

APPENDIX 1

TENTATIVE FACULTY RESEARCH SUMMARY (in alphabetical order)

1. Professor John R. Balmes, MD: For the past 20 years, Dr. Balmes has been primarily interested in studying the effects of exposures to occupational and environmental agents on respiratory health, especially with regard to asthma and airway inflammation. In the Human Exposure Laboratory in the UCSF Lung Biology Center, he conducts controlled human exposure studies with sampling of respiratory tract lining fluid to characterize acute exposure-response relationships for oxidant pollutant-induced airway inflammation. He is currently funded to investigate whether common polymorphisms in xenobiotic metabolizing enzyme genes (GSTM1, GSTP1, and NQO1) are associated with increased risk of ozone-induced enhancement of airway inflammatory responses to allergens in sensitized asthmatic subjects; to determine whether ozone-induced airway inflammation is correlated with decreased heart rate variability; and to assess the acute airway inflammatory effects of wood smoke.

To study the chronic effects of occupational and environmental agents on respiratory health, Dr. Balmes collaborates on epidemiological studies at UCSF and UC Berkeley. At UCSF, he has collaborated on studies of the effects of occupational exposure to respiratory tract irritants and environmental exposure to tobacco smoke on COPD outcomes (NHLBI) and the effects of environmental exposure to traffic and air pollutants on asthma outcomes (NIEHS). At UC Berkeley he has collaborated with Dr. Ira Tager to study the effects of cumulative lifetime exposure to ozone on lung function in healthy adolescents and short-term exposures to air pollutants on growth of lung function and disease severity in children with asthma in Fresno (NHLBI). With Dr. Kirk Smith, he co-leads a longitudinal study of the effects of exposure to biomass smoke on the growth of lung function in children in Guatemala (NIEHS). With Dr. Allan Smith, he has been investigating the role of ingested arsenic from contaminated drinking water on respiratory health in West Bengal and Bangladesh (NIEHS). Dr. Balmes is PI/Director of a CDC-funded program, the UCB Center for Environmental Public Health Tracking, which is developing methods for surveillance of health outcomes that may be related to exposures.

2. Professor Michael Bates, PhD: Dr Bates is Adjunct Professor of Epidemiology in the School of Public Health, but based in the Division of Environmental Health Sciences. Dr Bates had a background in chemistry and toxicology before obtaining his PhD in epidemiology at Berkeley. His research focus is on the health effects of occupational and environmental exposures to chemicals. Dr Bates is Principal Investigator of a NIEHS-funded epidemiologic study being carried out in New Zealand. This study is investigating whether long-term, low-level exposures to hydrogen sulfide gas in the Rotorua geothermal area cause any health effects. With Prof Katharine Hammond he is working on an epidemiologic study in the Bay Area of whether exposures to n-hexane solvent in parts cleaners cause persistent neurological or reproductive effects, and with Prof Kirk Smith he is investigating whether exposure to indoor cooking smoke is a risk factor for tuberculosis or cataract in studies in India and Nepal.

Other areas of research interest of Dr Bates include health effects of organochlorine compounds, such as dioxins and PCBs; whether dental amalgam fillings, which contain mercury, cause any health effects; cancer risks in fire fighters, and cancer risks associated with ingestion of arsenic in drinking water.

3. Professor Jack Colford, MD, MPH, PhD (*not available for a summer rotation in 2009*): Dr. Colford is a Professor of Epidemiology at the School of Public Health. He is a graduate of the Johns Hopkins School of Medicine and the UCB School of Public Health. He

completed a residency in internal medicine and a fellowship in infectious diseases at UCSF and was Chief Medical Resident at Stanford. Dr. Colford teaches courses in advanced epidemiologic methods and intervention trial design and has received several teaching awards, including two awards from students at the School of Public Health.

Colford is an author of more than 65 peer-reviewed scientific publications, including numerous peer-reviewed articles on the health effects of waterborne diseases. He has received more than \$19 million in research funding and was the Principal Investigator of four triple-blinded, randomized controlled trials of drinking water and health effects funded by the National Institutes of Health, the Centers for Disease Control, the Environmental Protection Agency, and the University of California. These have included large trials in the United States as well as a drinking water study in 22 villages in Bolivia. Dr. Colford was the Principal Investigator of the Mission Bay Epidemiology study about the health effects of recreational water exposure, funded by the California Regional Water Quality Control Board. Student opportunities in Dr. Colford's group might include both the collection and analysis of epidemiological field data.

4. Professor Brenda Eskenazi, PhD: Dr. Eskenazi is a Professor of Maternal and Child Health and Epidemiology at the University of California, Berkeley. She is a neuropsychologist and epidemiologist whose long-standing research interest has been the effects of toxicants including lead, solvents, environmental tobacco smoke, dioxin, and pesticides on human reproduction (both male and female) and child development. She is the Principal Investigator and Director of an NIH/EPA Center for Excellence in Children's Environmental Health Research (the "CHAMACOS" Project) which investigates the exposure pathways and health effects of pesticide exposure in farmworkers and their children and develops interventions to prevent future exposure. She is also the Principal Investigator on other NIEHS-funded projects on endocrine disruption: one based in Seveso Italy investigating the reproductive health of a cohort of women exposed to high levels of dioxin, and another examining the effects of persistent and nonpersistent endocrine-disruptors on neurodevelopment. She is also the PI of a grant from EPA examining the whether children with certain PON1 genotypes are at higher risk from exposure to pesticides. Dr. Eskenazi is currently conducting a study on the effects of benzene exposure on genetic and nongenetic markers in human sperm.

Dr. Eskenazi has contributed widely to the field of children's environmental health, including the Surgeon Generals Report on Smoking and Womens Health, The World Health Organizations Tobacco-Free Initiatives report on Environmental Tobacco Smoke, and the United States-Vietnam Committee on the Human Health and Environmental Exposures of Agent Orange and Dioxin in Viet Nam. She served on the State of California's Scientific Advisory Board for the Toxics Initiative (Proposition 65), which identifies chemicals as reproductive or developmental toxicants. Dr. Eskenazi has served on the Scientific Advisory Board of the Children's Health Environmental Coalition and on the Study Design Working Group of the National Children's Study. She is currently a member of the Expert Committee for the Stockholm Convention.

5. Professor Katharine Hammond, PhD: Dr. Hammond studies the exposures of people to toxic air contaminants. These might be environmental exposures such as secondhand smoke or occupational exposures. This research is usually coupled with studies of the health effects associated with these exposures. Some members of her team, which consists of students and staff, do chemistry laboratory work while others primarily work on evaluation of the data, using computers and statistical programs to evaluate and model exposures. Students would learn the methods associated with these studies under the direction of Professor Hammond.

She directs a laboratory, which contains equipment to sample the air and also chemistry instrumentation to analyze the samples collected. Several computers are available in the laboratory with software to conduct these analyses, including geographic information system software and statistical packages. Student projects could include any of the following:

- Evaluate data on allergen or endotoxin levels on dust collected from the beds of children with asthma
- Collect pine needle samples to evaluate airborne levels of polycyclic aromatic hydrocarbons (PAHs) and analyze samples using liquid chromatography and gas chromatography/mass spectrometry
- Develop methods to distinguish wood smoke from automobile exhaust
- Analyze samples of coal from China for PAHs and develop models to estimate exposure to coal emissions and PAHs in the past
- Evaluate the exposure of asthmatic children in various states across the U.S. as a function of smoke free environmental laws in those states
- Develop retrospective estimates of secondhand smoke concentrations on airplanes.

6. Professor Nina Holland, PhD: Dr. Holland is an adjunct professor at the School of Public Health and a director of the School's bio-repository and the Children's Environmental Health Laboratory. She has a background in genetics with extensive experience in molecular epidemiology, human cytogenetics, reproductive toxicology and biobanking. Dr. Holland has an international reputation for her research in the area of biomarkers of effect, and has conducted a number of studies on functional genetics and analysis of genetic susceptibility to environmental factors and predisposition to disease. Her main scientific interest is in molecular epidemiology of children's environmental health. She has organized and chaired several sessions on this topic at national and international meetings.

Currently, Dr. Holland is principal investigator on a study investigating functional genomics of paraoxonase in the cohort of Latino mothers and children. This longitudinal birth cohort has been followed by Dr. Holland in conjunction with Dr. Brenda Eskenazi, for many years. In addition, Dr. Holland is assessing the effects of GSTM1/T1 and multiple polymorphisms on ozone-induced allergic airway inflammation, as well as health effects and biomarkers in Guatemalan children exposed to biofuel indoor pollution, in conjunction with Professors Kirk Smith and Katharine Hammond. Drs. Holland and Eskenazi also recently completed a study evaluating endocrine disrupting effects of organochlorine pesticides on Latino children and mothers in agricultural communities. There is major student participation in Dr. Holland's laboratory with as many as seven undergraduates, three-four master's and doctoral students working concurrently. Students undergo training in an active lab environment where undergraduates work as team members with the graduate students under the direction of Dr. Holland and her research team. Undergraduate students receive degree credit through an independent study mechanism, present at the lab seminars, and complete their honors projects.

7. Professor Michael Jerrett, PhD: In 2006, Dr. Jerrett joined the SPH as an associate professor in the Division of Environmental Health Sciences, School of Public Health. Building on expertise in medical geography, geographic information systems, and spatial analysis, Dr. Jerrett currently assesses associations between air pollution and health in the United States, Canada, and Mexico, with special reference to social-spatial confounders and intra-urban exposure gradients. He is also engaged in determining the role of the built environment as a contributor to childhood obesity. He is principal investigator and co-PI on grants from the NIEHS, the NCI, and the EPA, as well as the Health Effects Institute, the Canadian Institutes of Health Research, and the Robert Wood Johnson Foundation. He was honored with the 2004

Dangermond Endowed Speaker in Geographic Information Science award at the Environmental Research Systems Institute and the University of California, Santa Barbara. In one of Dr. Jerrett's studies, the researchers are refining and applying new statistical methods for multilevel modeling of social characteristics that may explain the differences in symptoms (e.g., wheezing) and disease manifestations, such as asthma, between communities. Dr. Jerrett's facilities include four Xeon workstations, GIS software, statistical programming software, global positioning systems, pollution monitors, and assorted field equipment. Dr. Jerrett plans to train students to use GIS, perform GIS data processing and land use analysis. In future years of this internship program, Dr. Jerrett would be available to work with students in the field deploying pollution monitors.

8. Professor Thomas McKone, PhD: Dr. McKone's research group explores and quantifies how human exposure comes about, how exposure relates to health detriment, and how precisely these links can be quantified for a number of important pollutants. To pursue this effort, the research team has worked on:

- Defining and modeling chemical transport and transformation in the environment;
- Biotransfer and bioconcentration;
- Measuring and modeling dermal and inhalation exposures to contaminants in tap water and household dust;
- Chemical mass transport at inter-media contacts such as air/water, air/soil, air/vegetation, skin/water, etc.
- Assessing model uncertainty and reliability
- Public health and ecological impacts of energy, industrial, and agricultural systems

Dr. McKone has research facilities and equipment at both the University of California Berkeley and at the Lawrence Berkeley National Laboratory (LBNL). At these two institutions, the research team devotes much of its research to the development of probabilistic, multi-pathway, multimedia human and exposure/impact models. This group has two operating environmental chamber facilities designed for investigating emissions of pollutants from indoor sources under simulated, controlled indoor environmental conditions. Other relevant facilities at LBNL and UC Berkeley available to Dr. McKone include the Gas Chromatography/Mass Spectrometry/Data Analysis System and Laboratory; the Organic Chemical Analysis Laboratory, and the Aerosol Research Laboratory.

9. Professor Mark Nicas, PhD, MPH, CIH: Dr. Nicas is adjunct professor of environmental health sciences and director of the Industrial Hygiene Program. He advises two PhD students, 1 MS student, and 4 MPH students. He is an active researcher and has approximately 50 publications in the peer-reviewed environmental health literature. His current work focuses on two related areas. First, he develops mathematical models of contaminant emission rates (for both chemicals and pathogens) and of dispersion patterns in indoor air. He is extending a Markov chain model that he developed for gas-phase contaminants to describe the transport-and-fate of particulate contaminants in indoor environments. Second, he is engaged in microbial risk assessment research, and is interested in the potential interaction of different exposure pathways for the same pathogen--for example, emission into air due to coughing, leading to pathogen deposition onto surfaces, thereby permitting hand-to-surface-to-mucous-membrane transmission.

Undergraduate students working with Professor Nicas would have the opportunity to participate in research related to microbial risk assessment. Depending on the phase of the research at the time of participation, the student might be involved in experiments concerning droplet spray exposure; learning how to formulate a mathematical model; writing computer code; or performing a critical literature review.

10. Professor Stephen Rappaport, PhD: Dr. Rappaport has recently returned to UCB from the University of North Carolina, Chapel Hill. For many years, he has been active in research involving both environmental and biological monitoring. His current research focuses on development and application of biomarkers of exposure to genotoxic chemicals, including benzene, styrene, and polycyclic aromatic hydrocarbons. His work seeks to elucidate the human metabolism of these substances and inter-individual variability in biomarker levels due to genetic, environmental and lifestyle factors. Dr. Rappaport has published extensively in areas related to the assessment of long-term exposures to chemicals for purposes of controlling workplace hazards and of investigating exposure-response relationships. The principal opportunities for research experiences for students in this program are laboratory-based, relating to his biomarker work.

11. Research Scientists Megan Schwarzman, MD, MPH, and Michael Wilson, PhD, MPH, Green Chemistry and Chemicals Policy: In the Program in Green Chemistry and Chemicals Policy, we work at the nexus of the environmental health sciences and public policy to advance the field of green chemistry: the design, manufacture and use of chemicals and products to reduce or eliminate adverse effects on human health and ecosystems. We work within the University, as well as with community groups and state and federal government to advance chemicals policy and address the implications for human health and the environment of the production, use and disposal of chemicals and products. Our work focuses more specifically on: occupational health, the science of endocrine disruption, sustainable production, exposure assessment, reproductive health, the cumulative impacts of multiple stressors on ecosystem health, and European Union chemicals policy. (More at: <http://coeh.berkeley.edu/greenchemistry/>)

STEER students would participate in elements of our daily work as well as conducting a research project on a specific topic. Although we work with students to tailor a project to their specific interests, possible projects could address the following topics:

- **Climate Change and Green Chemistry:** The links between climate change and the chemicals sector are not well studied, though they have many implications for public health and the environment. Increasing our understanding of these links has the potential to inform solutions which reflect the true complexity and interconnectedness of our environment. Specific research project topics include:

1. Contributions of the chemical sector to energy use and greenhouse gas production;
2. Synergistic impacts of multiple environmental stressors on ecosystems, including chemical contamination and climate change;
3. Unintended consequences of single-sector solutions: when a climate solution is toxic, or a safer chemical product has a larger carbon footprint;
4. Health and environmental impacts of emerging "clean" technologies, including occupational hazards and the local, international and environmental justice implications of the production, global transport and disposal of e-waste.
5. The role of green chemistry in mitigating health and environmental problems in the clean tech sector.

- **Shaping State Policy: Reviewing Assessment Tools:** In October, 2008, Governor Schwarzenegger signed into law two bills that require California Environmental Protection Agency to establish a new chemicals policy. We are working closely with the state on the implementation of these new laws, which call for development of several chemicals assessment tools. Possible projects include reviews of the tools used for the following processes:

1. **Chemical Prioritization:** Building on a review started in 2007, identify "best practices" from a range of chemical prioritization schemes used in Europe and Canada;

2. Life Cycle Assessment: Review existing life-cycle assessment models and their capacity to minimize risk-shifting among environmental media, exposure pathways or manufacturing sectors;
3. Alternatives Assessment: Assess strategies for the practical development and diffusion of safer alternatives.

12. Professor Martyn Smith, PhD: Dr. Smith is a professor of toxicology and conducts NIEHS-funded research aimed at finding the causes of blood cancers (e.g., leukemia and lymphoma) in adults and children. Dr. Smith uses a molecular epidemiology approach using state of the art biomarkers and cultured stem and progenitor cell model systems. He studies benzene as a model because it is an established cause of blood diseases. Dr. Smith has two NIEHS-funded grants, an NCI grant, and funding from the National Foundation for Cancer Research. In addition to the work described above, Dr. Smith will develop advanced methods from the detection, quantification, and remediation of human exposure to toxic substances. He is also an investigator on a grant studying genetic susceptibility to Non-Hodgkin's Lymphoma. Dr. Smith's laboratory facilities at UCB are extensive and support his team of post-doctoral researchers, graduate and undergraduate students.

13. Professor Robert Spear, PhD: Dr. Spear is an engineer with research interests in the assessment and quantification of human exposures to toxic and infectious agents in the environment. His early work concerned the exposure of agricultural workers to pesticides. In recent years his research has concerned the use of mathematical and statistical techniques in the assessment and control of both workplace and community exposures. His current work, in collaboration with colleagues at UCB and at the Sichuan Institute of Parasitic Disease in China, focuses on environmental determinants of the incidence and control of the parasitic disease schistosomiasis. His group has pioneered the use of GIS/GPS technology for mapping and geo-referencing field data, and they have utilized remote sensing technology for the assessment of snail habitat and other landscape features relevant to defining the scale of control strategies. These data and site-specific information from field surveys are integrated through mathematical models that allow both tracking and forecasting of disease intensity over time. Recent work has focused on defining the internal potential of a village to sustain disease transmission and the spatial inter-connectedness of the disease transmission process between villages.

Opportunities for high school and undergraduate students potentially relate to data collection in the field in China and methods for the interpretation and analysis of these field data in Berkeley. A staff of full-time researchers and graduate students are available and experienced in mentoring and supervising undergraduates in research experiences.