, water infrastructure, PFAS, and agriculture. Following her graduation from MSU, Dunivin accepted a position as a Congressional Science and Technology Policy Fellow sponsored by the Soil Science Society of America working with the U.S. Senate Committee on Agriculture, Nutrition and Forestry under Ranking Member Debbie Stabenow, the Senior Senator from Michigan and also an MSU alumnus. As a committee staffer on Capitol Hill, Dunivin works on projects related to climate change, precision agriculture, and forestry. Her daily duties include meeting with stakeholders, working on legislation and keeping up-to-date on relevant science conversations in the field. Dunivin has enjoyed her time on the Hill so far and is pleased to see how much people really do care about the science involved in many of today’s current environmental challenges. As Dunivin works through her fellowship, she looks forward to discovering more about her career path

ahead - she hopes to find a perfect balance of science intersecting policy where she can create a direct impact on large populations.

Dunivin found the EITS program invaluable in preparing her for her role today, “My graduate coursework and research was extremely multidisciplinary, which made me comfortable learning about science in other fields. This is extremely helpful working on Capitol Hill because I am expected to work with science topics that span across disciplines.”





Brenna Flannery

Toxicologist, Center for Food Safety and Applied Nutrition, US Food and Drug Administration

At a glance:

Department: Food Science & Human Nutrition

Mentor: James Pestka

Dissertation: “Mechanisms of deoxynivalenol-induced anorexia and its impact on weight in the female mouse”

Defended: Dec 2012

Significant Achievements During Graduate School:

- » 2012: Completed the Food and Nutrition Study Abroad in Tanzania which included a special topics toxicology project
- » 2012: MSU Federal Credit Union Study Abroad Scholarship
- » 2012: LeAnn B. Goodwin Endowed Graduate Research Fellowship
- » 2011: W.K. Kellogg Institute for Food and Nutrition Research Scholarship in Food Science
- » 2010: Department of Microbiology Competitive Scholarship-Rogalski Fellowship in Toxicology
- » 2012: Frank C Lu Award, Society of Toxicology, Food Safety Specialty Section

Brenna Flannery grew up exploring and with a fascination for asking why things were the way they were. A focus on science felt like a natural fit as she went to college. After receiving her Bachelor of Science degree in Nutritional Sciences with a specialization in Health Promotion from Michigan State University, Flannery joined Teach For America where she taught high school math in Helena, AR, for two years. Realizing how much she missed science, Flannery returned to MSU to earn her Ph.D. in Food Science with a dual major in Environmental Toxicology. Flannery trained with Dr. James Pestka and completed her dissertation, “*Mechanisms of Deoxynivalenol-Induced Anorexia and its Impact on Weight in the Female Mouse.*”

Today Flannery is a Toxicologist at the Center for Food Safety and Applied Nutrition at the US Food and Drug Administration (CFSAN, FDA). Her area of focus in toxicology at the FDA is chemical contaminants in foods. When a chemical contaminant is found in a food product, Flannery is asked to determine whether the food product is a health concern. If deemed a health concern, the food product may be recalled or put on import alert. When a food product is recalled, it is removed from the market, which reduces the public’s exposure to that particular chemical contaminant from that food product. Flannery also provides scientific expertise for risk assessments of chemical contaminants in food. These risk assessments provide the scientific support for guidance/action levels of chemical contaminants in foods. Having guidance levels for chemical contaminants in food is important for the everyday person because when followed, they reduce a person’s exposure to a chemical contaminant from that food, thereby reducing their overall exposure and potential for exceeding an exposure level that may be a health concern.

Flannery’s long-term career goal is to help others by advancing public health, while also continuing to grow and learn professionally and personally. So far, her time at the FDA has exceeded

her expectations - there are always new problems to solve and new skills to learn. Flannery has also enjoyed FDA’s professional development program called “details” where she has been able to float to another position for 3-4 months to learn and expand her professional skill set.

Flannery found the multidisciplinary format of EITS to be invaluable to her career today, “Aside from EITS giving me the knowledge that I needed for my position, being part of a multidisciplinary program provided me the opportunity to learn how people from other disciplines might approach the same problem slightly differently, and how to appreciate different perspectives. Everything I do in my current position is always in a multi-disciplinary team (nutritionists, economists, engineers, chemists, etc.), and within EITS, students are from multiple areas of study (food science, biochemistry, microbiology, pharmacology/toxicology).” 🍀



Joseph Henriquez

Senior Regulatory Mammalian Toxicologist, Corteva Agriscience

A sense of curiosity and a need to do work that matters has always fueled Joseph Henriquez's education and career choices. After earning his Bachelors of Science in Biology from University of California Los Angeles, Henriquez earned his Master of Science in Biological Sciences at California State Polytechnic University. Henriquez then joined the lab of Dr. Norbert Kaminski at MSU and earned his Ph.D. in Pharmacology and Toxicology with a dual major in Environmental Toxicology. His dissertation was, "*Δ9-Tetrahydrocannabinol-mediated Suppression of the Interferon- α (IFN α) response by Plasmacytoid Dendritic Cells (pDC) and IFN α -mediated Activation of T Cells in Healthy and Human Immunodeficiency Virus (HIV) Infected Human Donors.*"

Today Henriquez is a senior regulatory mammalian toxicologist at Corteva Agriscience. His work is focused on ensuring that their crop protection products have undergone thorough toxicological evaluation and he helps to maintain their registration in various global markets so that farmers will continue to have access to safe and important agricultural tools. Internally, Henriquez cross-functionally collaborates with chemists, regulatory affairs, ecotoxicologists, and environmental fate and metabolism experts to ensure that their molecules have been properly evaluated. Externally, he engages and works collaboratively with regulatory agencies to address any concerns regarding human health. Finally, Henriquez is engaged in several initiatives to incorporate the most relevant in vitro toxicological approaches and align the companies' testing paradigm with the alternative approach initiatives of the USEPA and EFSA. In short, Henriquez works to ensure farmers continue to supply food to our growing global population using crop protection products that do not pose a significant risk to human health.

Henriquez chose to work at Corteva

Agriscience because he felt he would be able to make an impact on public health. We all need food and being able to do his part to ensure the safety of crop protection products used on global products was one way he felt he could have a larger influence. Still in the learning phase of his position, Henriquez hopes to continue to learn so that in the future he might have opportunities with even greater impact, perhaps by influencing policy or adoption of more relevant toxicological evaluations to human health. Henriquez commented, "I feel that being a regulatory toxicologist enables me to learn many of the skills I will need to reach this goal, including how to interact and build networks both within my company, between companies, and with regulatory agencies."

Henriquez was grateful for his time as an EITS student, "Training with various methods of toxicological evaluation, such as PBPK modeling and in vitro immunotoxicological assays, made me comfortable with alternative approaches to toxicological evaluations, which is the direction that most regulatory agencies and the industry as a whole are moving toward." 🍀

At a glance:

Department: Pharmacology & Toxicology

Mentor: Norbert Kaminski

Dissertation:

"*Δ9-Tetrahydrocannabinol-mediated Suppression of the Interferon- α (IFN α) response by Plasmacytoid Dendritic Cells (pDC) and IFN α -mediated Activation of T Cells in Healthy and Human Immunodeficiency Virus (HIV) Infected Human Donors*"

Defended: July 2018

Significant Achievements During Graduate School:

- » 2017: Best Paper Award, MSU Department of Pharmacology and Toxicology
- » 2017: 3rd Place - Best Presentation by a Student, Immunotoxicology Specialty Section, SOT
- » 2016: 1st Place Graduate Student Poster Presentation, Michigan Society of Toxicology
- » 2015: 1st Place Graduate Student Poster Presentation, Michigan Society of Toxicology
- » 2014-2018: Broadening Experiences in Scientific Training (BEST) Scholar, National Institutes of Health

FACULTY FEATURES



Patricia Ganey

Professor, Pharmacology and Toxicology

The pull of discovery, of being the first person to learn something, was what drove Patricia Ganey towards an education and career in science. She began with her undergraduate experience at the University of Maryland which allowed her to craft her own program with an emphasis on chemistry. After graduating with her B.S. in Biological Sciences, Ganey set her sights on real life experience and traveled the country for three months with friends – camping, hiking, and visiting National Parks on a trip of a lifetime. Ready to get back to work, Ganey accepted a position in Maryland as an analytical chemist for a company doing toxicity testing. This was where her interest in toxicology bloomed and after taking a course in toxicology at night, she knew she wanted to pursue graduate school to learn more.

Ganey's next move came when she chose MSU as the place to earn her Ph.D. in Pharmacology and Toxicology. She then completed a postdoctoral position at the University of North Carolina. Although her graduate thesis work had focused on the lung, at UNC Ganey worked for a researcher focused on the liver. Her work there spurred her on to start thinking about macrophages in the

liver and how that might relate to liver toxicity. When she joined the MSU faculty in 1990, Ganey's first funded grant was to study the role of macrophages in liver toxicity, setting her up on her path of research in inflammation. Ganey still finds inflammation a fascinating topic, "We think of it a lot differently now than we did when I was a graduate student. We know so much more about the components and the molecular mechanisms, but it is still just fascinating to me."

Ganey chose to return to MSU because she knew, as a young faculty member, that it would be important to form collaborations. "The wonderful thing about MSU is there are so many people on campus open to the possibility of collaboration," said Ganey. She has chosen to remain on campus for that same reason, in addition to her success in receiving funding and the community and family she has built around her in East Lansing.

Today, Ganey's research interests lie in the interaction of inflammation and chemically-induced liver injury. For many chemicals of diverse structure and mechanism of action, ongoing inflammation makes the liver more sensitive to toxic effects. Among the chemicals for

which this is true are some drugs and environmental contaminants. Dr. Ganey's research focus is on understanding the mechanisms by which inflammation causes this change in sensitivity. She studies inflammatory cells, including neutrophils and liver macrophages, as well as soluble mediators, like cytokines. A current project is aimed at development of assays that identify drugs that have the potential to cause idiosyncratic liver injury in people.

When drugs cause toxicity they fall into two big categories – dose-dependent toxicity and idiosyncratic toxicity. Idiosyncratic toxicities are drug reactions that occur rarely and unpredictably amongst the population. These reactions are a problem for human health because most often, when these reactions occur, the drug is removed from the market. The large majority of the population deriving benefit from that drug no longer have that option available for treatment due to the idiosyncratic toxicities that may have occurred in an extremely small population of users. The goal for Ganey and her laboratory is to create predictive methods that could foresee idiosyncrasies before a drug is released to the general market.

Using what they have learned from animal models of drug/inflammation interaction the Ganey and Roth laboratories have developed an in vitro assay that correctly identifies drugs known to cause idiosyncratic liver injury in people. A patent is currently pending on this project and Ganey and Roth are working with industry partner, ION-TOX, to further develop the assay.

As for the future, Ganey looks forward to retirement in another year with Dr. Robert Roth, her husband of 28 years. The pull of discovery has led her down many paths over the course of her career and she hopes that the legacy she leaves behind, through the students and post-docs she has trained and the research from the lab, has helped to move the field forward in trying to understand drug-induced liver injury, especially how inflammation can impact those responses. ♣



Sudin Bhattacharya

Assistant Professor, Biomedical Engineering,
Pharmacology and Toxicology

Sudin Bhattacharya grew up in India in a family of engineers – his father is a retired civil engineer who designed bridges, palaces and major road developments, and his brother is a mechanical engineer in the automotive industry. Bhattacharya excelled in an environment that encouraged science and math during grade school in India and decided to pursue his post-secondary education in engineering. After earning his B.M.E. in Mechanical Engineering from Jadavpur University, Bhattacharya came to the United States and earned his Master's in Mechanical Engineering from the University of Kentucky, followed by a Ph.D. at the University of Michigan. Even as he was working on his Ph.D. in Mechanical Engineering, some threads that led him to his career in computational toxicology today began to take shape.

While at U of M, Bhattacharya had a very mixed board of friends and collaborators who opened his eyes to some new areas of science he hadn't yet discovered. A course at the U of M Center for the Study of Complex Systems, which ended up being very interdisciplinary and encouraged thinking across fields, lit Bhattacharya's interest in a more interdisciplinary approach to science. During this time, Bhattacharya also attended a summer course in "Complex Systems Modeling" at the Santa Fe Institute in

New Mexico that reignited a fascination with the biological sciences. Bhattacharya realized there were lots of fundamental scientific questions left unanswered that ironically, his more quantitative and engineering background, could possibly help address. After doing some research on the up-and-coming fields of computational biology, bioinformatics, and computational toxicology – Bhattacharya realized he could find a way to contribute to these fields with the education he had already received.

With his new interests in mind, Bhattacharya sought out a postdoctoral position with the Computational Biology group at The Hamner Institutes for Health Sciences, who at the time, were working with IIT's Superfund Research Center as part of the Computational Core. "I realized I had a unique niche – I had a set of quantitative skills and yet I was very interested in fundamental problems in biology and toxicology," said Bhattacharya. To bring the two together, he knew he needed a place where he could receive specialized training and that is what he found at the Hamner – good mentors, collaborators and peers to learn from in the science-rich environment of Research Triangle Park, North Carolina.

Having developed a working relationship with several of the MSU IIT

faculty while at The Hamner, including Drs. Norbert Kaminski, John LaPres, Tim Zacharewski, Robert Roth and Brad Upham, when the time came to look for another position, Bhattacharya put MSU at the top of his list. He joined MSU in 2015 as a fixed term faculty member with IIT, with the knowledge that some new departments that might interest him were being set up on campus. In 2017 he joined the Department of Biomedical Engineering and CRIS as a Tenure-Track Assistant Professor and has really enjoyed being part of the initial thrust of computational toxicology research on campus.

Today, Bhattacharya's research interests include applications of single cell techniques in toxicology, as well as data science and machine learning techniques that can be applied to varied biological and toxicological problems. Bhattacharya's work focuses on bridging the gap between primarily statistical predictive models and more mechanistic mathematical models, which when used in conjunction can tell us more about the biological mechanisms and modes of action by which chemicals act to perturb cells and genes in our bodies. Specifically, Bhattacharya is studying how to predict Aryl Hydrocarbon receptor (AHR) binding sites and locations on our DNA where the receptor can attach and modulate target genes. Bhattacharya is using this research to determine if the general principles we learn from AHR binding to DNA can be extended to other transcription factors and nuclear receptors and to map the gene regulatory networks they mediate.

Bhattacharya is very interested in the questions, "Are there sections of the genome that are specifically "plastic" and act as early responders to a toxic perturbation? Also, how does the genome and epi-genome gear up to counter toxic challenges from the environment?" Bhattacharya finds science moving increasingly towards integration of experimental and computational methodologies, and believes that eventually there will be less of a separation between "wet" and "dry" labs in the biosciences and toxicology. Instead, he looks forward to a future where labs will have an interdisciplinary team, allowing a richer scientific discovery process. Bhattacharya is proud to be at the forefront of this movement forward in science. 🌱



Karen Liby

Associate Professor, Pharmacology and Toxicology

Karen Liby had a passion for science and math coursework from the beginning of her school days. It was no surprise that when she went to Hillsdale College to earn her bachelor's, she studied Biology and Chemistry (and History) and really enjoyed the combination of both sciences. She went on to earn her Masters degree in Human Anatomy from Palmer College before then heading to the University of Cincinnati College of Medicine to earn her Ph.D. in Cell and Molecular Biology, where her graduate project focused on cancer biology. Wanting to do something more translational, Liby chose a postdoctoral opportunity in a laboratory at Dartmouth Medical School that focused on drug discovery. Expecting to stay for five years, Liby stayed at Dartmouth for 12.5 years when a compound discovered in the chemistry department went all the way into clinical trials. Liby found it fascinating to be involved in the translational aspect of drug discovery – seeing a compound go from the chemistry department all the way to patients and a pending FDA approval was very exciting.

With a passion for drug discovery, Liby chose to come to MSU to join the Department of Pharmacology and Toxicology and their emerging drug discovery efforts led by Rick Neubig. “One of the things I noticed when I interviewed here was that there are no barriers for

collaboration. It is a big enough campus that there is expertise in so many different areas.” Today, Liby’s laboratory at MSU studies the role of inflammation in cancer and develops and tests new drugs for the prevention or treatment of cancer and other chronic diseases. Lung cancer, pancreatic cancer and a subset of breast cancer (estrogen receptor negative or ER-) are three of the leading causes of cancer death, and Liby and her team use the most relevant mouse models available of these diseases to study the development of these cancers and to test new drugs.

Multiple projects are ongoing in the Liby laboratory. Two of those projects are funded by the University of Michigan MTRAC for Life Sciences Innovation Hub, a statewide program that supports translational research projects in life sciences with high commercial potential. Liby works with Dr. Edmund Ellsworth, who runs a medicinal chemistry lab here at MSU, on the MiTRAC award for their project, “Novel Reginoids for Oncology.” Reginoids, selective ligands for retinoid X receptors, regulate important pathways relevant in cancer, making them promising targets for drug development. While there is a current FDA approved rexinoid in use, it doesn’t have the effects on immune cells that Liby and Ellsworth are seeing with their new compounds. The newer rexinoids that

their team is studying are exceptionally effective for both prevention and treatment in many clinically relevant mouse models, especially in lung and pancreatic tumors or in models of HER2+ breast cancer. With the MiTRAC funding, Liby and Ellsworth will evaluate the in vivo efficacy, pharmacokinetics, safety and mechanism of their lead compound.

Liby’s other MTRAC project, “Novel Nrf2 inhibitors,” with Dr. Aaron Odom is a Mi-Kickstart award. At least 30 percent of new lung cancer cases each year are driven by mutations in the NFE2L2 or Keap1 genes, which cause constitutive activation of the Nrf2 cytoprotective pathway. No currently available drugs effectively target Nrf2, even though Nrf2 mutations enhance tumor growth and resistance to chemotherapy and thus reduce overall survival. Using a high throughput screen of MSU libraries and compounds, Liby and Odom identified a novel Nrf2 inhibitor. With the MiTRAC award, they hope to synthesize additional compounds to improve physical properties and the best derivative will be evaluated in vivo in a relevant lung cancer model, alone and in combination with chemotherapy.

Liby also collaborates with fellow IIT-affiliated faculty member, Cheryl Rockwell, as well as EITS student, Di Zhang, on an R01 grant from NIH on “Nrf2, immune cells and lung cancer.” The team discovered unexpectedly that there is an immune signature in lung cancer in lungs of Nrf2 knockout mice, similar to what you see in humans. This finding begged the question, “Can you use an activator of Nrf2 in lung cancer to activate the immune cells to treat lung cancer?” In this first year of their five year grant, their team is putting in place the tools to do further studies. They hope to determine the consequences of using pharmacological activators and inhibitors of the Nrf2 pathway on immune cells and the prevention or treatment of lung cancer in order to optimize intervention strategies for lung cancer.

Lastly, Liby continues to receive funding from the Breast Cancer Research Foundation to develop new drugs and approaches for prevention of triple negative breast cancer, specifically BRCA-deficient tumors or hereditary breast cancer. Currently, the only effective pre-

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IIT FACULTY EXCELLENCE



Dr. William Atchison, received the 2019 Distinguished Neurotoxicologist Award from the SOT Neurotoxicology Specialty Section. Dr. Atchison has demonstrated a life-long commitment to neurotoxicology with significant research contributions to neurotoxicology, neuropharmacology, and neurobiology. His work has significantly advanced the understanding of metal neurotoxicity, particularly the cellular mechanisms of methyl mercury toxicity.

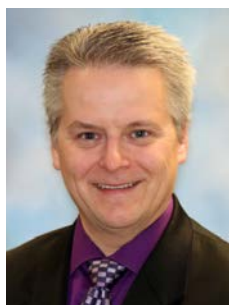


Dr. Sudin Bhattacharya won the Edward Carney Award for Predictive Toxicology at the 2018 Annual Meeting of the American Society for Cellular and Computational Toxicology (AS-CCT) held in Bethesda, Maryland. The annual award is given to recognize excellence in predictive toxicology and 2018 marks the fourth year the award has been bestowed. Bhattacharya received the award for his presentation, “*Integrating Genomics and Epigenomics into Predictive Toxicology of the Aryl Hydrocarbon Receptor.*”



Dr. Jay Goodman, professor of pharmacology and toxicology and IIT-affiliated faculty member, was recently awarded the distinction of Fellow by the American Association for the Advancement of Science (AAAS). Goodman was selected for this honor because of his efforts toward advancing science applications that are deemed scientifically or socially distinguished.

Dr. Goodman was also awarded Honorary Membership in the Federation of European Toxicologists and European Societies of Toxicology (EUROTOX). He is the first non-European to receive this award.



Dr. John Goudreau has been named the Michigan State University College of Osteopathic Medicine’s associate dean for research. He also will be the co-director of the DO-PhD training program, a combined degree program where students are trained to become physician scientists. Dr. Goudreau has also been named the new director of the Clinical and Translational Sciences Institute at MSU. Goudreau has an outstand-

ing background in basic, translational and clinical research.



Dr. Jack Harke, is the recipient of the 2019 Thomas T. Mercer Joint Prize Award from the American Association of Aerosol Research (AAAR) and the International Society for Aerosols in Medicine (ISAM). The award recognizes excellence in the areas of pharmaceutical aerosols and inhalable materials. The award honors the legacy of Thomas T. Mercer, an outstanding researcher and author whose work encompassed aerosol physics and chemistry as well as inhalation toxicology, industrial hygiene, and health physics.



Dr. Norbert Kaminski will serve as the new Scientific Advisor for ILSI North America’s Food and Chemical Safety committee. In this role, Dr. Kaminski will help ensure the saliency of the scientific output from work produced by the many sub-committees.

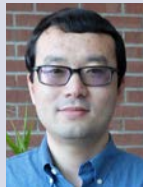
Kaminski was also elected to the Toxicology Forum Board of Directors, with his term beginning in October 2019.

Three New Faculty Join IIT in 2019



Dr. Leon Bruner
IIT Adjunct Faculty Member

Dr. Bruner is a 30-year veteran of the consumer products industry. Most recently, Dr. Bruner served as executive Vice President for Science & Regulatory Affairs and Chief Science Officer at the Grocery Manufacturer’s Association (GMA).



Dr. Jinpeng Li
Assistant Professor, Center for Research on Ingredient Safety

Dr. Li is a cellular and molecular toxicologist interested in better understanding and promoting the safe use of chemicals to protect as well as enhance public health.



Dr. Neera Tewari-Singh
Assistant Professor, Pharmacology & Toxicology

Dr. Tewari-Singh’s research pursues both basic and translational studies to develop approved and more effective targeted countermeasures/therapies against mainly the dermal and ocular injuries from chemical threat agent exposures.

AND ACHIEVEMENTS 2019



Dr. Gina Leininger is the 2019-20 recipient of the American Physiology Society's (APS), Central Nervous System Section New Investigator Award. The society's

New Investigator Award recognizes outstanding scientists in the early stages of their career who have made significant contributions and show great promise in their field of study.



Dr. Karen Liby, was recently selected for a Mi-Kickstart award from the University of Michigan MTRAC for Life Sciences Innovation Hub for her project, "Novel *Nrf2* Inhibitors." She also

received a Mi-TRAC award in 2019 for her project, "Novel *Rexinoids* for Oncology." Liby is an associate professor in the Department of Pharmacology and Toxicology.



Dr. Michelle Mazei-Robison received the 2019 Division for Neuropharmacology Early Career Award from the American Society for Pharmacology and Experimental Therapeutics (AS-

PET) Division for Neuropharmacology. The award was established to honor a young independent investigator working in neuropharmacology.



Dr. Laura McCabe, was recently named a MSU Foundation Professor, a designation given to outstanding faculty who demonstrate excellence in research and teaching while enhancing

the prominence of the institution. McCabe and three other professors joined the ranks of 36 fellow colleagues who have been named Foundation Professors in MSU history.



Dr. Ilce Medina Meza was selected to participate in the IFT Emerging Leaders Network Program which took place at the Institute for Food Technologists 2019 Annual Meeting in New Orleans, LA.



Dr. Cheryl Murphy recently received the Chandler-Misener Award from the Journal of Great Lakes Research, along with a team of three other MSU Department of Fisheries and

Wildlife researchers. The Chandler-Misener Award was created in 1974 to honor D.C. Chandler and A.D. Misener, the International Association for Great Lakes Research's first presidents. The award is presented to the authors of the "most notable" peer-reviewed paper in the current edition of the Journal of Great Lakes Research.



Dr. Cheryl Rockwell received the 2019 Toxicology Early Career Award from the American Society for Pharmacology and Experimental Therapeutics (AS-PET) Division for Toxicology. The

award was established to recognize excellent original research by early career investigators in the area of toxicology.



Dr. Neera Tewari-Singh, was recently awarded a \$1.423 million U01 grant from the National Institutes of Health - Countermeasures Against Chemical Threats Program (CounterACT) and National

Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS) for her project, "Targeted Therapeutic Approaches to Counteract Toxicity from Phosgene Oxime Skin Exposure."



Dr. Matthew Zwiernik was appointed to the Environmental Protection Agency Science Advisory Board (SAB) for a 3 year term beginning in January 2019. ♡

...Liby continued from page 15

vention strategy is prophylactic removal of the breast and ovaries. Liby focuses on immune cells that promote breast cancer cell growth and their role in triple nega-

tive breast cancer. She has identified a novel PARP inhibitor drug that blocks immune-cell activity. In collaboration with Dr. Sridhar at Northeastern University, Liby is working on incorporating

nanoparticle technology to enhance the efficacy and safety of these drugs. ♡



FACULTY PUBLICATIONS

During the 2018-2019 academic year, IIT affiliated faculty published more than 200 peer-reviewed articles. As a result, the IIT, and MSU research, has been highly visible in prominent peer-reviewed literature. The publications below are from July 1, 2018 to June 30, 2019.

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Amalfitano A, Martini C, Nocca G, Papi M, De Spirito M, Sanguinetti M, Vitali A, Bugli F, Arcovito A (2019). A protein chimeric self-assembling unit for drug delivery. *Biotechnol Prog.* 35(2):e2769. PubMed PMID: 30575331.

O'Connell P, Pepelyayeva Y, Blake MK, Hyslop S, Crawford RB, Rizzo MD, Pereira-Hicks C, Godbhere S, Dale L, Gulick P, Kaminski NE, Amalfitano A, Aldhamen YA (2019). SLAMF7 Is a Critical Negative Regulator of IFN- α -Mediated CXCL10 Production in Chronic HIV Infection. *J Immunol.* 202(1):228-238. PubMed PMID: 30530590.

Pepelyayeva Y, Rastall DPW, Aldhamen YA, O'Connell P, Raetz S, Alyaqoub FS, Blake MK, Raedy AM, Angarita AM, Abbas AM, Pereira-Hicks CN, Roosa SG, McCabe L, Amalfitano A (2018). ERAP1 deficient mice have reduced Type 1 regulatory T cells and develop skeletal and intestinal features of Ankylosing Spondylitis. *Sci Rep.* 8(1):12464. PubMed PMID: 30127455.

Andrechek, Eran R.

Swiatnicki MR, Andrechek ER (2019). How to Choose a Mouse Model of Breast Cancer, a Genomic Perspective. *J Mammary Gland Biol Neoplasia*. Review. PubMed PMID: 31227983.

Liu K, Newbury PA, Glicksberg BS, Zeng WZD, Paithankar S, Andrechek ER, Chen B (2019). Evaluating cell lines as models for metastatic breast cancer through integrative analysis of genomic data. *Nat Commun*. 10(1):2138. PubMed PMID: 31092827.

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Bernard, Jamie J.

Bernard JJ, Gallo RL, Krutmann J (2019). Photoimmunology: how ultraviolet radiation affects the immune system. *Nat Rev Immunol*. Review. PubMed PMID: 31213673.

Chakraborty D, Bernard JJ (2019). Lipectomizing Mice for Applications in Metabolism. *Methods Mol Biol*. 1862:245-250. PubMed PMID: 30315472.

Bernstein, Alison I.

Kochmanski J, VanOeveren SE, Patterson JR, Bernstein AI (2019). Developmental Diethylstilbestrol Exposure Alters DNA Methylation at Genes Related to Dopaminergic Neuron Development and Parkinson's Disease in Mouse Midbrain. *Toxicol Sci*. 169(2):593-607. PubMed PMID: 30859219.

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Gasior K, Wagner NJ, Cores J, Caspar R, Wilson A, Bhattacharya S, Hauck ML (2019). The role of cellular contact and TGF-beta signaling in the activation of the epithelial mesenchymal transition (EMT). *Cell Adh Migr*. 13(1):63-75. PubMed PMID: 30296203.

Zhang Q, Caudle WM, Pi J, Bhattacharya S, Andersen ME, Kaminski NE, Conolly RB (2019). Embracing Systems Toxicology at Single-Cell Resolution. *Curr Opin Toxicol*. 16:49-57. PubMed PMID: 31768481.

Bourquin, Leslie D.

Abdirahman ZZ, Bourquin LD, Sauvée L, Thiagarajan DG (2018). Food safety implementation in the perspective of network learning. *International Journal of Food Studies* 7:17-29.

Bourquin LD, Thiagarajan D (2018). Spillover Effects of Export-Oriented SPS Technical Assistance on the Domestic Food Safety Situation. Final Report for the WTO Standards and Trade Facility, October 2018. https://www.standardsfacility.org/sites/default/files/STDF_PPG_535_Final_Report.pdf.

Boyd, Stephen A.

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Li Y, Chuang YH, Sallach JB, Zhang W, Boyd SA, Li H (2018). Potential metabolism of pharmaceuticals in radish: Comparison of in vivo and in vitro exposure. *Environ Pollut*. 242(Pt A):962-969. PubMed PMID: 30373041.

Sallach JB, Crawford R, Li H, Johnston CT, Teppen BJ, Kaminski NE, Boyd SA (2019). Activated carbons of varying pore structure eliminate the bioavailability of 2,3,7,8-tetrachlorodibenzo-p-dioxin to a mammalian (mouse) model. *Sci Total Environ*. 650(Pt 2):2231-2238. PubMed PMID: 30292116.

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- Wagner JG, Millerick-May ML (2019). "Respiratory Toxicology" in *Toxicology Principles for the Industrial Hygienist*, 2nd Edition; WE Luttrell, J Church, KR Still, Eds. AIHA, Fairfax, VA.
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- Wu, Felicia**
- Liverpool-Tasie LSO, Turna NS, Ademola O, Obadina A, Wu F (2019). The occurrence and co-occurrence of aflatoxin and fumonisin along the maize value chain in southwest Nigeria. *Food Chem Toxicol*. 129:458-465. PubMed PMID: 31085221.
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FACULTY PROFESSIONAL SERVICE

The affiliated faculty of the IIT participate in many external activities that promote the development of research and science in their chosen field. These activities include editorial boards, review groups or study sections, scientific advisory boards and committees, and officers in scientific societies. The professional service activities below are from July 1, 2018 to June 30, 2019.

Andrechek, Eran

- » Editorial Board, Present Journal of Mammary Gland Biology and Neoplasia
- » Metastasis Research Society Outreach Group 1
- » Study Section Member: Swiss National Science Foundation, NY State Rowley Grant Reviewer, DoD Study Section, Swiss National Science Foundation Review, NCI PAR Special Emphasis Study Section, NIH TCB Study Section (Ad Hoc),

NIH ZRGI BMCT-CI Study Section (Ad Hoc)

Bernard, Jamie J.

- » Secretary/ Treasurer, Carcinogenesis Specialty Section, Society of Toxicology
- » Current Concepts in Toxicology Committee Member for SOT

Bernstein, Alison I.

- » Reviewer: Physiology and Behavior, BMC Genomics, Journal of

Neuropathology & Experimental Neurology, Frontiers in Neurology, Frontiers in Neuroscience

- » Guest Editor, Frontiers in Genetics

Bhattacharya, Sudin

- » President, Michigan SOT Regional Chapter
- » Secretary, SOT Computational Toxicology Specialty Section

Bourquin, Leslie D.

- » Chair, NSF International Global

Food Safety Advisory Council

- » Consumer Goods Forum, Global Food Safety Initiative - GFSI Technical Committee Member, Vice Chair of Global Markets Primary Production Technical Working Group, Member of GFSI Primary Production Task Force
- » Technical Advisory Network Member, Food Safety Preventive Controls Alliance
- » Editorial Board, Foods Journal

Boyd, Stephen A.

- » Consultant, Michigan Farm Bureau (regarding PCB uptake by soybeans)
- » Member and Past Chair, Technical Assistance Group, Pine River Superfund Citizen Task Force (Velsicol Superfund Site)
- » Consulting Editor, Soil Science

Bursian, Steven J.

- » Member, Health Advisory Board of NSF International

Carignan, Courtney

- » Chair, Mentoring Committee for the International Society of Exposure Science
- » Organizing Committee, Second National Conference on Per- and Polyfluoroalkyl Substances
- » Scientific Advisor, ATSDR Community Assistance Panel for Pease Tradeport
- » Ad-hoc reviewer: Environmental Health Perspectives, Journal of Exposure Science and Environmental Epidemiology, Thyroid, Environment International, Environmental Science and Technology, and Chemosphere
- » Environmental Science and Policy Program Advisory Council
- » Emerging Issues Committee, Center for Research on Ingredient Safety
- » CANR PFAS Working Group
- » Advisory Role, MSU Extension PFAS Contamination Response
- » Food Science Curriculum Committee

- » Food Science and Human Nutrition Awards Committee

Copple, Bryan L.

- » Study section member, Hepatobiliary Pathophysiology (HBPP)

Doseff, Andrea

- » Director, Physiology Graduate Program
- » Director, Post-baccalaureate Graduate Program SiGuE (Success in Graduate Education)
- » Associate Editor, Journal of Pharmacology and Therapeutics
- » Grand Rounds Sparrow, Presentation 2/26/2019 - Targeting the Immune System with Flavonoid Rich Diets: A Journey of Team Science and Translational Research
- » Co-Chair, American Heart Association Study Section
- » National Institute of Health. Study Section Immunology and Immunotherapy
- » Service at MSU: Council on Diversity and Community (CDC), College of Natural Sciences, CNS Graduate Education Strategic Plan Committee, Graduate School Strategic Plan, Graduate School Mentoring Task Force

Ewart, Susan L.

- » Reviewer, Microbiology and Infectious Diseases Research Committee (MID), National Institutes of Health
- » Reviewer, Stimulating Access to Research in Residency (StARR) (R38) ZAI1 AMC-A MICommittee, National Institutes of Health/NIAID

Ganey, Patricia E.

- » Editorial Board, Journal of Toxicology and Environmental Health
- » Editorial Board, Toxicology
- » Councilor, International Union of Toxicologists for the SOT
- » Past President, Society of Toxicology

Goodman, Jay I.

- » Editorial Board, Toxicology
- » Associate Editor, Regulatory Pharmacology and Toxicology
- » Member, Board of Directors, Toxicology Forum
- » Member of the Nominating Committee, Society of Toxicology
- » Member of the Committee to Evaluate the IRIS (US Environmental Protection Agency's Integrated Risk Information System) Protocol for Inorganic Arsenic, National Academies of Science, National Research Council, Board on Environmental Studies and Toxicology

Gulbransen, Brian D.

- » Chair of 2019 American Neurogastroenterology and Motility Society (ANMS) Young Investigator Forum, Chicago, IL, USA
- » Member, Digestive Disease Week (DDW) 2020 Abstract Review; American Gastroenterological Association (AGA); Enteric Neurobiology Section: Cell and Molecular Biology (Including Neurons, Glia, ICC, Smooth Muscle and Stem Cells)
- » Member, Little Brain Big Brain Application Review Committee
- » Member, Michigan Physiological Society Awards Committee
- » Member, American Physiological Society GI & Liver Physiology Section Trainee Development Committee
- » Member, Michigan State University Institutional Animal Care and Use Committee (IACUC)
- » Member, Michigan State University Department of Physiology Research Committee (Chair 2018-2019)
- » Member, Crohn's and Colitis Foundation National Scientific Advisory Committee (NSAC), Research Awards Committee
- » Regular Member, NIH, NIDDK DDK-C 2018/05 DDK-C subcommittee
- » Ad-hoc Member, NIH, Panel

2019/08 ZRGI ETTN-B (71) R

- » Member, American Neurogastroenterology and Motility Society Small Grants Program Review Committee
- » Guest Associate Editor, Cellular and Molecular Gastroenterology and Hepatology (CMGH)
- » Editor, Neurogastroenterology and Motility
- » Associate Reviews Editor, Experimental Physiology

Harkema, Jack R.

- » Co-chair, Society of Toxicologic Pathology Scientific Program Committee
- » Co-chair, 2019 Society of Toxicologic Pathology 38th Annual Symposium, Environmental Toxicologic Pathology and One Health, Raleigh, NC, June 22-27, 2019

Hayes, A. Wallace

- » Co-chairperson. Workshop: Where Has It Gone: Reproducibility, Bias and Translatability. American College of Toxicology. West Palm Beach, FL November 6, 2018
- » Chairperson and Speaker, Overview of Toxicology of the FAAH Inhibitor BIA 10-2474. In Overview of Toxicology, Mode of Action and Pharmacology of the FAAH Inhibitor BIA 10-2474. American College of Toxicology, West Palm Beach, FL November 7, 2018
- » Invited Speaker. History of the Rodent Cancer Bioassay in Chemical Risk Assessment and What Did We learn? Society of Toxicology Annual Meeting. Baltimore MD, March 11, 2019
- » Organizer/Chairperson/Speaker. Workshop: Alternatives to Animal Use in Risk Assessment of Mixtures. Cuban Society of Animal Laboratory Sciences and Cuban Society of Toxicology. Havana, Cuba. April 12, 2019
- » Member, SOT/FDA Colloquium Organizing Committee. Society of Toxicology/Food and Drug Administration. 2019-present
- » Invited Speaker, History and Toxicology of Marijuana. New Cannabis Frontiers in Public Health, Medical Science, and Food Safety. International Food Technology. New Orleans, LA June 5, 2019

colony of Marijuana. New Cannabis Frontiers in Public Health, Medical Science, and Food Safety. International Food Technology. New Orleans, LA June 5, 2019

- » Member, Scientific Committee, 24th Interdisciplinary Toxicology Conference, Toxcon 2019, June, 2019, Vyhne, Slovakia
- » Keynote Lecture. Integrating New Emerging Science into the Risk Assessment Paradigm. Toxcon 2019. Vyhne, Slovakia. June 26, 2019
- » Chairperson. Session 1. The New Toxicology: Mixtures. Toxcon 2019, Vyhne, Slovakia, June 26, 2019
- » Keynote Lecture, Risk Assessment and Cosmetic World. 2019 International Symposium for Risk Assessment in Cosmetic Products, Ministry of Food and Drug Safety. Seoul, Korea, September 23, 2019
- » Plenary Presentation, Approaches for Mixtures. XI Mexican Congress of Toxicology. San Luis Potosi, Mexico. September 25, 2019
- » Invited Speaker, Proposed Approaches for Mixtures. In Science Session III – How Can New Technology Impact Research Studies? ILSI 2019 Annual Meeting, Clearwater, FL. January 8, 2019
- » Invited Speaker, History of Cannabis and Introduction to the Spectrum of Cannabinoids Toxicology. In The Re-Emergence of Cannabis: New Frontiers in the Potentials and Pitfalls of Inhalation and Oral Exposure. 43th Annual Winter Meeting, Toxicology Forum, Crystal City, Virginia, January 30, 2019
- » Moderator, SOT FDA Colloquia on Emerging Toxicological Science: Challenges in Food and Ingredient Safety, Redesigning the Rodent Bioassay for the 21st Century, Wiley Auditorium, US FDA, CFSAN, College Park, MD, February 20, 2019
- » Chairperson, Scientific and Regulatory Update in the Application of the 3Rs Principle in Chemical and Drug Development. Society of Toxicology Annual Meeting. Baltimore MD, March 13, 2019

- » Invited Speaker. History of the Rodent Cancer Bioassay in Chemical Risk Assessment and What Did We learn? Society of Toxicology Annual Meeting. Baltimore MD, March 11, 2019
- » Organizer/Chairperson/Speaker. Workshop: Alternatives to Animal Use in Risk Assessment of Mixtures. Cuban Society of Animal Laboratory Sciences and Cuban Society of Toxicology. Havana, Cuba. April 12, 2019
- » Member, SOT/FDA Colloquium Organizing Committee. Society of Toxicology/Food and Drug Administration. 2019-present

Hegg, Colleen C.

- » Reviewer, NIH NIDCD Fellowship Application review
- » Co-Chair, Judging, College of Veterinary Medicine Phi Zeta Research Day
- » Director, Comparative Medicine & Integrative Biology Graduate Program

Hollingworth, Robert M.

- » Officer, Agrochemicals Division, American Chemical Society

Jackson, James E.

- » Member, American Chemical Society
- » Member, National Academy of Inventors
- » Member, Michigan Green Chemistry Round Table
- » Member (and past chair), Meridian Township Environmental Commission
- » Member, Brownfield Redevelopment Authority, Meridian Township, MI

Jones, A. Daniel

- » Review Editor, Frontiers in Plant Metabolism and Chemodiversity
- » Secretary and Executive Board member, Metabolomics Association of North America
- » Scientific Organizing Committee member, MANA2019 Conference

- » Scientific Advisory Panel, Michigan PFAS Action Response Team, State of Michigan
- » NIH CSR Special Emphasis Panel, 2019/01 ZRG1 BCMB-T(30), (Shared and High-End Instrumentation for Mass Spectrometry Applications); September 2018
- » NIH Special Emphasis Panel ZRG1 OTC-J (55)S (Innovative Basic Research on Adducts in Cancer Risk Identification and Prevention), November 2018
- » NIH Special Emphasis Panel 2019/05 ZRG1 IMST-K (02) M (Member Conflict - Interdisciplinary Molecular Sciences and Training), February 2019
- » Ad hoc proposal reviewer: Canada Foundation for Innovation, August 2018

Kaminski, Norbert E.

- » Chair, External Review Committee for the Interdisciplinary Program in Toxicology at Texas A&M University
- » Past President, Society of Toxicology
- » NIEHS National Advisory Environmental Health Sciences Council
- » Member, National Academy of Sciences, Committee on the Use of Emerging Science for Environmental Health Decisions
- » Member, Joint Committee for NSF/ANSI Standard 500 GRAS-PAS Ingredient Review
- » Member, National Academy of Sciences, Institute of Medicine Committee on the Health Effects of Marijuana
- » Editorial Board, Toxicology

LaPres, John J.

- » Associate Editor, Toxicology Reports
- » Grant Reviewer, Congressionally Directed Medical Research Programs

Lee, Kin Sing

- » Reviewer: Journal of Medicinal Chemistry, Journal of Fluorine Chemistry, ChemMedChem, ACS Neuroscience
- » Organizer, 45th Michigan Pharmacology Colloquium

Leininger, Gina M.

- » Ad hoc Reviewer: Diabetes, Journal of Neuroscience, Nature Communications, Nature Medicine, Neuropeptides, Neuropharmacology, Scientific Reports
- » Society Service: The Obesity Society Annual Program Committee
- » Abstract Reviewer: The Endocrine Society, The Obesity Society, The American Diabetes Association
- » Grant Reviewer: NIDDK Fellowships Panel

Li, Ning

- » Section Editor, Drug and Chemical Toxicology
- » Manuscript Reviewer: Toxicology Letters, Atmospheric Environment, Journal of Allergy and Clinical Immunology, Science of the Total Environment, Allergy

Liby, Karen T.

- » Editorial Board, AACR Cancer Prevention Research
- » Editorial Board, Scientific Reports
- » ASPET Summer Undergraduate Research Fellowship (SURF) director at MSU
- » Member, PREVENT Program Scientific Review Panel
- » Member, AACR Breast Cancer Research Grants Scientific Review Committee
- » Member, Pancreatic Cancer Action Network, 2019 Translational Research Grant Scientific Review Panel
- » Reviewer, Wellcome Trust Sir Henry Dale Fellowship Proposal
- » Reviewer, NIH F30/F31/F31 Fellowship Review Panel: Cancer Immunology and Immunotherapy

Luyendyk, James P.

- » Standing member, XNDA Study Section
- » Chair, SOT Committee for Diversity Initiatives
- » Senior Councilor, Mechanisms Specialty Section, Society of Toxicology

- » Editorial Board, Journal of Thrombosis and Haemostasis
- » Editorial Board, Toxicological Sciences

Mansfield, Linda S.

- » Appointed as Albert C. and Lois E. Dehn Endowed Chair
- » Study Section Member, National Institutes of Health, National Institute of Allergy and Infectious Diseases Branch, Standing NIH Study Section, Immunity and Host Defense Study Section (IHD), Scott Jakes SRO
- » Member: Society for Mucosal Immunology, American Society for Microbiology, Conference of Research Workers in Animal Diseases, American Associations of Veterinary Immunologists, World Association for the Advancement of Parasitology, American Association for the Advancement of Science, American Veterinary Medical Association, Michigan Veterinary Medical Association, American Association of Veterinary Parasitologists

Mazei-Robison, Michelle

- » American College of Neuropsychopharmacology (ACNP) Women's Task Force
- » ASPET Division for Neuropharmacology Program Committee
- » ASPET Division for Neuropharmacology Executive Committee
- » Catecholamine Society, Councilor

McCabe, Laura

- » Women in Bone and Mineral Research Committee, American Society of Bone and Mineral Research
- » FASEB Science Policy Committee, FASEB
- » Grant Program Council and Operating Committee For Cores, Michigan Diabetes Research and Training Center/Translational Research
- » Faculty Steering Committee and FDP Executive Committee, Federal Demonstration Partnership
- » Chair, Science Policy Committee,

- American Physiological Society
- » Animal Care and Experimentation Committee, American Physiological Society
- » SPC Chair Member, Council, American Physiological Society
- » Associate Editor, Journal of Cellular Biochemistry, Molecular Biology Reports, World Journal of Diabetes
- » Editorial Board, Physiological Reviews
- » Grant Review Panels: NIH Skeletal Biology Development and Disease Study Section Member, NIH ZDK1 GRB-B MI LRP Review, European Calcified Tissue Society – External Grant Reviewer

Medina Meza, Ilce G.

- » Editorial Board, Food Research International

Masako, Morishita

- » Study Section Peer Reviewer: NIH R01 RFA-CA19-009: U.S.-China Program for Biomedical Collaborative Research, 2910/10 ZRGI OBT-M (50) R, Special Emphasis Panel/Scientific Review Group

Murphy, Cheryl A.

- » Steering Committee, High-Throughput Screening and Environmental Risk Assessment, SETAC North America
- » Associate Editor, Ecotoxicology
- » Reviewer for the NRC Research Associateship Programs (RAP) review panel
- » Wisconsin Sea Grant Preproposal and Full Proposal Panel Review Member
- » Reviewed Proposal for Center of Excellence sponsored by the European Science Foundation
- » Society for Environmental Toxicology, North America, Professional Awards Committee

Paneth, Nigel S.

- » External Advisory Committee, University of Pennsylvania MPH Program

- » Scientific and Editorial Board, Supercourse in Epidemiology, University of Pittsburgh
- » Scientific Advisory Group, Norwegian Mother and child Cohort (MoBa) and Danish National Birth Cohort (DNCCB) combined cerebral palsy study (MOBAND)
- » Executive Committee, ECHO Study (Environmental Influences on Child Health Outcomes), NIH, 2016-2018
- » External Advisor, Screening to Improve Health in Very Premature Infants in Europe (SHIPS) Study, INSERM, Paris, funded by European Commission, 2015-present

Petroff, Brian K.

- » Section Chief, Endocrinology, MSU Veterinary Diagnostic Laboratory

Robison, A.J.

- » Reviewer, Molecular Neuropharmacology and Signaling

Rockwell, Cheryl E.

- » Editorial Board, Molecular Pharmacology
- » Editorial Board, Pharmacological Research
- » Associate Editor, BMC Pharmacology & Toxicology
- » Ad hoc member, Systemic Injury by Environmental Exposure Study Section
- » Ad hoc member, Hypersensitivity, Allergy and Mucosal Immunology Study Section

Rosenman, Kenneth D.

- » Co-Leader, Occupational Health Work Group, Conference of State and Territorial Epidemiologists
- » Secretary, Board of Directors of the Michigan Occupational and Environmental Medical Association
- » Member, Michigan Pesticide Advisory Committee

Roth, Robert A.

- » Editorial Board, Journal of Toxicology and Environmental Health
- » Associate Editor, Journal of Pharmacology and Experimental Therapeutics
- » Member/Consultant, Technical Committee on the Application of Genomics to Mechanism-based Risk Assessment, ILSI, Health and Environmental Sciences Institute (HESI)
- » Member, NIH Study Section: Xenobiotic and Nutrient Disposition and Action
- » Member, Endowment Fund Board, Society of Toxicology
- » External Advisory Committee, Curriculum in Toxicology, University of North Carolina at Chapel Hill
- » External Advisory Committee, Graduate Program in Pharmacology, University of Kansas Medical Center

Rowlands, Craig

- » Member, US EPA Science Advisory Committee on Chemicals (SACC)
- » Member, US EPA TSCA PBT Panel
- » Member, Board of Directors, Johns Hopkins University, Center for Alternatives to Animal Testing (CAAT)

Sikarskie, James G.

- » Member, AVMA Committee on Environmental Issues

Tewari-Singh, Neera

- » Editorial Boards: Cutaneous and Ocular Toxicology, Francis and Taylor Journal
- » Faculty Advisory Committee, MSU Department of Pharmacology and Toxicology
- » Vice President, Dermal Toxicology Specialty Section, Society of Toxicology
- » Treasurer, Ocular Toxicology Specialty Section, Society of Toxicology
- » Chair and Organizer, Continuing Education Course Session: Beauty

of the Skin is in the Eye of the Beholder: A Basic Course on Dermal and Ocular Toxicology, Society of Toxicology 2019 Annual Meeting

Tiedje, James M.

- » Bioscience External Science Advisory Committee, Berkeley National Laboratory
- » Science Advisory Committee, Denmark's CENPERM (Cntr for Permafrost change in Greenland) Project
- » Appointed by NAS to the U.S. National Committee for Soil Science
- » Co-Chair of Amer Soc Microbiol Coalition on Antimicrobial Resistances
- » Plenary Closing Speaker at 5th Intl Environmental Dimensions of Antibiotic Resistance, Hong Kong
- » Plenary Closing Speaker at 17th Intl Symposium on Microbiol Ecology, Leipzig
- » Member of Science Advisory Comm for Consortium for Monitoring, Technology, and Verification (Nuclear Non-proliferation)
- » Member of Simons Foundation Bioscience Advisory Committee
- » Steering Comm member of NMDC (Nat'l Microbiome Data Collaborative)

Trosko, James

- » Member, Advisory Board to the MSU-COM Institute for Global Health
- » Reviewer for multiple scientific journals and grant reviews for international granting agencies (Italy, Brazil, Korea, Czech Republic, France)
- » Consultant to Dr. Mari Dezawa, Director of Human Stem Cell Research, Tohoku University, Sendai, Japan

Uhal, Bruce

- » Member, College of External Reviewers, European Science Foundation
- » Editorial Board Member, Frontiers in Pediatrics

Upham, Brad L.

- » Associate Editor, Journal of Toxicology
- » Associate Editor, BioMed Research International
- » Elected Officer: Member-at-Large (IVACS), Society of In Vitro Biology

Veiga-Lopez, Almudena

- » Chair, Graduate Student Affairs & Curriculum Committee, Department of Animal Sciences, Michigan State University
- » Reviewer, Scientific Reports, Toxicological Sciences, Environmental Pollution, Reproductive Toxicology, Endocrinology, Human Reproduction, Biology of Reproduction, Molecular Reproduction and Development, Journal of Ovarian Research, Fertility & Sterility
- » Ad hoc Abstract Reviewer, Endocrine Society Annual Meeting
- » Ad hoc Grant Reviewer, Michigan Alliance for Animal Agriculture Pilot Grants
- » Ad hoc Grant Reviewer, NIH Pathway to Independence Award Study Section (PA-18-397/8), National Institutes of Environmental Health (NIEHS/NIH).
- » Symposium Organizer, Diving deep: mechanisms of endocrine disruptors in pregnancy and relevant biomarkers, International Society of Exposure Science and the International Society for Environmental Epidemiology (ISEE-ISEE 2018), August 2018
- » Symposium Organizer, Endocrine Disruptors and Obesity-related Outcomes: Windows of Susceptibility in Women's Health, Obesity Society Annual Meeting, November 2018
- » Program Committee, Reproductive and Developmental Toxicology Specialty Section (RDTSS) of the Society of Toxicology
- » Co-organizer, Michigan Alliance for Reproductive Technologies (MARTS) Annual Meeting, East Lansing, MI, 2019

Wagner, James G.

- » Associate Editor, Inhalation Toxicology
- » Editorial Board, Particle and Fibre Toxicology
- » Member, Finance Committee, Society of Toxicology
- » Member, Program Committee, Environmental, Occupational and Population Health; American Thoracic Society
- » Member, Committee for Threshold Limit Values for Chemical Substances (TLV-CS); American Conference of Governmental Industrial Hygienists (ACGIH)

Wu, Felicia

- » Member, MSU Presidential Transition Committee
- » Member, MSU Presidential Search Committee
- » MSU AFRE Food Policy Search Committee
- » Area Editor, Risk Analysis
- » Section Editor, World Mycotoxin Journal
- » Editorial Board, Archives of Environmental and Occupational Health
- » Expert Reviewer, Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6)

Zacharewski, Timothy R.

- » Editorial Board, Toxicological Sciences
- » Editorial Board, Toxicology & Applied Pharmacology
- » Ad-Hoc Committee Member, National Institutes of Health – Special Emphasis Panel
- » Ad-Hoc Committee Member, Health Canada
- » Ad-Hoc Committee Member, Canadian Institutes for Health Research
- » Ad-Hoc Committee Member, The French National Research Agency (ANR)

Zhang, Wei

- » Associate Editor, Canadian Journal of Soil Science, Journal of Environmental Quality
- » Guest Editor, Vadose Zone Journal
- » Chair, SSSA Soil Physics and Hydrology Division Mentoring Committee
- » Committee Member, AGU Unsaturated Zone Technical Committee, ASABE NRES-21 Hydrology Group
- » Member of Multistate Research Project W3188: Soil, Water, and Environmental Physics Across Scales
- » Member of Multistate Research Project NC1187: The Chemical and Physical Nature of Particulate Matter Affecting Air, Water and Soil Quality
- » Secretary General, International Symposium on Agro-Environmental Quality, Nanjing, China

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Academic Dept. / Disciplinary Ph.D. Programs

(Participate in the IIT's EITS graduate program.)

Animal Science
 Biochemistry & Molecular Biology
 Cell & Molecular Biology
 Chemistry
 Comparative Medicine & Integrative Biology
 Earth & Environmental Sciences
 Fisheries & Wildlife
 Food Science & Human Nutrition
 Forestry
 Genetics
 Integrative Biology
 Microbiology & Molecular Genetics
 Neuroscience
 Pathobiology & Diagnostic Investigation
 Pharmacology & Toxicology
 Plant, Soil, & Microbial Sciences
 Physiology

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Birgit Puschner, College of Veterinary Medicine
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Leo Kempel, College of Engineering
Norman J. Beauchamp, Jr., College of Human Medicine
Andrea Amalfitano, College of Osteopathic Medicine
Phillip Duxbury, College of Natural Science
Douglas Buhler, Director, AgBioResearch



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