

## 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. 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.

### 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 and Education Core (COEC), and the Pilot Project (including the Translational Pilot Project) and Career Development programs. In addition, CEHS has a Global Environmental Health Sciences Program and 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

Effective April 2012, professor John M. Essigmann began serving as the director of the Center for Environmental Health Sciences, taking over from professor Leona D. Samson, who completed a very successful 11-year term of service. Professor Essigmann is a highly regarded CEHS faculty member whose research is at the interface of chemistry, biology, and public health, specializing in the mechanisms by which cells respond to DNA damage. Through synthetic methods, novel DNA damage products are prepared and then cloned into genomes of viruses. Following replication of the damaged viruses in cells, he is able to determine if the lesions studied will be mutagenic or toxic to the host.

The CEHS membership currently consists of 39 science and engineering faculty and researchers, an increase of three faculty members over the previous year. Thirty-six members are from MIT; three are from Harvard University (professors David Hunter, Jiali Han, and Ravi Thadhani). The 36 MIT members include one senior research scientist

and three principal research scientists. The members of the Administrative Core, which is charged with the center's overall operation, include Professor Essigmann, director; professor Peter C. Dedon, deputy director; Amanda Tat, administrative officer; Sophea Chan Diaz, financial administrator; Kimberly J. Bond Schaefer, senior administrative assistant; and Dorian Julius Kersch, information technology co-op student. COEC, which emphasizes education for K–12 teachers and students as well as adults, is responsible for all CEHS outreach activities. COEC partners with three MIT organizations: the MIT Museum, the MIT Edgerton Center, and the Harvard Catalyst Clinical Research Center at MIT (HCCRC). COEC is led by Dr. Kathleen Vandiver (director) and professor Bevin 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 the direction and codirection of Dr. John Wishnok and Dr. 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 Jennifer Calvo 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 Dr. Ravi Thadhani (codirector of HCCRC) 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 HCCRC

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 professor Gerald N. Wogan (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 Program, directed by professor Steven R. Tannenbaum, 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. This program provides initial support for junior investigators and new support for senior investigators to establish new lines of research in environmental health sciences and toxicology. The program also stimulates investigators from other areas of endeavor to apply their expertise to environmental health research and promotes the development of novel COEC activities arising directly from the research of center members.

Finally, CEHS has established the new 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 \$9.7 million in FY2012 and resulting in approximately 230 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, the Singapore-MIT Alliance for Research and Technology, and various foundations and companies.

In April 2011, 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 six projects (five pilot projects and one translational pilot project). These funded projects started in May 2011. In an additional effort to promote interest in translational research, CEHS issued a separate call for Translational Pilot Projects in November 2011. This second call resulted in the awarding of two more translational pilot projects with a start date of January 2012.

In October 2011, the MIT Center for Environmental Health Sciences held its first translational open house with researchers from the Center for the Study of Inflammatory Bowel Disease at the Massachusetts General Hospital (MGH). The event was a great success in attracting over 100 clinicians, scientists, and students, all interested in the role of inflammation in human disease. In a mix of presentations and posters, the event facilitated discussions among MGH and MIT researchers and led to several new collaborations. Due to the overwhelmingly positive response to this first translational open house, CEHS plans to host focused themes for future workshops in areas such as the effects of DNA repair and infectious disease on environmental exposures. We hope to continue this effort to maintain relationships between CEHS members and clinicians at MGH.

COEC's accomplishments include the following: (1) teaching hands-on science both locally and nationally to students and teachers, (2) supporting science communication experiences for undergraduates and graduates at MIT, (3) promoting scientific literacy through a variety of hands-on environmental health science programs for the public at community events, and (4) leading new professional development workshops in environmental health for nurses and for state justices. Some of the COEC activities are run through the MIT Museum. COEC's *Learning Lab: The Cell* exhibit concluded in November 2011 after a four-year run. This activity reached many classroom groups as well as thousands of museum visitors. The curricular materials in place at the MIT Museum are being used in a project with the Boston Public Schools; COEC is currently in the second year of a three-year grant to provide LEGO® molecular biology sets, a curriculum, and teacher professional development workshops to schools in Boston. COEC has participated in teacher education activities nationally as well, expanding to other NIEHS P30 centers. This will be the third year that COEC has presented at the Environmental Health Science Summer Institute at the University of Texas M.D. Anderson Cancer Center. COEC continues to create opportunities for MIT students and postdoctoral scholars to participate in informal public health education, both with the Cambridge Science Festival and with Citizen Schools' after-school programs.

Lastly, COEC, in conjunction with the Broad Institute, presented a workshop to an unusual and highly educated audience: 33 national and state justices in 47 US jurisdictions. This two-day workshop offered a crash course in scientific information and methods for legal professionals. The workshop was cosponsored by the Advanced Science and Technology Adjudication Resource Center, a professional organization funded by the US Department of Justice.

For the eighth consecutive year, the center offered the highly popular CEHS Poster Session in May 2012, attended by the highest number of participants on record. This event attracts over 100 participants, including CEHS members, 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.

In the past year, the center has hosted eight 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 continued to cosponsor three named lectureships, the Robert S. Harris, Gerald N. Wogan, and David B. Schauer lectures. Dr. Judith Campisi presented the Robert S. Harris Lecture, “Cancer and Aging: Rival Demons?” in March, while Dr. Annette K. Larsen presented the Gerald N. Wogan Lecture, “The Epithelial-Mesenchymal Transition and Anticancer Drug Resistance: Cause and Effect or Independent Pathways?” in April. Dr. Roger I. Glass presented the David B. Schauer Lecture, “Global Health in the 21st Century: A View from Fogarty” in May. In addition, CEHS sponsored a special seminar for Dr. Katharina Schlacher in March. Her presentation was on “Rethinking the Replication/Repair Interface: A Protection Pathway Connects Fanconi Anemia Tumor Suppressors to RAD51 and BRCA1/2.”

### **Plans for 2012–2013**

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. With a new CEHS director, the goals for 2012–2013 are (1) to reassess the center’s membership, with the specific objectives of attracting younger 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 our field; and (4) to make better use of the Community Outreach and Education 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 represented a developing world hub for research and training for many years. In addition, several center members have laboratories and strong commitments in Singapore. Professor Samson has a project in which she collaborates with several NIEHS-sponsored researchers on arsenic exposure in Vietnam.

### **Career Development Program**

The Career Development Program will initiate formal mentoring activities for junior members of the center that will complement departmental mentoring activities and enhance the participation of junior members in center activities. The Friday Forum series will be expanded to include an annual session on grant proposal writing skills; in the

interim, the center has been supporting grant-writing workshops sponsored by other organizations for junior CEHS faculty members. Professor Essigmann will serve as a mentor in this program. For many years, the faculty members 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 members of the center.

### **Integrative Health Sciences Facilities Core**

This 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 \$25,000 in direct-cost funding for five novel and innovative research projects related to environmental health issues and one to two 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 spring 2013. Emphasis will be given to activities that eventually lead to NIEHS grant applications.

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

The new initiatives for COEC include plans to partner with the Emergent Behaviors of Integrated Cellular Systems Center to develop programs for MIT, the University of Illinois, and George Tech; create a new CEHS MIT Museum exhibit with professor Graham Walker; and design a self-paced LEGO® toolkit for teaching molecular genetics and environmental health to nurses. In the upcoming year, we anticipate that COEC will develop programming materials that will inform the general public of the work performed by center members for local and national environmental health communities. Start-up funding for such initiatives may become available through the Pilot Project Program.

### **Friday Forum Lecture Series**

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 also invites speakers from other labs and departments who are performing environmental health research. We plan to increase this lectureship series from monthly to bimonthly when possible. Furthermore, we will expand the series to include an annual session on grant proposal writing skills and a session providing a practical perspective on life in academic research and teaching for young scientists aspiring to careers in academia in conjunction with the Career Development Program.

### **Poster Session**

We will continue this successful activity.

### **Newsletter**

Our goal is to continue publishing a newsletter twice a year during the academic period. The winter 2011/2012 and spring 2012 newsletters can be viewed [online](#). All editions of the newsletters are also distributed to center members and our sponsoring agency, NIEHS.

**John M. Essigmann**

**Director**

**Professor of Biological Engineering and Chemistry**

**Peter C. Dedon**

**Deputy Director**

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