

Center For Environmental Health Sciences

Overview

The overriding goal of the Center for Environmental Health Sciences (CEHS) continues to be to study 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—in other words, the organism's genetic susceptibility. Environmental health research at MIT encompasses a wide range of disciplines and the CEHS continues to bring together faculty members who employ a diverse set of research tools to tackle problems relevant to environmental health sciences.

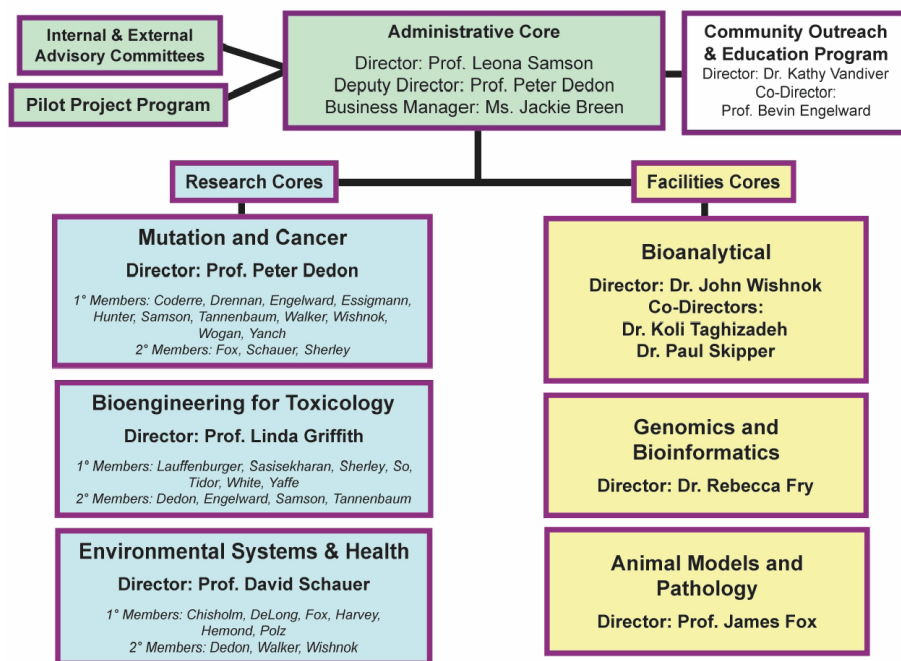
Organization

As shown below in the organizational chart, CEHS continues to be comprised of an administrative core, the Community Outreach and Education Program (COEP), the Pilot Project Program, three research cores, and three facilities cores. Center membership currently consists of 29 faculty scientists and engineers, 28 from MIT and one from Harvard University (Dr. David Hunter), which represents a loss of two members (Peter Sorger and Tom Ellenberger) since 2004–2005. Four additional faculty have pilot projects funded by CEHS. The members of the administrative core, which is charged with overall operation of the center, include Professor Leona Samson (Biological Engineering Division [BE]), director; Professor Peter Dedon (BE), deputy director; Jacqueline Breen, administrative officer; Sophea Chan, financial assistant; and Kay Walsh, administrative assistant. (Ms. Walsh left the CEHS in May and joined the Office of Sponsored Programs where she assists with the Research Administration Improvement Initiative. We are currently seeking her replacement.) The COEP is responsible for all outreach activities of the CEHS, which currently emphasize K–12 education for teachers and students and also adult and community outreach through the Museum of Science and the MIT Museum. The COEP is administered by Dr. Kathleen Vandiver, director; Professor Bevin Engelward (BE), codirector; and Amy Fitzgerald (Edgerton Center), coordinator.

Research in CEHS is organized into three research cores that build on the strengths of the Center's membership and reflect a vision for the future of environmental health research. These are the Mutation and Cancer Research Core, the Bioengineering for Toxicology Research Core, and the Environmental Systems and Health Research Core. The theme of each core derives from the members' research interests, and all are linked by the center's overarching focus on defining how biological systems respond to exposure to environmental agents. The Mutation and Cancer Research Core, directed by Professor Dedon, addresses the relationships between DNA damage, DNA repair, mutation, and cancer associated with exposure to environmental and endogenous chemical and physical agents. The Bioengineering for Toxicology Research Core, directed by Professor Linda Griffith (BE, Mechanical Engineering [ME]), was created to facilitate the development of new experimental tools and analysis methods relevant to

environmental influences on human health, with a range of approaches spanning the molecular-cellular systems length scales. The mission of the Environmental Systems and Health Research Core, now directed by Professor David Schauer (BE), is to understand the relationships that link environmental processes and human health in terms of exposure to chemical agents as well as biota. This is most aptly illustrated by the triad of dependent interactions of aflatoxin, hepatitis virus, and human liver cancer, which has been a research foundation for CEHS since its inception over three decades ago.

MIT Center for Environmental Health Science



Three state-of-the-art facilities cores reflect CEHS's research directions. The cores are heavily used by CEHS researchers, with each contributing to the research of at least 10 members. Under the direction of Drs. John Wishnok (BE), Koli Taghizadeh, and Paul Skipper (BE), the Bioanalytical Facilities Core provides center members with the latest tools, techniques, and expertise in the characterization and quantification of chemical substances and modifications of cellular molecules such as DNA and protein. The core operates as a resource for the center and provides training for students and postdocs to become proficient in mass spectrometry analysis. The Genomics and Bioinformatics Facilities Core is directed by Dr. Rebecca Fry, who succeeds Professor Peter Sorger, and provides center members with an integrated facility for microarray fabrication and analysis, database storage, database 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 the organism to environmental influences at the systems level. The Animal Models and Pathology Facilities Core, directed by Professor James Fox (Division of Comparative Medicine, BE), provides center members with the latest technology 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 tissue by histological and image analysis.

Accomplishments in 2005–2006

CEHS has maintained a strong volume of research support, totaling over \$7.8 million in 2005–2006. These research programs are funded through a variety of sources, including the National Institute of General Medical Sciences, the National Cancer Institute, the Department of Energy, the National Science Foundation, the American Cancer Society, the Defense Advanced Research Projects Agency, and the National Institute of Environmental Health Sciences (NIEHS).

With the continued support of our NIEHS Center Grant, which was awarded last year, we have been able to provide support for six pilot projects for the year 2005–2006. Pilot project funding allows for the conduct of novel research activities that utilize multidisciplinary approaches to the study of environmental health sciences. Investigators and the pilot projects supported during the 2005–2006 period include the following:

- Professor Patrick Doyle (Chemical Engineering), Technologies to Rapidly Scan Single Genomic DNA Molecules;
- Associate professor Catherine Drennan (Chemistry), Structural Studies of the AlkB Family of Proteins;
- Assistant professor Kimberly Hamad-Schifferli (ME), Antisense Gene Regulation with Nanoparticle-DNA Conjugates;
- Arlin Rogers, chief, Comparative Pathology Lab (Division of Comparative Medicine), Molecular Determinants of Liver Tumorigenesis following Combined Exposure to Aflatoxin B1 and Infectious Hepatocarcinogens in a Mouse Model;
- Assistant professor Krystyn Van Vliet (Materials Sciences and Engineering), In Vitro Platforms to Assess Mechanically Modulated Environmental Exposure; and
- Kathleen Vandiver, director, COEP, The Cell is a Molecular Machine

An additional call for pilot project applications was made in June and we anticipate funding an additional five to six projects.

Through our Center Grant funding we continue to support the COEP, which promotes community-level scientific literacy through a variety of programs targeted to students and their teachers from grade four through the undergraduate curriculum, as well as to continue to provide faculty with resources from both the research and facilities cores. One of the goals of the COEP program is to create opportunities for MIT academics to participate in public health education.

COEP continues to run three highly successful activities: the after school sessions in October on environmental health science for Summerbridge Cambridge, an excellent academic program for local middle school students; the two-day summer workshop on environmental health science research for teachers in July; and the classroom instruction sessions at the Edgerton Center on environmental health topics such as cell division and groundwater for students.

Other COEP achievements this year include the following:

- In November 2005, in conjunction with MIT Museum staff, COEP was awarded pilot project funding from CEHS to create the first-ever Learning Lab at the MIT Museum. COEP is creating this hands-on exhibit space in which DNA-directed protein synthesis will be taught using LEGO models. School groups and museum visitors will be able to learn about the health implications of DNA damage and its relationship to disease when the exhibit opens in November 2006.
- In March 2006 COEP personnel contributed to the success of the Boston Museum of Science's Symposium for Biotech Educators. Professor Bevin Engelward gave the keynote address on DNA damage and repair to over 320 teachers, and Kathy Vandiver and Amy Fitzgerald gave two highly attended teacher workshops.
- In May 2006 COEP sponsored a Friday Forum where the director of the advocacy group Toxics Action, Jay Rasku, discussed the environmental health issues in New England communities. At this seminar, an undergraduate also gave a report on the toxicity of a pesticide in common use on suburban lawns.

In conclusion, we are pleased that both faculty and students have directly contributed to the success of all the outreach projects mentioned above.

In addition to the many COEP activities, a major highlight of the center's activities in 2005–2006 was the Third Annual CEHS Poster Session. This event attracted over 150 participants comprised of CEHS members, students, postdoctoral scientists, and staff, as well as other MIT faculty members, presenting 58 scientific posters in an afternoon session at MIT. This year the center offered prizes to poster participants. Our secret panel of judges included Drs. Bevin Engelward, John Essigmann, and Peter Wishnok. Prizewinners were:

1st place graduate student—Daniel Jarosz from the Walker Lab
1st place postdoc—Dharini Shah from the Samson Lab

2nd place graduate student—Diana Borenshtein from the Schauer Lab
2nd place postdoc—Jim Delaney from the Essigmann Lab

3rd place graduate student—Leah Blasiak from the Drennan Lab
3rd place postdocs—a tie between Bo Pang from the Dedon Lab and Michelle Williams from the Tannenbaum Lab.

The Poster Session has become an annual event that receives overwhelmingly positive feedback in terms of promoting scientific exchange and collaborations, as well as introducing the CEHS to the broader MIT community. An abstract book was published and we anticipate having this available on the CEHS website for viewing.

In other publication-related activity, the CEHS website underwent changes during the year both in format and content. Two editions of the CEHS Newsletter were published, a spring/summer edition that highlighted the research of Dr. Ed DeLong, and a winter/spring edition that highlighted the history of flatoxin research at MIT and the work of

Dr. Gerald Wogan. Several members of CEHS had the honor of providing cover art for their scientific work in the following publications:

Garcia A., C.J. Bosques, J.S. Wishnok, Y. Feng, B.J. Karalius, J.R. Butterson, D.B. Schauer, A.B. Rogers, and J.G. Fox. "Renal Injury Is a Consistent Finding in Dutch Belted Rabbits Experimentally Infected with Enterohemorrhagic Escherichia Coli," *Journal of Infectious Diseases* 193 (April 2006): 8, 1125–1134. Epub March 6, 2006.

Li, C., B. Pang, T. Kiziltepe, L. Trudel, B. Engelward, P. Dedon, and G. Wogan. "Threshold Effects of Nitric Oxide-Induced Toxicity and Cellular Responses in Wild-Type and p53-Null Human Lymphoblastoid Cells," *Chemical Research in Toxicology* 19 (March 2006): 3, 399–406.

Margolin, Y., J.-F. Cloutier, V. Shafirovich, N. Geacintov, and P.C. Dedon. "Paradoxical Hotspots for Guanine Oxidation by a Chemical Mediator of Inflammation," *Nature Chemical Biology* 2 (July 2006): 365–366. Epub June 4, 2006.

Neeley, W., and J. Essigmann. "Mechanisms of Formation, Genotoxicity, and Mutation of Guanine Oxidation Products," *Chemical Research in Toxicology* 19 (April 2006): 4, 491–505.

Niles, J., Wishnok, J., and S. Tannenbaum. "Peroxynitrite-Induced Oxidation and Nitration Products of Guanine and 8-Oxoguanine: Structures and Mechanisms of Product Information," *Nitric Oxide* 14 (March 2006): 2, 109–121.

Plans for 2006–2007

During the coming year the CEHS will begin to focus on strategic planning in order to address the changing requirements of the NIEHS Center Grant program. This process will also allow us to evaluate the changing needs of CEHS members as well as provide an opportunity to recruit new faculty whose research is relevant to the environmental health sciences. We will begin to address the requirement for a new Integrated Health Sciences facility as well as a Program on Global Initiatives in Environmental Health Sciences, which will be spearheaded by Dr. Gerald Wogan.

Pilot Projects

CEHS will continue its long-standing and successful Pilot Project Program, the specific goals of which are to:

- provide initial support for new investigators to establish environmental health projects,
- allow exploration of possible innovative new directions representing a significant departure for established investigators in environmental health sciences, and
- stimulate investigators from other areas of endeavor to apply their expertise to environmental health research.

We anticipate disseminating a call for proposals in January 2007 for funding beginning April 2007. It is anticipated that CEHS will provide \$15,000–\$25,000 for four to six novel and innovative research projects related to environmental health issues. Priority will

be given to projects that involve collaboration and have a likelihood of subsequent independent funding. Also, the CEHS will coordinate its Pilot Project Program with that of the Woods Hole Oceanographic Institute (WHOI) Center for Oceans and Human Health, which is jointly sponsored by the NIEHS and NSF and has several areas of research complementary to CEHS.

Community Outreach and Education Program Activities

The COEP will continue the activities described earlier with the additional development of new Edgerton Center teaching activities. These activities include MIT Museum events, teachers workshops, Teachers as Scholars sessions, and Edgerton Center events. We will also begin new programs involving teachers and students from the John D. O'Bryant School of Mathematics and Science in Boston. This Boston public school is comprised of 7–12 grade students participating in a curriculum enriched in math and science.

Friday Forum

CEHS will continue the highly successful Friday Forum series in which Center members share their research programs in monthly presentations at an event intended to promote interaction among members and attract new members in an informal social setting.

Retreat

A retreat was held in July 2005 at the MIT Endicott House. We hope to hold retreats as an annual event to provide an opportunity to highlight ongoing research, new core innovations and technology (particularly with regard to science and engineering projects), and programs driving Center research, as well as to promote interactions among CEHS members.

Poster Session

We will continue this successful activity again in 2006–2007. We will attempt to coordinate this with the WHOI Center for Oceans and Human Health to promote an exchange among members of these two research groups.

Newsletter

We anticipate publishing the CEHS Newsletter twice a year to highlight the research of CEHS faculty as well as other Center activities.

Leona D. Samson, Director and Professor of Biological Engineering

Peter C. Dedon, Deputy Director and Professor of Biological Engineering

More information about the Center for Environmental Health Sciences can be found at <http://cehs.mit.edu/>.