

Center for Environmental Health Sciences

The overarching goal of the [Center for Environmental Health Sciences](#) (CEHS) is to study the biological effects of exposure to environmental agents so that we can better understand and predict how such exposures affect human health and the dynamic relationship we have with other living things. Three fundamental components influence the physiological effects of environmental exposures: the nature of the exposure, the duration of that exposure, and how well the exposed organism is equipped to deal with the exposure—that is, the organism’s genetic susceptibility. Environmental health research at MIT encompasses a wide range of disciplines, and CEHS continues to bring together faculty members who employ a diverse set of research tools to tackle problems relevant to environmental health sciences. During the past several years, CEHS has begun to include focused efforts on problems of particular relevance to the developing world, along with adding more human population-based studies. We also have reached out increasingly to the MIT engineering community, because our engineering colleagues are critical players on the front lines of efforts to address the reality of environmental hazard remediation.

Organization

Fulfilling the requirements of the National Institute of Environmental Health Sciences (NIEHS), our sponsoring agency, CEHS is composed of an Administrative Core, the Community Outreach Education and Engagement Core (COE2C), the Career Development Core, the Pilot Project (including the Translational Pilot Project) Program, and the Global Environmental Health Sciences Program. In addition, CEHS has four facilities cores, including the Integrative Health Sciences Facilities Core. Research activities are grouped into the following themes that build on the strength of the center’s membership:

- DNA damage, DNA repair, and mutagenesis
- Microbes and environmental disease susceptibility
- Inflammation chemistry and biology
- Bioengineering tools applied to toxicology
- Organism exposure and response
- Chemistry and transport of air and water pollution

The CEHS membership currently consists of 44 science and engineering faculty and researchers, an increase of two faculty members over the previous year. Forty-two members are from MIT and two are from Harvard University (professor David Hunter and Dr. Ravi Thadhani). The 42 MIT members include one senior research scientist and two principal research scientists. The members of the Administrative Core, which is charged with the center’s overall operation, include professor John M. Essigmann, director; professor Bevin Engelward, deputy director; Amanda Tat, administrative officer; Sophea Chan Diaz, financial administrator; Kimberly J. Bond Schaefer, senior administrative assistant; Lany Leung, office assistant; and an information technology co-op student from Northeastern University. The Community Outreach Education and

Engagement Core helps communities become more aware of environmental hazards that can adversely affect their health and encourages healthy life choices. COE2C partners with three MIT organizations: the MIT Museum, the MIT Edgerton Center, and the Harvard Catalyst Clinical Research Center at MIT. COE2C is led by Dr. Kathleen Vandiver (director) and Professors Essigmann and Engelward (co-directors) with support from Amy Fitzgerald and Dr. Amanda Gruhl (outreach coordinators). Dr. Gruhl has a PhD in toxicology from MIT.

CEHS continues a long tradition of providing its membership with state-of-the-art research facilities that reflect, nurture, and support the center's research directions. CEHS researchers use four facilities cores—the Bioanalytical Facilities Core, the Genomics and Imaging Facilities Core, the Animal Models Facilities Core, and the Integrative Health Sciences Facilities Core—each contributing to the research efforts of at least 10 center members.

Under the direction and co-direction of Drs. John Wishnok and Koli Taghizadeh, respectively, the Bioanalytical Facilities Core provides center members with the latest tools, techniques, and expertise in the characterization and quantification of virtually any molecule in a biological system, including modifications of cellular molecules such as DNA, RNA, and protein, as well as state-of-the-art proteomics and metabolomics research capabilities. This facilities core operates as a resource for the center and provides invaluable training for students and postdoctoral scholars to become proficient in biological mass spectrometry and other state-of-the-art analytical methods.

Drs. Stuart Levine and Robert G. Croy oversee the Genomics and Imaging Facilities Core, which provides center members with a variety of sophisticated quantitative imaging technologies and an integrated facility for microarray fabrication and analysis, database storage and management, data mining, and modeling. These tools are critical to the goal of moving CEHS research to higher levels of complexity in an attempt to understand the response of an organism to environmental influences at the systems level.

The Animal Models Facilities Core, directed by professor James G. Fox, provides center members with the latest technologies for the application of animal models to environmental health research, including the generation of genetically engineered mice, embryo rederivation of imported mice, colony management, and preparation and interpretation of murine tissues by histological and image analysis.

Under the direction of Professors Engelward and Essigmann and Dr. Catherine Ricciardi, the Integrative Health Sciences Facilities Core was developed to help CEHS members translate their research activities into clinical and epidemiological realms. This effort involved formalizing a relationship between CEHS and the MIT Catalyst Clinical Research Center to develop a facilities core that would provide services to CEHS members involved in human health research, particularly studies with clinical human samples, clinical research, and statistics for human population-based studies and other activities.

Another major program in CEHS is the Global Environmental Health Sciences Program, led by Dr. Gerald N. Wogan (director) and professor Peter C. Dedon (co-director). This program focuses on developing collaborative relationships between CEHS members and international researchers in environmental health, as well as on developing research training and education exchange programs for graduate students and postdoctoral scholars. Our global efforts thus far include Thailand, Vietnam, and Singapore.

CEHS has a long-standing commitment to fostering the careers of its young scientists and junior faculty. The Career Development Core, directed by Professors Essigmann and Engelward, provides a broad range of opportunities for the advancement of its members at all stages of their careers. From research support and career coaching to global opportunities for outreach, CEHS provides resources that promote success and enable community engagement in environmental health. Examples include:

- Mentoring
- Financial support
- Research resources
- Speaking opportunities for junior faculty
- New Frontiers Seminar Series
- Translational research support
- Outreach opportunities
- Global Program in Public Health
- Responsible conduct of research

The center continues its successful and popular Pilot Project Program, which is overseen by the center director and deputy director along with the Internal Advisory Committee. This program provides initial support for junior investigators and support for senior investigators to establish new lines of research in environmental health sciences and toxicology. The program also stimulates investigators from other fields of research to apply their expertise to environmental health research and promotes the development of novel COE2C activities arising directly from the research of our center members.

Finally, CEHS has established the Translational Pilot Project Program, which is separate from the regular Pilot Project Program. The goal of this program is to encourage CEHS members and others to pursue translational research in which fundamental research activities are moved progressively from cell-based systems to animal models and ultimately into human clinical and epidemiological studies. The importance of this type of research warrants special funding outside of the regular Pilot Project Program.

Accomplishments

CEHS has maintained a strong volume of research support, totaling over \$7.6 million in FY2014 and resulting in nearly 240 publications. These research projects are funded through a variety of sources, including the National Institutes of Health (National Cancer Institute, National Institute of Allergy and Infectious Diseases, National Institute of Biomedical Imaging and Bioengineering, and NIEHS), the National Science

Foundation, the Department of Defense, the Singapore-MIT Alliance for Research and Technology, and various foundations and companies.

In March 2014, CEHS hosted an External Advisory Committee meeting to gain valuable feedback for the upcoming competitive renewal application. We have received the final report, which we will discuss during our retreat scheduled for August 27. In April 2014, early in the center's grant cycle, we issued a call for Pilot Project and Translational Pilot Project proposals, which resulted in the award of five pilot projects (two basic science projects and three translational projects). These funded projects started on May 1, 2014. A prior call issued in September 2013 was geared specifically toward junior investigators, and this resulted in the award of two translational pilot projects.

NIEHS mandates that each of its 20 core centers participate in a program of community engagement and outreach. The goals are twofold: developing partnerships with community members to translate and disseminate the center's research science and evaluating outreach models, disseminating the results at local and national levels, and promoting models for national implementation.

In 2013–2014, COE2C developed several new community partnerships in the Boston area. For example, the partner relationship with the Mystic River Watershed Association (MyRWA) has developed rapidly. This organization includes several environmental justice communities such as Chelsea, as well as 22 towns along the urban river with a legacy of serious industrial pollution. MyRWA requested our help for a human health risk study addressing boating on the Malden River, a major tributary of the Mystic River. COE2C has engaged several center faculty members who are now advising MyRWA and looking for ways to involve MIT students in this research. The overall goal of the partnership is to give the public greater access to the river for recreational boating and quality outdoor time. We are pleased to have made such great gains in the area of community partnerships over the past year.

The past year has been productive in terms of the second national goal (evaluating outreach models, disseminating results, and promoting models for implementation) as well. We have received very positive assessments from several hundred teachers attending our workshops offered in Boston as well as in New York, New Hampshire, Maine, Tennessee, and Texas. In addition, COE2C has disseminated more than 226 "Atoms and Molecules" classroom teaching sets in 15 different states. In August 2013, the NIEHS Partners in Environmental Public Health (PEPH) network invited Dr. Vandiver, COE2C's director, to present her curriculum at a PEPH webinar titled "Reaching Our STEM Potential"; PEPH's request for a teacher professional development webinar about climate and air pollution led to the posting of this webinar on YouTube as a means of further disseminating these teaching tools.

For the 10th consecutive year, the center offered its highly popular CEHS Poster Session in May 2014, attended by the highest number of participants on record. The event attracted over 100 participants, including CEHS members, faculty, students, postdoctoral scholars, scientists, and staff. The Myriam Marcelle Znaty Research Fund continues to sponsor cash prizes for the best poster presentations in both graduate student and

postdoctoral scholar categories. The CEHS Poster Session receives overwhelmingly positive feedback in terms of promoting scientific exchange and collaborations, as well as introducing CEHS to the broader MIT community.

Over the past year, the center hosted six Friday Forum lectures. This long-standing series of informal research seminars is one of the most popular CEHS-sponsored events and has generated significant collaboration in environmental health research with new center members. Presentations were given by new center members, potential members, and Pilot Project award recipients.

In addition, the center held its first New Frontiers Seminar Series this year. This series is specifically aimed at providing postdocs with the opportunity for feedback on their job interview preparation. Talks are advertised to the entire CEHS community and are attended by senior faculty who ask questions that help postdocs in preparing for their interviews. Importantly, following the presentation, junior and senior faculty meet privately with the postdoc speaker and discuss speaking strategies, organization, and clarity.

The center continues to co-sponsor three named lectureships, the Harris, Wogan, and Schauer lectures. Dr. Steven Hecht presented the Gerald N. Wogan Lecture, *"Tobacco Carcinogen and Toxicant Biomarkers in Cancer Prevention,"* in October 2013. Dr. Joseph Graziano presented the Robert S. Harris Lecture, *"Poison in the Well: Exposure, Consequences and Remediation of Arsenic in Bangladesh,"* in April 2014. Dr. Sebastian Suerbaum presented the David B. Schauer Lecture, *"The Coevolution of the Gastric Carcinogen Helicobacter Pylori with Its Human Host,"* in May 2014.

CEHS also sponsored three special seminars. The speakers were Dr. Aswin Mangerich (August 2013), who presented on *"Poly(ADP-ribosylation): A Post-Translational Modification Regulating Genotoxic Stress Response by Modifying Physico-Chemical Properties of Target Proteins"*; Dr. Thomas Helleday (October 2013), who presented on *"Targeting MTH1 for a Non-Personalized Strategy for Treatment of Cancer"*; and Dr. Jonas Korlach, who presented on *"The Return of Finished Genomes."*

Plans for 2014–2015

In the next year, the CEHS leadership will be actively engaged in strategic planning discussions to reflect the evolution of the center membership as well as the CEHS organizational chart as we embark on the center's competitive renewal application due in February 2015. The CEHS director and deputy director will focus on goals for 2014–2015 after the CEHS retreat in August. These goals are as follows: (1) to reassess the center's membership, with the specific objectives of attracting junior faculty and helping foster relationships where possible between scientists and engineers; (2) to stimulate center members' participation in the Global Environmental Health Sciences Program, given that environmental pollution knows no geopolitical boundaries and the diseases of the developing world disproportionately affect less affluent populations in the United States; (3) to reexamine the Career Development Core and the Integrative Health Sciences Facilities Core, to make sure they are fully in concert with best practices in our field; (4) to continue our dialogue with members of the External Advisory Committee;

and (5) to make better use of the Community Outreach Education and Engagement Core to help showcase to our community some of the exceptional research performed by center members. As always, the CEHS leadership will continue efforts to engage the broader MIT community in research activities related to environmental health sciences.

Global Environmental Health Sciences Program

CEHS will continue our ongoing collaboration with the Chulabhorn Graduate Institute in Bangkok, which has been a developing world hub for research and training for many years. In addition, several center members have laboratories and strong commitments in Singapore. Professor Leona D. Samson and Professor Engelward have a project in which they collaborate with several NIEHS-sponsored researchers on arsenic exposure in Vietnam.

Career Development Core

The Career Development Core conducts mentoring activities for junior center members that will complement departmental mentoring activities and enhance the participation of junior members in the center's activities. For many years, the faculty members involved in the Toxicology Training Grant program (Professor Essigmann is the principal investigator, and Professors Dedon and Engelward serve on the Executive Committee) have led a series on responsible conduct of research for the trainees. We will open this series to all junior faculty members of the center. This training is central to the development of young scientists. Junior faculty are also the primary presenters in our Friday Forum series, which recruits, among others, previous awardees from our Pilot Project Program. The chance to present in front of senior colleagues in this well-attended series allows for excellent opportunities for career feedback. The series of lectures attended by graduate students, postdocs, and junior faculty over Independent Activities Period (IAP) as part of the responsible conduct of research program will be expanded by two sessions. The center will continue the New Frontiers Seminar Series in the upcoming year, and we plan to establish two new programs: the Grant Proposal Writing Workshop and the Page One Program.

Integrative Health Sciences Facilities Core

The Integrative Health Sciences Facilities Core will continue to provide center members with guidance on moving their research activities toward translational and clinical applications. A formal mechanism will be developed to engage a larger fraction of the Boston biomedical community in the affairs of the center.

Pilot Project and Translational Pilot Project Programs

CEHS plans to continue providing funding for novel and innovative research projects related to environmental health issues and translational research projects. Priority will be given to projects that involve collaborations, new environmental health and toxicology research activities, junior investigators, and projects with a likelihood of subsequent independent funding. A call for pilot projects is possible in late fall 2014 in addition to our standard spring 2015 call release. Emphasis will be given to activities that eventually lead to an NIEHS grant applications.

Community Outreach Education and Engagement Core

In conjunction with the staff of the MIT Edgerton Center, COE2C will continue to perform outreach activities in basic science and health education. These activities include MIT Museum events, teacher workshops, and workshops for health care professionals in collaboration with the MIT Catalyst Clinical Research Center. In the coming year, COE2C will develop several new partnerships with Tribal Nations living in highly contaminated regions of Maine. Also, it will publish two papers, one describing novel teaching methods for simulating gene-environment interactions and the other outlining a unique, hands-on way to teach introductory chemistry using LEGO™ bricks as atoms. COE2C plans to lead a DNA hands-on workshop at the American Public Health Association's conference in New Orleans in November 2014 and to complete a new exhibit at the MIT Museum, *Comet Chip Detection Technology for DNA Damage and Repair*. This display will demonstrate how CEHS research can lead to significant breakthroughs in explaining how the environment affects human health.

Friday Forum Lecture Series

The CEHS will continue its highly successful Friday Forum lecture series in which center members and CEHS Pilot Project award recipients share their research programs in monthly presentations at an event designed to promote interaction among current members and attract new members to the center in an informal social setting. CEHS will also invite speakers from other departments, labs, and centers who are performing environmental health research.

Poster Session

We will continue this successful activity in the upcoming year.

Newsletter

Our goal is to continue publishing a newsletter twice a year during the academic period. The newsletters will be available online through our newly revamped website, scheduled for completion in August 2014. All editions of the newsletters are also distributed to center members, our sponsoring agency (NIEHS), and peer P30 centers.

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