

## Center for Environmental Health Sciences

The overriding goal of the [Center for Environmental Health Sciences](#) (CEHS) is the study of the biological effects of exposure to environmental agents so that we may 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—i.e., 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 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 and disease susceptibility
- inflammation chemistry and biology
- bioengineering for toxicology
- exposure and response

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 center also has 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 Leona D. Samson, director; professor Peter C. Dedon, deputy director; Amanda Tat, administrative officer; Sophea Chan Diaz, financial coordinator; Julie Coiro, administrative assistant; and an information technology system administration assistant (position currently vacant). COEC, which emphasizes education for K–12 teachers and students as well as adult and community outreach through the MIT Museum and the MIT Edgerton Center, is responsible for all CEHS outreach activities. COEC is administered by Dr. Kathleen Vandiver, director; associate professor Bevin Engelward, codirector; and Amy Fitzgerald, outreach coordinator.

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; each core contributes to the research efforts of at least 10 center members: the Bioanalytical Facilities Core, the Genomics and Imaging Facilities Core, the Animal Models Facilities Core, and the Integrative Health Sciences Facilities Core.

Under the direction of Drs. John Wishnok and 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 sophisticated 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 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 the MIT Catalyst Clinical Research Center) and Professors Dedon and Samson, 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 professors Gerald Wogan (director) and John Essigmann (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 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 in 2010–2011**

CEHS has maintained a strong volume of research support, totaling over \$9.5 million in FY2011 and resulting in approximately 250 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.

Early in the center's 2010–2011 grant cycle, the Pilot Project Program provided support for three projects using supplemental funding from NIEHS. With full funding of CEHS by NIEHS, we issued a call for Pilot Project and Translational Pilot Project proposals in April, which resulted in the award of a total of six projects (five pilot projects and one translational pilot project). These funded projects started on May.

In conjunction with the MIT 150th celebration open house, CEHS sponsored "Got Gunk on Your DNA," an event showcasing the center's successes in environmental health and toxicology research. The open house event comprised three activities, including:

- a review of the discovery of aflatoxins as a major cause of liver cancer around the world
- demonstrations of a new high-throughput technology, the CometChip, that measures DNA damage in humans (invented by CEHS member, associate professor Bevin Engelward)
- demonstrations showcasing the sophisticated and ultrasensitive measurement technologies of the Bioanalytical Facilities Core, including how the instruments can be used to detect drug-doping

The event also included an extremely popular children's activity table, with hands-on experiments involving freezing flowers in liquid nitrogen and growing bacteria in petri dishes. Event details are highlighted in the center's spring newsletter, which is available on the CEHS website.

Through COEC, CEHS continues its long tradition of promoting community-level scientific literacy through a variety of hands-on programs for youth and teachers (e.g., a two-day summer teacher workshop on environmental health science research) from sixth grade through high school. COEC runs highly successful activities on the MIT campus, in the surrounding community, and even across the US. An exhibit at the MIT Museum, *Learning Lab: The Cell*, continues to reach many classroom groups as well as a large number of museum visitors. COEC continues to create opportunities for MIT students and scholars to participate in informal public health and science education, such as at the Cambridge Science Festival, where the center encourages and supports young scientists in their own outreach efforts. In addition, COEC was invited by the Boston Public Schools to provide LEGO® molecular biology sets, a curriculum, and professional development to every high school in the district. Additionally, COEC has exported this curriculum to beta sites such as the University of Rochester in New York (a colleague center). Lastly, COEC is continuing to provide programs for health professionals in collaboration with the MIT Catalyst Clinical Research Center. COEC currently offers an annual two-day workshop, Cell Biology for Nurses and Health Professionals, that provides 15 continuing education units for participants.

For the seventh consecutive year, the center offered its highly popular CEHS Poster Session in February 2011, attended by the highest number of participants on record. This event attracts over 100 participants, including CEHS members, students, postdoctoral scholars, scientists, and staff, as well as many MIT faculty, students, and postdoctoral researchers. 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.

Last year, the center hosted seven 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 two named lectureships, the Harris and the Wogan lectures. Professor Marsha R. Rosner presented the Gerald Wogan Lecture, "From Signal Transduction to Metastasis: Regulators of MAP Kinase," on March 31, while Dr. Thomas A. Kunkel presented the Robert S. Harris Lecture, "The Asymmetry of Eukaryotic DNA Replication and Its Consequences," on May 12.

### **Plans for 2011–2012**

With the reorganization of CEHS over the past few years, the goal for 2011–2012 is to fully implement the changes in terms of center members' participation in the Global Environmental Health Sciences Program, the Career Development Program, and the

Integrative Health Sciences Facilities Core, in addition to the continued successful operation of COEC and the other facilities cores. 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**

Activities in the this program will increase with the continuation of a program to host Thai graduate students in CEHS member laboratories for up to one year as part of an ongoing collaboration with the Chulabhorn Graduate Institute in Bangkok.

### **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-writing skills; in the interim, the center has been supporting grant-writing workshops sponsored by other organizations for junior CEHS faculty members.

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

This facilities core plans to issue another call later this summer or in early fall to attract more translational research. This core will continue to provide center members with guidance on moving their research activities toward translational and clinical applications.

### **Pilot Project and Translational Pilot Project Programs**

We will issue another call for Translational Pilot Project proposals in August/September 2011, around the same time as the CEHS translational open house, which will allow CEHS to attract clinical researchers at Massachusetts General Hospital and other local hospitals to submit applications. CEHS plans to continue providing \$25,000 in direct-cost funding for five novel and innovative research projects related to environmental health issues and two translational research projects. Priority will be given to projects that involve collaboration, new environmental health and toxicology research activities, and junior investigators and to projects with a likelihood of subsequent independent funding.

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

COEC will continue the activities described earlier in conjunction with the staff of the Edgerton Center. These activities include MIT Museum events, teacher workshops, and the new workshop series for health care professionals in collaboration with the MIT Catalyst Clinical Research Center. The new two-day nurse workshop provides continuing education credits for nurses and broadens COEC's target audience. In the coming year, COEC expects to take the teacher professional development workshop presentations to other NIEHS P30 centers. The K-12 national science, technology, engineering, and mathematics (STEM) education initiative will continue to be important to COEC, as demonstrated by our continuing partnership with the Boston Public Schools. This fall, COEC will be expanding environmental health science education with additional professional workshops. We have a team of 20 National Institutes of

Health research nurses attending the nurse workshop in October 2011 and a group of 20 national and state justices attending an environmental health science workshop in September 2011. The latter is cosponsored by the Advanced Science and Technology Adjudication Resource Center.

### **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. 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-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 again.

### **Newsletter**

Our goal is to continue publishing a newsletter twice a year during the academic period. The fall 2010 and spring 2011 newsletters can be viewed [online](#). All editions of the newsletters are also distributed throughout the MIT community.

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