

## 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 (COE<sup>2</sup>C), the Pilot Project (including the Translational Pilot Project) Program, the Career Development 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 as they affect disease susceptibility to environmental agents
- Inflammation chemistry and biology
- Bioengineering for toxicology
- Exposure and response to environmental hazards

CEHS membership currently consists of 43 science and engineering faculty and researchers, an increase of four faculty members over the previous year. Forty members are from MIT and three are from Harvard University (professors David Hunter, Jiali Han, and Ravi Thadhani). The 40 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 Essigmann, director; associate professor Bevin Engelward, deputy director (who replaced professor Peter Dedon after 11 years of service); Amanda Tat, administrative officer; Sophea Chan Diaz, financial administrator; Kimberly Bond Schaefer, senior administrative assistant; Jennifer Henry, 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. COE<sup>2</sup>C partners with three MIT organizations: the MIT Museum, the MIT Edgerton Center, and the Harvard Catalyst Clinical Research Center at MIT. COE<sup>2</sup>C is led by Dr. Kathleen Vandiver (director) and Professor Engelward (codirector) 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 director Dr. John Wishnok and codirector Dr. Koli Taghizadeh, 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 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 Dr. Thadhani and Professors Dedon and Essigmann, 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 Wogan (director) and Professor Dedon (codirector). 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 Program, directed by Professor Essigmann, focuses on promoting career development and providing mentorship, as well as providing new research opportunities for senior investigators who bring novel technologies and approaches to bear on CEHS research themes.

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 COE<sup>2</sup>C activities arising directly from the research of our center members.

Finally, CEHS has established a translational pilot project program, which is separate from the regular Pilot Project Program mentioned above. 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 \$8.5 million in FY2013 and resulting in approximately 286 publications. These research projects are funded through a variety of sources, including the National Institutes of Health (National Cancer Institute and NIEHS), the National Science Foundation (NSF), the Department of Defense, the Singapore-MIT Alliance for Research and Technology, and various foundations and companies.

In March 2012 we issued a call for Pilot Project and Translational Pilot Project proposals, which resulted in the award of seven projects (five pilot projects and two translational pilot projects). These funded projects began in May 2012. Another call was issued in February 2013, which resulted in the award of four projects (three pilot projects and one translational pilot project). In an increased effort to stimulate interest in translational research as well as basic environmental health science, CEHS plans to issue another call for pilot projects in September 2013.

To meet community needs in environmental health literacy, COE<sup>2</sup>C continued its tradition of promoting hands-on learning by leading highly engaging activities in many locales—on the MIT campus, in the surrounding community, and across the United States. On campus, COE<sup>2</sup>C concluded a four-year exhibition at the MIT Museum called *Learning Lab: The Cell*, where student and teacher workshops utilized our LEGO molecular biology sets. This program transitioned easily to a classroom setting and continues to be a popular field trip offering at the MIT Museum for high school biology classes.

COE<sup>2</sup>C offers several community engagement activities, including field trips for students and workshops for teachers. COE<sup>2</sup>C was invited by the Boston Public Schools to provide LEGO molecular biology sets and teacher professional development workshops to every high school in the district. This effort, supported by a National Aeronautics and Space Administration (NASA) initiative with the MIT Edgerton Center, concluded in May 2013 and resulted in the contribution of six LEGO molecular biology sets and the training of 14 teachers. COE<sup>2</sup>C also participated in community public health events such as the Cambridge Science Festival in partnership with the Harvard School of Public Health. In February, COE<sup>2</sup>C participated in the Family Science Days event organized by the American Association for the Advancement of Science held in Boston, MA, where MIT undergraduate and graduate students helped out as volunteers in the two-day event. We drew lively crowds using LEGO bricks and participatory activities to model how combustion reactions produce carbon dioxide and how air pollutants are harmful to human health. These events not only help the COE<sup>2</sup>C reach the general public with messages about MIT environmental health science research and public health, but they also provide opportunities for MIT students to communicate science in layman terms.

COE<sup>2</sup>C has also expanded its outreach efforts to the national level. For example, COE<sup>2</sup>C provided educational workshops in molecular biology for high school students in Illinois and Georgia in conjunction with Emergent Behaviors of Integrated Cellular Systems, an NSF Science and Technology Center. Other out-of-state activities included a statewide conference in Northport, ME (sponsored by the University of Maine), and the Environmental Health Teacher Summer Institute in Houston, TX (sponsored by Texas A&M University).

COE<sup>2</sup>C will continue to provide programs for health professionals in collaboration with the MIT Catalyst Clinical Research Center. In addition, COE<sup>2</sup>C received an invitation from national nurse faculty leaders to participate in a National Human Genome Research Institute workshop in the summer of 2013. Unfortunately, however, this workshop was canceled due to sequestration, so we look forward to another opportunity next year.

For the ninth consecutive year, the center offered its popular CEHS Poster Session in May 2013, attended by the highest number of participants on record. This year the event attracted more than 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 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.

The center continues to cosponsor three named lectureships, the Robert S. Harris, Gerald N. Wogan, and David B. Schauer lectures. Dr. Michael Marletta presented the Harris Lecture, "Functions of Nitric Oxide: From Human to Prokaryotic Biology?" in April. Dr. Stephen Barthold presented the Schauer Lecture, "There's Something about Borrelia," in May. Dr. Steven Hecht is scheduled to present the Wogan Lecture in October. Also, CEHS sponsored a special seminar for Dr. Sharon Cantor in March 2013. Her presentation was on "DNA Damage Pathway Coordination by the BRCA1-associated Helicase, FANCI."

### **Future Plans**

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 center's organizational chart. The CEHS director and new deputy director will focus on the goals for 2013–2014, which are (1) to reassess the center's membership, with the specific goal 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 Program and the Integrative Health Sciences Facilities Core, to make sure they are fully in concert with best practices in the field; (4) to reevaluate the membership of the External Advisory Committee and to coordinate a meeting among the committee's members, the center director, and the new deputy director; 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 to collaborate with the Chulabhorn Graduate Institute in Bangkok, which is a developing world hub for research and training. In addition, several center members have laboratories and strong commitments in Singapore. Professor Leona Samson is working on a project in collaboration with several NIEHS-sponsored researchers on arsenic exposure in Vietnam.

### **Career Development Program**

The Career Development Program conducts mentoring activities for junior center members that 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 of the center's junior faculty members. Junior faculty members are also the primary presenters in our Friday Forum series, which recruits, among others, previous awardees from our pilot project programs. The opportunity 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 as part of the responsible conduct of research program will be expanded by two sessions. These additional sessions will focus on grant proposal writing skills.

### **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. Calls for pilot projects will be issued in early fall 2013 as well as spring 2014. Emphasis will be given to activities that eventually lead to NIEHS grant applications.

### **Community Outreach Education and Engagement Core**

In conjunction with the staff of the MIT Edgerton Center, COE<sup>2</sup>C will continue to perform outreach activities in basic science and health education. These activities include MIT Museum events, teacher workshops, and workshop series for health care professionals in collaboration with the MIT Catalyst Clinical Research Center. In the coming year, COE<sup>2</sup>C expects to distribute educational materials to other NIEHS P30 peer centers, particularly on the topics of climate change and air pollution. The K-12 national science, technology, engineering, and mathematics education initiative as well as nurse workshops in genetics will continue to be important to COE<sup>2</sup>C.

### **Friday Forum Lecture Series**

CEHS will continue its 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 winter 2012 and spring 2013 newsletters can be viewed [online](#). All editions of the newsletters are also distributed to center members, our sponsoring agency (NIEHS), and peer P30 centers.

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