DEPARTMENT OF

ENVIRONMENTAL & OCCUPATIONAL HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

UNIVERSITY OF WASHINGTON

BIENNIAL REPORT

2007–2009

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Changing Needs... Unchanging Values

Carol Martin

The 2007–2009 biennium was a time of wrenching change for virtually everyone. The stock market collapsed, major companies folded, and unemployment rates soared. Washington state was not spared economic trauma, and the University of Washington experienced its share of bad news. Despite these challenges in our state and an equally stressful uncertainty about the shape of our future economy, the Department of Environmental and Occupational Health Sciences' mission remains unchanged. We continue to value clean air, clean water, safe food, and safe workplaces. These fundamentals are the focus of our research, teaching, and service, and in turn, our motivation to transfer and translate our research findings and technologies into highly effective prevention practices. Our work at the university remains strongly connected to this mission.

The cover of this report reflects the diversity of human activity and enterprise, and our common and universal need to protect our well-being as we engage in life's many tasks and challenges.

In our sixth biennial report, we describe research from our laboratories that work to protect the health and safety of children and teenagers in our local communities, address occupational hazards in the welding industry and in agriculture, and identify sources of air pollution in Puget Sound. Our research depends on strong collaborations and partnerships with local school districts, the Puget Sound Clean Air Agency, and the Washington State Restaurant Association, to name a few. These stories also demonstrate our commitment to support and train current and future practitioners.

Our department prepares students for challenges in environmental and occupational health, and is indebted to its alumni for the work they continue to do after graduation. For this reason, we also feature five alumni who have made important contributions to the field of environmental and occupational health and who are inspirational examples to our students. Their careers have led them to positions in industry, in academia, and in state and national policy-making agencies.

We hope you enjoy learning more about our department and the breadth of our research, teaching, service, and outreach efforts. Our ultimate goal is to improve public health outcomes through sound science that translates into effective public health practices and policies. Please join us as we describe a number of ways in which we strive to accomplish this goal.

—David Kalman, chair

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people and programs







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Professor David Eaton presents at a nanoscience and ethics forum
Jackelin Tran (MS, Occupational and Environmental Exposure Sciences, 2009) on a class field trip at a food processing plant
Research Scientist Dianne Botta in the lab
Members of the Field Research and Consultation Group

bottom row, l to r:
2009 Environmental Health Research Experience Program participants
PhD student Ryan Blood researches whole-body vibration on buses
Professor Zhengui Xia and her lab staff research molecular mechanisms involved in cell death

Gavin Sisk

KAREN VANDUSEN

Board Member,
Washington State Board of Health

PREVENTIVE MEDICINE

BS 1965
MSPH 1974

ALUMNI PROFILE

First of Many

Karen VanDusen explains her successful 43-year career in environmental health with the lines from the Robert Frost poem, "The Road Not Taken:"

Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference.

Now serving her second governor-appointed term on the Washington State Board of Health, VanDusen believes her decision to major in preventive medicine, even though there were no women in the program at the time, enabled her to enjoy many "firsts" in her career.

She was the first woman to graduate from the UW's Environmental Health undergraduate program (then part of the School of Medicine's Department of Preventive Medicine). In the same year, VanDusen was the first woman hired by the Seattle–King County Health Department as an environmental health specialist, so novel at the time that she was featured on the front page of a Seattle newspaper. She became the first woman president of the Washington State Environmental Health Association and the first woman board member of the National Environmental Health Association.

Later, VanDusen was a member of the first Environmental Health Program's management team in the "re-established" Washington State Department of Health, one of the first Environmental Health faculty members in the newly established UW School of Public Health and Community Medicine (as it was then called), and one of the first community members appointed to serve on the King County Board of Health.

VanDusen credits her career opportunities to the excellent grounding she received as a student in our department. Because of its approach to public health preparation and skill building, she learned "essential components of a successful career: complex knowledge and skills, coupled with being curious, working hard, being willing to go the extra mile, keeping a positive attitude, and being involved with professional organizations."

VanDusen has also taught at Western Washington University and The Evergreen State College, been a private consultant, directed the UW Department of Environmental Health and Safety, and held several offices in state and national public health and environmental health organizations. She cites the decade she spent as an undergraduate advisor and assistant professor in our department as one of her most rewarding.

To current students, VanDusen cites her concern with the growing gap left by those, like her, entering retirement. "The environmental health profession and public health agencies need strong, committed leaders as the public health system faces some of its greatest challenges."

"Remember," continues VanDusen, "it is the control of basic environmental health factors that have made some of the greatest gains in quality and quantity of life to date. Take elective classes that build a strong understanding of science and risk and develop communication skills and an understanding of community organizations. Learn government and legislative processes, public health policy, and the legal and historical framework that is the foundation of public health. Then be open to diverse career opportunities . . . and when a door of opportunity opens, go through it. It might just be the road that makes all the difference in your life." ■

At a Glance...

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Occupational and Environmental Medicine

Toxicology

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Undergraduate Program Office

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Field Research and Consultation Group

Occupational and Environmental Medicine Clinic

CENTERS, INSTITUTES, AND RESEARCH PROGRAMS

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Center for Ecogenetics and Environmental Health

Collaborative Center for Healthy Work and Environment

Disease Investigation through Specialized Clinically Oriented Ventures in Environmental Research

Institute for Risk Analysis and Risk Communication

- *Center for Child Environmental Health Risks Research*
- *Pacific Northwest Center for Human Health and Ocean Sciences*
- *Pacific Northwest Center for the National Children's Study*

Multi-Ethnic Study of Atherosclerosis and Air Pollution

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Occupational Epidemiology and Health Outcomes Program

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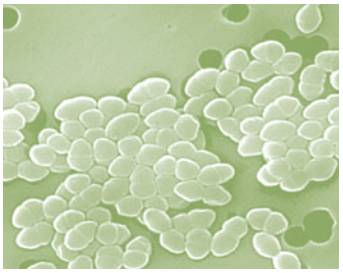
In More Detail...

Degrees, Programs, Centers, and Institutes



IN OUR DEPARTMENT...

We identify, seek to understand, and help manage the effects of the environment on human health by

- evaluating and controlling workplace hazards
- investigating issues of food and water safety
- discovering the mechanisms of occupationally and environmentally related diseases
- improving methods for treatment and disposal of solid and toxic wastes
- researching how the environment interacts with genetics to influence human health
- studying how environmental chemicals affect the health of children
- educating the next generation of occupational and environmental health professionals

ACADEMIC PROGRAMS AND DEGREES

Graduate Academic Programs and Degrees

Environmental Health (EH) students learn to identify sources of contamination in air, water, soil, and food; how contamination is spread; strategies to prevent or control effects on human health or environmental quality; and means of communicating risk information to the public and to health professionals. Students can earn an Master of Science (MS) degree in Environmental Health and a doctorate (PhD) degree in Environmental and Occupational Hygiene. *http://depts.washington.edu/envhlth/acad_programs/eh/*

Occupational and Environmental Exposure Sciences (ES) (formerly Industrial Hygiene and Safety) students learn to identify, evaluate, and manage health risks found in a wide variety of community and occupational settings. Students earning the MS degree become skilled health professionals and have the option of completing either a thesis or a project/portfolio. Students earning a PhD degree in Environmental and Occupational Hygiene obtain advanced research training in exposure assessment and control methods. *http://depts.washington.edu/envhlth/acad_programs/es/*

The **Occupational and Environmental Medicine** (OEM) program gives physicians a better understanding of the clinical and scientific principles in environmental and occupational health. Training can focus on epidemiology, occupational and environmental hygiene, biostatistics, health services, and toxicology. This program leads to an MPH degree. A concurrent residency/fellowship program is available. *http://depts.washington.edu/envhlth/acad_programs/oemp/*

The **Toxicology** (Tox) program focuses on identifying, understanding, and analyzing toxic agents and their effects on human health. Research areas include neurological, hepatic, renal, and respiratory systems; prenatal and neonatal development; and carcinogenic and genetic effects of toxicants. The program also offers a focus on risk assessment. Both MS and PhD degrees are offered. *http://depts.washington.edu/envhlth/acad_programs/toxicology/*

The **Environmental and Occupational Health** (EOH) Master of Public Health degree program focuses on the recognition, assessment, and control of environmental and occupational hazards, the impact of these hazards on health and society, and approaches to regulations, enforcement, and policy

l to r: Eric Tanenbaum (BS, 2009); Members of the Pacific Northwest Agricultural Safety and Health Center; Research Scientist Mike Espinoza; vancomycin-resistant *enterococci*; Environmental Health Laboratory staff; Research Professor Gary Franklin; Continuing Education Program staff



Photo credits (l to r): Charles Treser, Sarah Fischer, Sarah Fischer, CDC/Janice Haney Carr, Sarah Fischer, Rae Wu, Letty Limbach

development. In contrast to the MS degree programs, which are measurement-oriented and specialized, this MPH degree program provides a broader perspective, with emphasis on applications and policy implications. *http://depts.washington.edu/envhlth/acad_programs/mph-eoh/*

The **Master of Public Administration** and **Master of Science** or **Master of Public Health** (MPA/MS or MPA/MPH) are concurrent master's degree program options with the Daniel J. Evans School of Public Affairs (Evans School). The four concurrent degrees are: MPA/MS Environmental Health, MPA/MS Exposure Sciences, MPA/MS Toxicology, and MPA/MPH Environmental and Occupational Health. These programs are structured for students interested in environmental and occupational health and its use in public health policy and management. The collaboration between our department and the Evans School makes it possible to complete the two degrees in three years rather than four, with faculty from both schools involved in teaching, advising, and research. *http://depts.washington.edu/envhlth/acad_programs/concurrent/*

Undergraduate Academic Degree Program

Through our **Bachelor of Science in Environmental Health** program, students learn to identify and control environmental factors that can adversely affect human health. Our faculty introduce students to potential environmental health hazards, risk assessment, prevention, and epidemiological and microbiological principles. Because environmental health students work with tools commonly used in the field, they are well prepared to find meaningful employment after graduation, or to further their education in a graduate or professional degree program. *http://depts.washington.edu/ehug/*

SERVICE PROGRAMS

The **Continuing Education Program** (CE) provides environmental and occupational health training in Washington, Oregon, Idaho, and Alaska. *http://depts.washington.edu/ehce/*

CE has four components:

- The **Worker Education and Training Program** provides training on hazardous waste, emergency response, and related topics to tribal governments and organizations, pre-apprenticeship programs, and other underserved worker populations in our region.
- The **Northwest Center for Occupational Health and Safety Continuing Education** program supports professional, employer, and worker education in industrial hygiene and safety, ergonomics, occupational medicine, and occupational health nursing. *http://depts.washington.edu/ehce/NWcenter/schedule.html*
- The **Pacific Northwest OSHA Education Center** offers open enrollment courses, which are tailored to individual employers, and Safety and Health Specialist Certificate programs, meeting standards set by the Occupational Safety and Health Administration (OSHA). *http://depts.washington.edu/ehce/OSHA/index.html*
- The **Young Worker Safety and Health Program** provides training and develops and distributes high school curriculum materials throughout Washington state to raise awareness of workplace health and safety issues for working teenagers. *http://www.uwworksafe.com/*

The **Environmental Health Laboratory** provides consultation and chemical analytical services to Washington's employers, labor groups, and governmental organizations. It also assists researchers within the university. The laboratory has been accredited by the American Industrial Hygiene Association since 1977. *http://depts.washington.edu/ehlab/*

The **Field Research and Consultation Group** conducts field-based research and provides occupational health and safety consultation to companies that request assistance. Consultants observe work practices, collect samples or data, obtain laboratory analyses, and make recommendations for controlling workplace exposures. Priority is given to small businesses whose problems are not readily addressed by the private sector. *http://depts.washington.edu/frcg/*

The **Occupational and Environmental Medicine (OEM) Clinic** provides care to patients with illness or injury caused by occupational or environmental exposures. The multidisciplinary group includes specialists in occupational medicine, internal medicine, neurology, pulmonary medicine, pediatrics, industrial hygiene, toxicology, epidemiology, and public health. It is also a Center of Occupational Health and Education, improving workers' compensation through educational outreach. The clinic provides consultation services on a wide range of medical, legal, and regulatory issues that affect workers throughout the state. *http://depts.washington.edu/oemp*

CENTERS, INSTITUTES, AND RESEARCH PROGRAMS

The **Center for Chemically Related Illness** is managed by the Occupational and Environmental Medicine program. At the center, patients receive clinical evaluation and treatment for medical conditions caused by chemical exposures. The center's outreach programs improve public understanding of the health effects of chemical hazards. The center also conducts research to better understand chemically related illnesses and to improve the quality of care for patients. *http://depts.washington.edu/oemp*

The **Center for Ecogenetics and Environmental Health** (CEEH), funded by the National Institute of Environmental Health Sciences (NIEHS), studies how genetic factors influence human susceptibility to environmental health risks and diseases. Within CEEH, the Community Outreach and Ethics Core seeks to improve public understanding of the ways genetic and environmental factors interact to increase the risk of disease. The center, in collaboration with the UW Institute for Public Health Genetics, addresses the ethical, legal, and social issues related to genetic information and gene-environment interactions. The center provides support and access to state-of-the-art research tools to its nearly 100 members through several "Facility Cores," including Functional Genomics, Functional Proteomics, and Analytical Cytometry. These cores allow CEEH investigators to perform genetic analyses of large numbers of samples. In 2009, a metabolomics core will be added. *http://depts.washington.edu/ceeh/*

The **Collaborative Center for Healthy Work and Environment**, formally the International Scholars in Occupational and Environmental Health, is funded by the Fogarty International Center of the US National Institutes of Health (NIH). This center focuses on training through research on high priority health issues in collaborating countries, primarily Vietnam, Thailand, Cambodia, and Laos. *http://depts.washington.edu/cchwe/*

Our department was awarded a **DISCOVER Center on Cardiovascular Disease and Traffic-Related Air Pollution**. Center researchers are examining the relationship between exposure to traffic-related air pollutants and the occurrence of cardiovascular diseases. The study, composed of five closely linked projects, aims to increase understanding of human biological mechanisms affected by air pollution. The ultimate mission is to transfer the research findings into improved clinical and public health practice.

The **Institute for Risk Analysis and Risk Communication** (IRARC) works to improve risk assessment methods and the scientific foundations supporting risk assessments. IRARC serves as an integrating institute that includes three research centers and related research activities. *http://depts.washington.edu/irarc/*

- The **Center for Child Environmental Health Risks Research** is funded by the US Environmental Protection Agency (EPA) and NIEHS to understand the mechanisms that define children's susceptibility to pesticides. Center researchers work in the lab, in the field, and in the community to bring a unique approach to the study of children's environmental health. *http://depts.washington.edu/chc/*
- Researchers in the **Pacific Northwest Center for Human Health and Ocean Studies** investigate the links between ocean processes and human health, how environmental conditions trigger blooms of harmful algae in marine waters and their impact on human health. This center is funded by NIEHS and the National Science Foundation and includes researchers from our department and the UW College of Ocean and Fishery Sciences. *http://depts.washington.edu/pnwh2o/*

- The **Pacific Northwest Center for the National Children's Study** is one of 22 study centers across the nation selected to assess environmental influences on the health and development of children from before birth through age 21. Overall, the national study will involve a representative sample of 100,000 children in order to understand how diseases, such as asthma and autism, may be influenced by environmental factors and genetics.

The **Multi-Ethnic Study of Atherosclerosis and Air Pollution** (MESA Air) investigates the relationship between long-term air pollution exposure and the development of cardiovascular disease and progression of subclinical atherosclerosis. MESA Air participants are a diverse group of more than 6,000 men and women from six states across the United States. Funded by a 10-year major research grant from the EPA, the study is headquartered at the UW, and involves more than a dozen collaborating institutions. MESA Air builds on the MESA study, a large-scale NIH medical research study of characteristics and risk factors of heart disease. During the MESA Air study, researchers will estimate participants' levels of air pollution exposure to better understand the health effects of pollutants. *http://depts.washington.edu/mesaair/*

The **Northwest Center for Occupational Health and Safety** is one of 17 education and research centers funded by the National Institute for Occupational Safety and Health (NIOSH). It supports graduate and continuing professional education in industrial hygiene and safety, occupational medicine, and occupational health nursing. The center serves practitioners in Washington, Oregon, Idaho, and Alaska. *http://depts.washington.edu/nwcohs/*

The **Occupational Epidemiology and Health Outcomes Program** conducts research to identify factors related to preventable disability among injured workers; develops evidence-based quality indicators, guidelines, and technology assessments related to injured worker health care; and conducts program evaluation of health care delivery innovations for the state workers' compensation system. *http://depts.washington.edu/occepi/index.html*

The **Pacific Northwest Agricultural Safety and Health Center** (PNASH) conducts research and promotes best health and safety practices for Northwest producers and workers in farming, fishing, and forestry. PNASH works closely with employers, labor groups, community organizations, health care providers, government agencies, and other universities in the region. PNASH researchers provide expertise in exposure assessment of chemical hazards and new production technologies, work with underserved and vulnerable populations, and transfer research findings and solutions to the agricultural community. Current projects address pesticide safety, heat-related illness, traumatic and musculoskeletal injuries, and microbial hazards. *http://depts.washington.edu/pnash/*

The **Pediatric Environmental Health Specialty Unit** (PEHSU) is a regional training and consultation center for clinicians and public health professionals in Alaska, Idaho, Oregon, and Washington. Its services address identification, prevention, diagnosis, management, and treatment of environmentally related health effects in children. PEHSU is funded by the Centers for Disease Control and Prevention–Agency for Toxic Substances and Disease Registry and the EPA. *http://depts.washington.edu/pehsu/*

The **Superfund Research Program** is an NIEHS-sponsored, interdisciplinary program among researchers from our department, Epidemiology, Biostatistics, Pathology, Genome Sciences, Civil Engineering, and Forest Resources. The program has two overall goals. The first is to develop biological markers that indicate damage to the nervous system caused by chemicals commonly found at hazardous waste sites. The second is to develop ecological and engineering methods to monitor and reduce these exposures in the environment. Research findings are disseminated by our Research Translation and Outreach Core to government agencies, community groups, and other stakeholders in the Puget Sound area. *http://depts.washington.edu/sfund/* ■

OEM Clinic staff (top row, l to r): Elena Schroeder, Jordan Firestone, Kathlene Mirgon, Jane Bean, Amy King, Regina LaVassaur (bottom row, l to r): Nancy Beaudet, Ginger Ellingson, Catherine Karr, Victor Van Hee

Letty Limbach

Eddy Rauser

DAVID BONAUTO

Associate Medical Director, Safety and Health
Assessment and Research for Prevention Program (SHARP),
Washington State Department of Labor and Industries

OCCUPATIONAL AND ENVIRONMENTAL MEDICINE

MPH 2000

ALUMNI PROFILE

On the Front Lines, Keeping Workers Safe

Almost every week, David Bonauto drives more than 120 miles round trip to treat injured workers at the Harborview Occupational and Environmental Medicine (OEM) Clinic in Seattle. He considers his clinical work important to his full-time job in Olympia as associate medical director in the Safety and Health Assessment and Research for Prevention (SHARP) Program. SHARP, which receives federal funding to track occupational illnesses and diseases, offers evidence-based information about workplace health and safety prevention strategies to employers and workers in Washington state.

"We're a research program," Bonauto explains. "Part of our efforts is to create new knowledge, to try to identify areas where more information about occupational safety and health is needed, to focus our research on industries at highest risk for occupational injury and illness, and to be innovative in our approaches to getting the word out about occupational safety and health."

SHARP's data and analyses create an important knowledge base for policy decisions made by the Washington State Department of Labor and Industries (L&I). L&I works to protect the safety, health, and security of Washington's workers and manages the workers' compensation system.

Bonauto received his undergraduate degree from Bowdoin College in 1987, and took a job at the General Electric Corporation, where he worked on new compounds and filed seven US patents in two years. He earned his MD degree at Columbia University College of Physicians and Surgeons in 1993, then trained in Internal Medicine at Columbia Presbyterian Medical Center, and received his board certification in 1996.

He later moved to Washington state and took a position in a Bremerton hospital, where he saw patients who suffered from lung-related diseases, potentially linked to their work in naval shipyards. His interest in work hazards led him to enroll in our department's Occupational and Environmental Medicine program, where he received his MPH in 2000. He accepted a position with SHARP soon after and has been there ever since.

Among other primary responsibilities, Bonauto conducts long-term studies to determine the relationships between workplace exposures and injuries and illnesses.

As an attending provider at the OEM Clinic, Bonauto says his work allows him to understand "the dynamics of being injured, how workers relate to their employers, the workers' compensation system, and difficulties in going back to work." Workers may fear being injured again, and the job may not be able to accommodate the limitations created by the worker's injuries, explains Bonauto. At the clinic, he also experiences firsthand how the workers' compensation system functions.

"Relative to a lot of other systems," he says, "it's pretty impressive in its efforts to protect and take care of injured workers and be efficient in claims."

While his job is one of a kind, he is optimistic that DEOHS graduates will find rewarding opportunities in government work. The program at the UW, says Bonauto, is looked on favorably, and he says graduates he has worked with "do high-quality work."

Bonauto is a clinical assistant professor in our department and in the Department of Medicine. ■

What we do...
and whom we serve







Photo credits (top row, l to r): Stacey Holland, Diesel Bus Study team, Courtesy of Rick Neitzel, Cathy Schwartz; (bottom row, l to r): Jennifer Gill, Ken Hammond USDA, Stacey Holland

top row, l to r:

Personal protective equipment is important to workers in industry

The Diesel Bus Study team monitored more than 200 school buses before and after retrofits

PhD student Rick Neitzel measures noise levels of forestry equipment

Researchers measured air pollution in Puget Sound, including at the port

bottom row, l to r:

PhD student Erin Peck and Ming-Yi Tsai (PhD, Environmental and Occupational Hygiene, 2007) present on climate change

PEHSU's team of experts provide evidence-based advice on the role of environmental exposures on child health

PNASH conducts research on environmental and occupational health risks that Washington's agricultural workers may encounter

Tackling Welding Hazards

New Avenues to Better Control Workplace Risks

Welding is a workplace task with significant hazards, including common injuries and illnesses, such as burns and metal fume fever. Welders are among workers regularly seen in our Occupational and Environmental Medicine Clinic at Harborview. The clinic offers comprehensive services for the treatment of occupational and environmentally related exposure, illness, and injury.

Research suggests that occupational exposures to welding fumes may increase the risk of respiratory and neurological disease. However, the available data generally are too limited to offer conclusive answers. According to the National Institute for Occupational Safety and Health (NIOSH), scientists and policymakers face a need for more and better data on ways to understand and reduce exposures to welding fumes.

DEOHS researchers are studying ways to prevent injuries and illness to determine safer work practices for welders. A multi-pronged approach is likely to be more successful in addressing the occupational hazards involved and determining which strategies can be employed to reduce these risks. The variety of expertise in our department allows us to research different facets of welding hazards, which in turn, can provide new avenues to better control workplace risks and keep welders safe.

Welder uses a local exhaust ventilation system

Bridget Igoe

In this article, we highlight our research projects and also show how they provide educational opportunities for our students, who work alongside researchers on real-life problems that affect our state's workers and businesses.

EXPOSURES AND PARKINSONISM

DEOHS researchers are using epidemiological methods to investigate welders' exposures to manganese and other metals as risk factors for parkinsonism. The evidence from previous research on parkinsonism among welders is inconsistent and controversial.

Parkinsonism is a syndrome that is characterized by bradykinesia or extreme slowness of movements, rigidity, and involuntary tremor. Parkinson's disease is one major form of parkinsonism, and affects more than one million people in the United States. Several other diseases manifest similar symptoms, including manganism, which is also classified as a parkinsonian syndrome. Manganism or manganese poisoning is a condition resulting from chronic exposure to manganese fume. However, manganese exposure in the workplace may not be identified as a risk factor because a worker exposed to manganese shows subtle symptoms that develop over time and the condition manifests similar symptoms to the non-occupational Parkinson's disease.

Some material safety data sheets on welding metal alloys list parkinsonism as a potential hazard. Yet, no definitive epidemiologic evidence has been published to support this hazard assessment. In fact, there remains substantial controversy regarding the relationship between welding and parkinsonism, justifying the need for further epidemiologic study.

A study published in 2005, led by Dr. Brad Racette of Washington University in St. Louis, Missouri, suggested a link between occupational exposure to manganese fumes and elevated risk of parkinsonism in welders.

DEOHS Professors Harvey Checkoway and Noah Seixas are collaborating with Racette on an epidemiological study to assess the relationship between exposure to manganese and other metals and the risk and progression of parkinsonism

in shipyard welders. Approximately 1,000 shipyard welders in Wisconsin volunteered and as part of the study, will undergo standardized neurological examinations to determine whether they have parkinsonism. Welding fume exposures will be assessed by reviewing historical exposure monitoring data and measuring blood levels of manganese and other metals. Follow-up exams will be conducted to assess disease progression. Funding for this research is provided by the National Institute of Environmental Health Sciences through the UW Superfund Research Program grant. Findings from this study will help workers, businesses, and health care providers better understand the risks of welding on manganese steel.

SHIPYARD WELDERS AND EXPOSURES

Predicting welders' exposures isn't always easy. Exposures can vary by type of ventilation used, type of welding performed, and duration of welding activity, as welders typically don't weld for eight hours straight. Two key factors in determining level of exposure are the type of welding done and the space in which welders work.

Joseph Nelson, a graduate student in the Occupational and Environmental Exposure Sciences program, is working with Professor Noah Seixas to characterize welding fumes and to predict exposures to welders who work in the shipyards.

Nelson collected 165 samples of welding fumes from air samplers worn by more than 60 welders. He analyzed these welding fume samples for 12 different metals and total particulates. Early results showed that the shipyard welders he evaluated were exposed to an average of 4.4 mg/m^3 of welding fumes when working outdoors, 7.7 mg/m^3 when working in a shop, 7.8 mg/m^3 when working in an enclosed space, and 12.9 mg/m^3 when working in a confined space. Enclosed spaces include cargo holds, tanks, quarters, machinery, and boiler spaces. Confined spaces are smaller, allow limited access, and may restrict the natural movement of air; examples include a ship's double bottom tank, cofferdam, or other space which by its small size and confined nature can readily create or aggravate a hazardous exposure.

Welders work in all types of spaces, from confined to open spaces outdoors

Martin Cohen; background images: ©2009 www.photos.com

Best Practices for Welders, a video training package and manual developed by the Field Research and Consultation Group

background images: ©2009 www.photos.com

Seventy percent of the samples collected exceeded NIOSH's recommended exposure limit for manganese. Of the workers who were exposed to levels of manganese greater than the recommended exposure limit, only 40% used ventilation or respiratory protection, observed Nelson.

He hopes his study will help employers in the shipyards set policy for welder exposures and will also affect work practices, particularly given that his results suggest that respiratory protection should be required until improvements in ventilation use and configuration can be made.

CHROME 6

In addition to manganese, another compound receiving a great deal of attention is hexavalent chromium or chrome 6. The consequences of excessive exposure to airborne chrome 6 include damage of the nasal septum, asthma, bronchitis, lung cancer, and skin changes, including allergic dermatitis.

In February 2006, the US Department of Labor's Occupational Safety and Health Administration (OSHA) lowered the permissible exposure limit for chrome 6 from 52 to 5 micrograms per cubic meter of air. Chrome 6 can be found in paints, pigments, metal plating, and wood-preserving solutions and also can be generated when welding or thermal cutting on stainless steel or other metals with high chromium content.

Nationwide, the new rule impacts 558,000 workers in general industry, including painters, metal platers, and welders. Fifty percent of these workers are welders who work in a wide variety of industries, including metal fabrication shops, foundries, shipyards, and maritime maintenance.

Over the past two years, the Field Research and Consultation Group (Field Group) has collected air monitoring data on welders' exposures. The Field Group found that almost 40% of the samples collected from welders working on stainless steel showed exposures to chrome 6 greater than the permissible exposure limit.

AIRBORNE EXPOSURES

While some effects linked to chrome 6 might arise from topical exposure, others are clearly dependent on the uptake and distribution of the metal within the human body.

The respiratory system filters out particles as the air moves into the lungs. But the smallest particles, those that can enter the lung sacs or alveoli, may then enter the blood stream and eventually be eliminated through the urine. Researchers have long suspected that the levels of chrome 6 concentrations inhaled, absorbed, and deposited in the human body vary according to the size distribution of the particles dispersed in the air. Size distribution refers to the range of particle diameters and the relative abundance of particles at each size. Particles with diameters greater than about 10 micrometers have a low likelihood of entering the respiratory tract beyond the throat; as diameters fall below this value, particles have a greater likelihood of entering the alveoli, and therefore, pose increasing threat of lung damage and uptake by the body.

Because data are limited to support the theory that individual exposures are associated with particle size, Danielle Parette (MS, Industrial Hygiene and Safety, 2009) worked with Professor Michael Morgan to compare the exposure of painters and welders to airborne concentrations of chromium. Parette's study investigated these two work processes to assess the size distribution of chrome 6 particles and how the size of the particles may have played a role in determining how much of the compound was absorbed into the body.

Welders performing manual metal arc welding on stainless steel are exposed to welding fumes that contain fine particles with diameters of less than 2.0 micrometers. Spray painters often use pigments containing chrome 6, but the pigments are expected to be encapsulated in relatively impermeable paint particles whose diameters are typically greater than 8.5 micrometers.

Parette found that five of the seven welders tested showed an increase in urinary chromium levels over a work week while

six out of nine painters showed the opposite: a decrease in total chromium levels over the same period. Her results, says Parette, suggest that processes generating "smaller sized particles may result in a greater amount of total chromium biomarker in the urine due to the ability of smaller particles to penetrate deeper into the lungs and cross the respiratory membrane more readily."

Another department graduate, Timothy Carter (MS, Occupational and Environmental Exposure Sciences, 2009) worked with Morgan on a related study and examined the particle size distribution and bioavailability of chrome 6 compounds generated by two processes, chromic acid electroplating and spray-painting using chromium-based pigments. He found that electroplaters had higher urinary chromium levels and were exposed to a significantly greater fraction of respirable-size chrome 6 particles than spray-painters.

Biomonitoring for chrome 6 uptake, coupled with information about the size distribution of chromium fume or dusts, will improve the ability of occupational health professionals to evaluate the risks from exposure and the effectiveness of respiratory protection programs and other exposure controls.

HOW EFFECTIVE ARE LEV SYSTEMS?

Given that many welders already use local exhaust ventilation (LEV) or respirators, departmental researchers are investigating the degree of protection these offer.

Oleg Antonchuk (MS, Industrial Hygiene and Safety, 2008) worked with Professor Noah Seixas and the Field Group to evaluate LEV used in welding. An LEV is a mechanical system that draws fumes away from the welder's breathing zone. This is the preferred method to capture airborne contaminants at their source, thereby potentially reducing or even eliminating the need for respiratory protective devices.

Antonchuk evaluated two common LEV systems and two common types of welding, gas metal arc and flux core arc. He looked at differences in the exposures among welders using the two LEV systems and no ventilation at all while welding in four different positions.

His results showed that LEV systems were effective if the distance between the hood and the source of fumes were no more than two duct or hood diameters from the arc or weld. (The Field Group recommends no more than 1.5 duct diameters.) However, maintaining a close proximity to the weld is not always feasible in some industrial settings. Additional determinants, such as welder's body position and type of welding process used also influence the effectiveness of LEV systems.

BEST PRACTICES FOR WELDERS

In 2009, the Field Group developed a video training package applicable to all industrial sectors in order to raise awareness of welders' potential exposures to chrome 6. The Hexavalent Chromium Exposure Controls (HexChEC) video training package includes six modules on chrome 6 health hazards and best practices for reducing fume exposures, emphasizing the effective use of LEV systems. An accompanying manual and poster tool for assessing potential exposures are also included.

The training materials were funded by a Washington State Department of Labor and Industries (L&I) Safety and Health Investment Projects (SHIP) grant. The Field Group worked closely with the Puget Sound Shipbuilders Association and the Western Washington Chapter of Sheet Metal Contractors of North America, as well as an advisory group of welders and their employers.

The video shows footage of preferred and proven exposure controls for welders, and in particular, the effective use and placement of LEV systems. The materials will be available free of charge on the L&I website: *http://www.lni.wa.gov/*.

FURTHER READING

Antonini JM. Health effects of welding. *Crit Rev Toxicol* 2003;33(1):61–103.

Hexavalent chromium: *http://lni.wa.gov/Safety/Topics/AtoZ/default.asp?KWID=363*

Occupational Safety and Health Administration's safety and health topics: Welding, cutting, and brazing *http://www.osha.gov/SLTC/weldingcuttingbrazing/*

NIOSH strategic research on welding identifies data needs, Advances studies: *http://www.cdc.gov/niosh/updates/welddata.html*

Racette BA, Tabbal SD, Jennings D, Good L, Perlmutter JS, Evanoff B. Prevalence of parkinsonism and relationship to exposure in a large sample of Alabama welders. *Neurology* 2005;64:230–235. ■

Occupational Health & Safety

A Retrospective of the Education and Research Center

For more than 32 years, the Northwest Center for Occupational Health and Safety (NW Center) has been a widely recognized training ground for current and future practitioners interested in occupational health and safety and the proper management of hazardous materials. A diverse offering of continuing education courses brings the NW Center in frequent contact with business, labor, and practitioners to share research findings meaningful to practice.

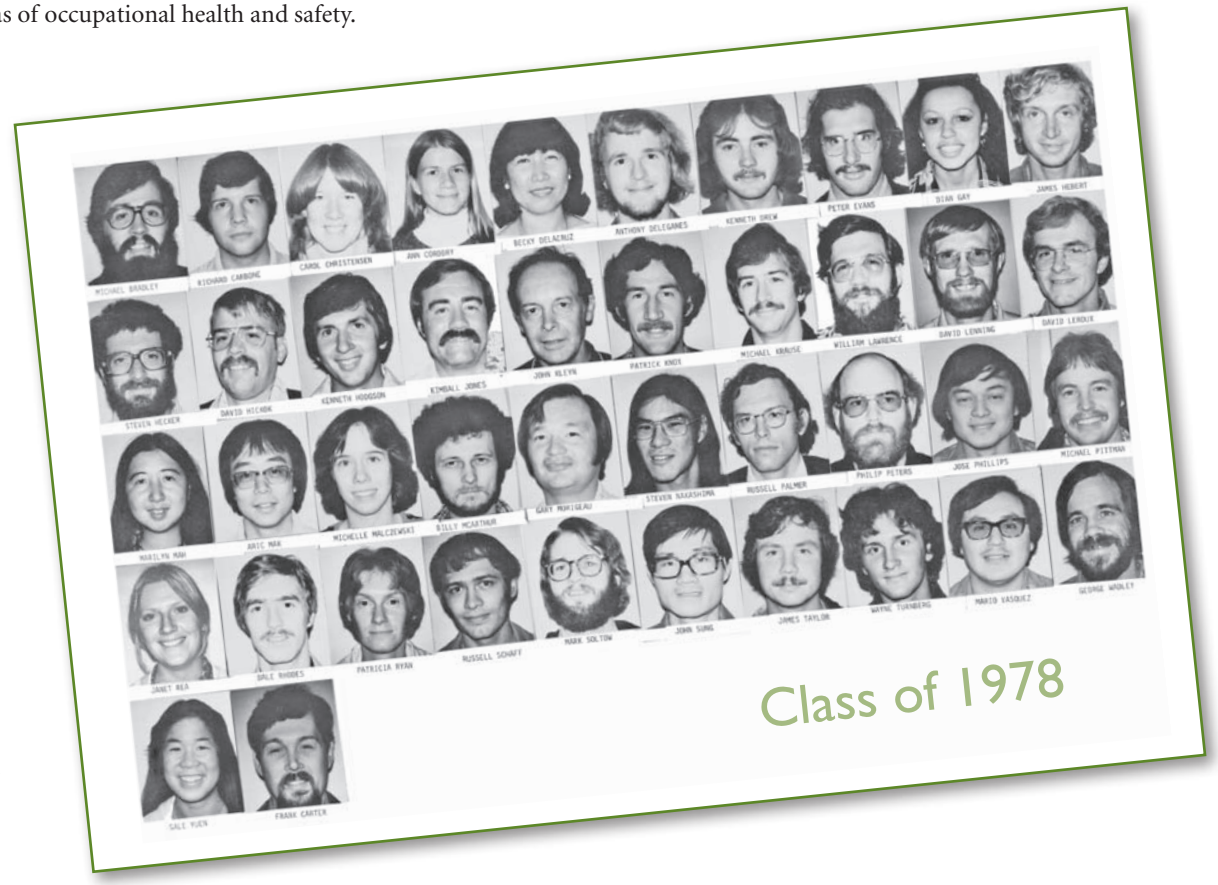
In 1977, the University of Washington was one of the first institutions in the country to receive funding from the National Institute for Occupational Safety and Health (NIOSH) to start an Education and Research Center (ERC), and serve the four-state region: Washington, Alaska, Idaho, and Oregon. NIOSH currently funds 17 of these university-based ERCs around the country.

Directed by Professor Noah Seixas, the NW Center receives approximately $1.2 million per year from NIOSH. This federal funding, combined with long-time departmental support, has allowed DEOHS and the NW Center to build a solid infrastructure in the areas of occupational health and safety.

STUDENT SUPPORT

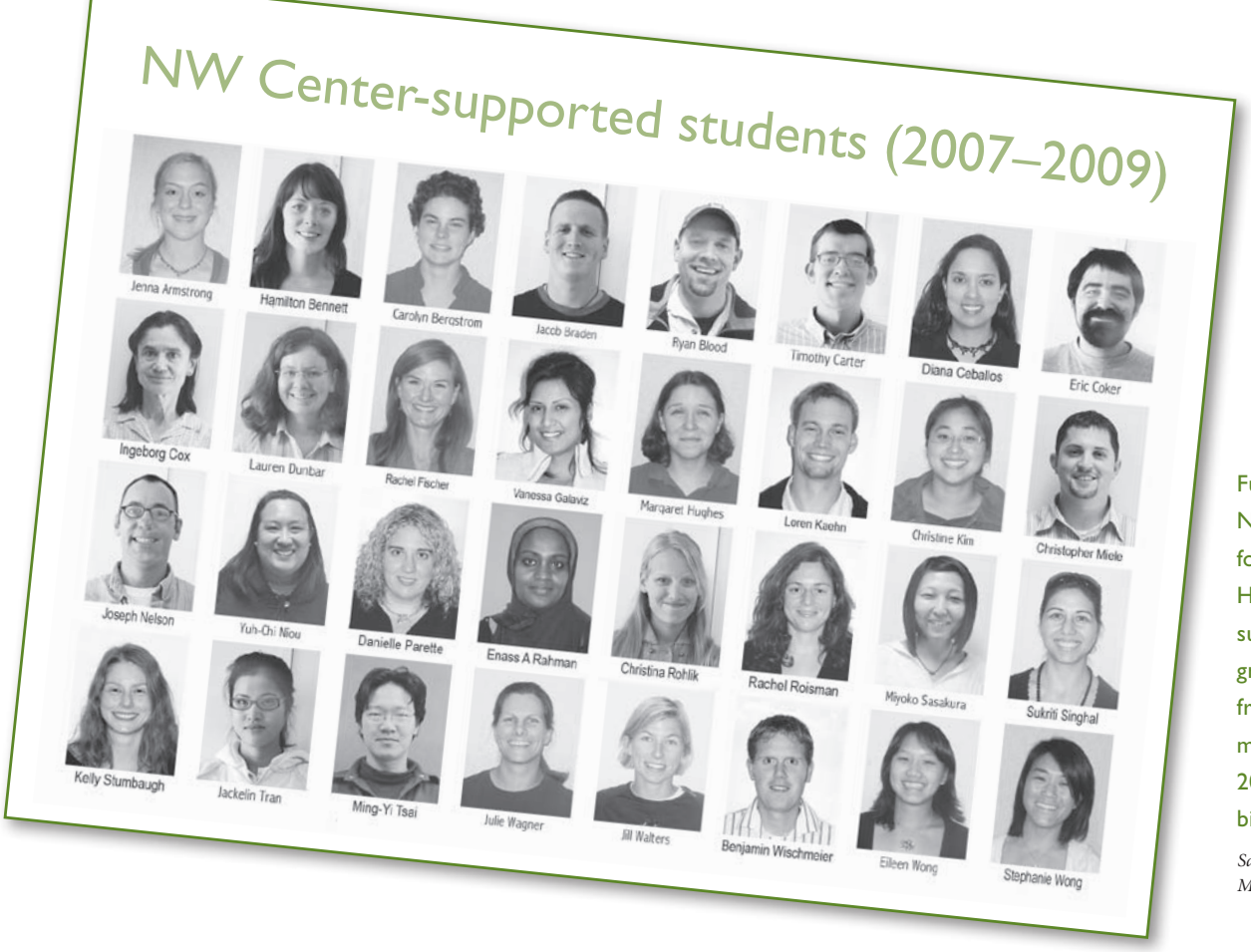
The majority of funding received from NIOSH supports graduate students intending to pursue careers in occupational health and safety. During the 2007–2009 biennium, the NW Center supported graduate students in our department as well as in nursing and health services. Students enroll in one of five specializations, which include exposure sciences (industrial hygiene), occupational medicine, occupational health nursing, hazardous substances management, and occupational health services.

The NW Center provides opportunities for students in different fields to collaborate and work with the NW Center's 37 core and 59 affiliated faculty from various disciplines. "This characteristic differentiates the NW Center's program from every other training grant program," says Professor Michael Morgan, director of the NW Center from 1998 to 2003. He explains: "the goal of NIOSH is to foster better understanding in each discipline of what the other disciplines do and are



Some of the students enrolled in our department's graduate degree programs in 1978 were funded by the newly established Northwest Center for Occupational Health and Safety

DEOHS Archives



Funding from the Northwest Center for Occupational Health and Safety supported 32 graduate students from our department during the 2007–2009 biennium

Sarah Fischer, Monica Leibrant

capable of. The idea is to make all occupational health and safety professionals more effective through their enhanced understanding of the skills and abilities of the others."

When professionals with common foundational knowledge and goals combine their different skill sets, they can better prevent and minimize the risks associated with the workplace, says Professor Emeritus Gerald van Belle, former chair of the department and director of the NW Center from 1991 to 1998. "The state benefits from this kind of center. Students are funded. They learn science, and also do some good," he says.

A new proposal by the NW Center calls for "Collaborative Research Training" to support graduate students who would like to focus on occupational health issues but are in disciplines not yet covered by the program, explains Seixas. The disciplines being proposed include epidemiology, toxicology, and industrial and systems engineering.

The NW Center has had a tremendous influence on training professionals in fields related to occupational health and safety, especially within Washington state. Notably, in a 2009 alumni survey commissioned by the NW Center and our department, nearly all of the alumni surveyed worked in a field related to environmental and occupational health, and more than half have worked in the field for 10 or more years. In fact, 69% of the alumni surveyed said their employment was in Washington state. Most felt they had made a positive impact on the environment, worker health and safety, and general population health and safety in their careers. The alumni surveyed included a large portion of graduates who had been supported by the NW Center when they were students in our department as well as in the Occupational Health Nursing Program and the Health Services Research Training Program.

Of the survey respondents who graduated in the last 15 years, 79% rated the training they received as "excellent" or "very good." Two out of every five alumni were "very" or "somewhat likely" to take a continuing education course within the next five years, and nearly two-thirds of the respondents had taken a continuing education course within the past 10 years.

CONTINUING EDUCATION

The NW Center's continuing education courses are largely for practicing occupational health professionals: nurses, physicians, industrial hygienists, and safety professionals. Department faculty, practitioners, or partner faculty from other universities develop the curriculum, explains Steven Hecker, director of Continuing Education and Outreach. Our department's Continuing Education Program (CE) offerings now include three distinct but interrelated programs: the NW Center courses, the Pacific Northwest OSHA Education Center, and hazardous materials and emergency response

courses funded through the Worker Education and Training Program of the National Institute of Environmental Health Sciences (NIEHS) Western Regional University Consortium.

Sharon Morris, director of CE from 1983 to 1994, explains that all continuing education courses were conducted at NIOSH headquarters in Cincinnati before the ERCs were created. After ERCs were funded, more people had access to safety and health training and a greater variety of courses could be offered across the country.

Morris was present at the "birth" of the ERCs. Before she came to the UW, she was a legislative officer at NIOSH, where she served as the agency's liaison to Congress. She participated in meetings the NIOSH director, the late Dr. Jack Finklea, held with members of Congress to develop and fund ERCs around the country. Later, she transitioned from a policy-making position to the UW, where she played a role in shaping our ERC program. Morris retired from the UW in June 2005.

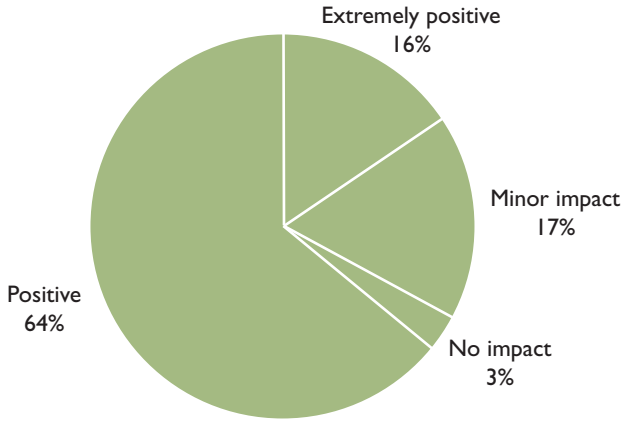
The NW Center has been a pioneer in calling attention to occupational health issues. Sharon Morris started the Conference on Occupational Hazards to Health Care Workers in 1983. Nothing like it existed at the time, says Hecker. Morris remembers it as a brainchild of then Department Chair Gilbert Omenn. "His concern was that health care workers looked after the health of others, but they were not aware of hazards to their own health," says Morris. One of the first articles published in peer-reviewed literature on the hazards faced by health care workers came out of the initial conference. The conference was offered every two or three years, for 24 years.

Efforts to bring national health issues to the forefront continue, such as offering courses on patient handling and workplace violence. Also in 2009, CE helped plan and develop the Nanotechnology Health and Safety Forum in Seattle. Co-sponsored with the Battelle Memorial Institute and a broad consortium of public and private partners, the forum brought together representatives from insurance companies, law firms, national regulatory agencies, non-profits, private manufacturing and research companies, as well as toxicologists and other related academic professionals. In December 2009, the NW Center will host a Forum on the Aging Workforce, another issue critical to business and labor as the current economy influences a shift in workforce demographics.

The NW Center uses a combination of open-enrollment courses in large population centers, such as Seattle and Spokane, Washington; Portland, Oregon; Boise, Idaho; and Anchorage, Alaska; and alternative methods, such as video, e-learning, and customized on-site training to reach people in remote areas. For example, the Occupational and Environmental Medicine Grand Rounds, a dinner and lecture series offered monthly in Seattle, is now being streamed live online. Grand Rounds is a collaboration between the NW Center and the UW Occupational and Environmental Medicine program.

The move toward distance learning has not lessened the NW Center's resolve to maintain good teaching practices. In June 2010, the NW Center will partner with the Occupational Health Nursing Program to hold a three-day Occupational Health Nursing Seminar. The training course targets nurses who are not specialists in occupational health or medicine, but who desire greater familiarity with the field. The course will be offered both online and on-site, and departmental researchers plan to analyze the differences in classroom versus online training effectiveness.

GRADUATES' PERCEPTION OF THEIR IMPACT IN THE FIELD



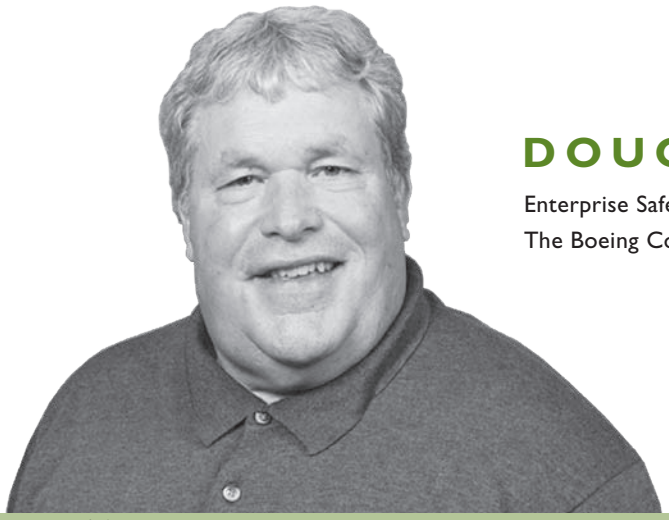
Alumni's responses to the survey question: How would you describe the impact you feel you have had on the environment and on worker and general population health and safety? This survey was commissioned by the NW Center and our department.

FOR FURTHER READING

Northwest Center for Occupational Health and Safety *http://depts.washington.edu/nwcohs/*

NIOSH Education and Research Centers for Occupational Safety and Healthy, *http://niosh-erc.org/*

History of the Education and Research Center *http://niosh-erc.org/about/history.shtml* ■



Courtesy of The Boeing Company

DOUGLAS BRIGGS

Enterprise Safety Director,
The Boeing Company

INDUSTRIAL HYGIENE AND SAFETY

MS 1984

ALUMNI PROFILE

Creating Even Safer Workplaces

At the bottom of every email Douglas Briggs sends is the saying: "The business of safety and the environment is personal." It could sum up his work. He leads the development and deployment of a new company-wide effort to further improve workplace safety called "Safety Now" at The Boeing Company, where he's worked since 1990. Underlying this effort is the concept that everyone is responsible for his or her own safety as well as the safety of co-workers.

"It's one of the most rewarding positions I've held in 35 years," says Briggs. He lauds the commitment that Boeing has taken to best its already impressive workplace safety record.

He started his career working for the US Department of Labor's Occupational Safety and Health Administration (OSHA) as a field industrial hygienist, inspecting steel mills and foundries in Chicago. Then, in 1977, he received an OSHA training grant, and he enrolled in the Industrial Hygiene and Safety program at the UW to research health hazards in shipbuilding.

In 1981, he took a job at Todd Shipyards Corporation as the corporate director of environmental/occupational safety and health. "I wanted to make a difference," says Briggs.

In 1998, Boeing offered him a senior-level position at its Renton factory. Senior Lecturer Emeritus Stan Freeman, one of Briggs' instructors in DEOHS, had worked at the same Renton factory as a senior safety manager. Briggs remembers Freeman took an operating or systematic approach to environmental health and safety and management. What he taught me, said Briggs, "is foundational to how I look at the world." A systematic approach sees compliance with safe and healthy practices and processes across company divisions as fundamental to a company's ability to increase productivity and quality.

Briggs describes himself at the start of the master's program at the UW as a rugged individualist: a hard worker, a tenacious person that outworked everyone else, putting in 16 hours a day, making inroads through his own efforts. But through graduate school projects, he was encouraged to collaborate, and he found that practice instrumental to how he approached his work in subsequent positions. "No matter the position, you have to work with people," he explains.

Briggs says his communication skills and business acumen were as valuable as his technical competency in his career.

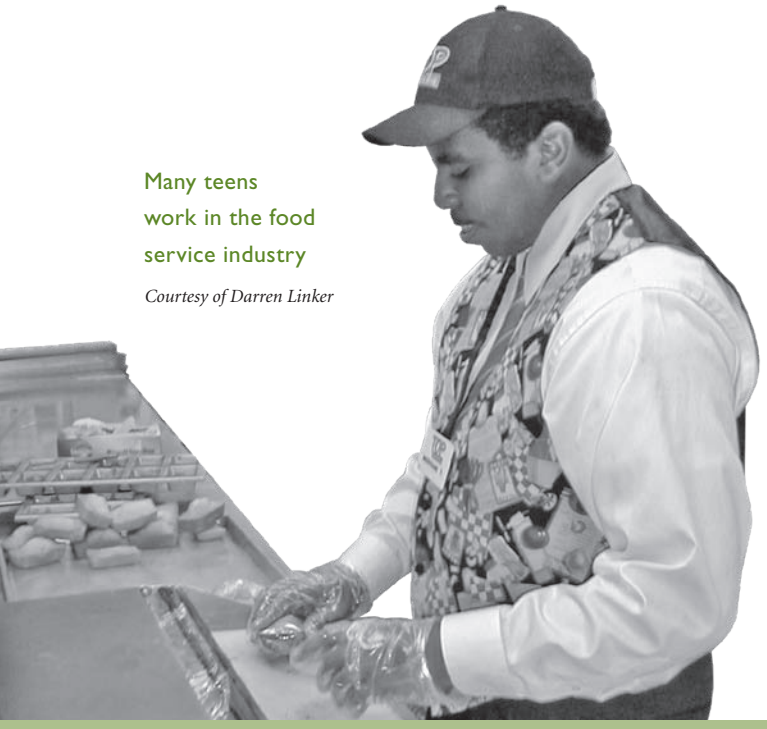
For 10 years, Briggs served on the advisory board of our Northwest Center for Occupational Health and Safety, an Education and Research Center. This experience, as well as his continuing relationship with the department, puts him in regular contact with DEOHS faculty, students, and staff. He advises students to keep their "eyes wide open" to jobs in which they can apply their technical knowledge, but also to be cognizant of what other values they can bring to an organization. ■

Protecting Teen Workers

Young Worker Safety and Health Program

Teen workers, who make up a sizable portion of the workforce in Washington state, have an injury rate almost twice as high as working adults. Based on injury claims accepted into the workers' compensation system, from 2000 to 2008, 13,568 teens between the ages of 11 and 17 were injured on the job in Washington state. However, the actual number of injuries is likely greater because teen workers are less likely to report workplace injuries.

A number of factors make teen workers particularly vulnerable to workplace injury: many lack experience, emotional maturity, and refined communication skills; they have limited knowledge about their legal rights or what tasks are prohibited by child labor laws; and they have a sense of invulnerability primarily due to a still developing sense of risk perception.



Many teens work in the food service industry

Courtesy of Darren Linker

Teens typically are reluctant to ask questions or convey concerns to their supervisors for fear of appearing incompetent or being fired. As a result, they may find themselves using unsafe equipment or performing tasks for which they are not trained.

YOUNG WORKER SAFETY

In October 2009, our department's Young Worker Safety and Health Program commemorated more than a decade of work with the Washington State Department of Labor and Industries (L&I) to educate and protect teen workers. The collaboration developed curriculum and other educational resources for high school teachers, and educated students and employers about workplace health and safety.

Started in 1997, the program grew out of the School-to-Work Opportunities Act signed into law by US President Bill Clinton, which aimed to help youth effectively transition from school to career-oriented work. Mary Miller, a child labor specialist and occupational health nurse in the Employment Standards Program of L&I, was among those who recognized that the legislation did not include health and safety training as a necessary program component. Miller, who is in regular contact with employers and teachers, instructs them about child labor laws and also assists in enforcing those laws. Her counterpart in our department was Program Manager Darren Linker, who trained teachers and led the development and evaluation of health and safety curricula and other educational materials.

INTERACTIVE CURRICULA

In an effort to reach the largest number of teens, Linker worked with more than 1,000 teachers across the state, training them to use the materials in their standard high school courses. For teachers like Betsy Robinson, the curriculum works

By the numbers...

13,568
teen worker-related injuries were reported in Washington state from 2000–2008

1,052
Washington state teachers trained and received curriculum materials from 2000–2008

1+2+5
1 website, 2 videos, and 5 curricula produced by DEOHS to better protect teen workers

"fantastically." She explains: "Safety is so critical. Kids need to ask questions and be aware of what's legal and what's not." Robinson has been using the curriculum for eight years and has reached more than 300 high school students. She also "spreads the word" when she co-teaches career and technical education courses to teachers at Bates Technical College in Tacoma.

"We developed hands-on, interactive lessons that we provide directly to teachers and make available on the web," says Linker. "Our curriculum accommodates different learning styles and keeps students engaged in what otherwise might be "boring" information about safety regulations, injury prevention techniques, and work practice policies." In 2008, Linker received the Outstanding Service Award from the Washington Association for Career and Technical Education for his work.

COLLABORATIONS

The Young Worker Program worked closely with teachers and industry groups to develop the materials. "Our role is to find out what industry needs and apply our expertise to help deliver it," says Steven Hecker, director of DEOHS Continuing Education and Outreach.

Although the curricula target different industries, with job-specific examples and lessons, the materials cover the same basic fundamentals: identifying hazards, understanding worker rights and child labor laws, developing solutions to reduce and eliminate hazards, communicating with supervisors, dealing with and preventing sexual harassment, and applying ergonomics. The goal is to help provide each student with a basic foundation of workplace health and safety knowledge.

In 2008, Miller and Hecker convened a new Young Worker Safety Advisory Network to connect with representatives from education, labor, industry, and other public agencies. They also collaborated with industry partners on two L&I Safety and Health Investment Projects (SHIP) grants.

In the first SHIP grant project, Linker, Miller, and Hecker, with other health educators, partnered with the Washington Governor's Industrial Safety and Health Advisory Board to develop and market a basic safety and health curriculum for teens called OSHA's 11. The Advisory Board, composed of labor and management representatives from every major industry in the state, also sponsors the annual Governor's Industrial Safety and Health Conference. OSHA's 11 is modeled on the general industry OSHA-10 health and safety course, which is widely recognized by employers, says Hecker. They credit materials initially developed by Diane Bush, Chris Miara, and other members of the Young Worker Safety and Health Network.

For the second project, the team, in collaboration with the Washington Restaurant Association (WRA), developed health and safety curricula called "ProSafety" for ProStart, a high school culinary arts program. WRA members are restaurants and food and beverage service businesses, including well-recognized names, such as Kentucky Fried Chicken and Ivar's. Many teens work in the hospitality and food service industry; teen injury rates in this sector outnumber other industries.

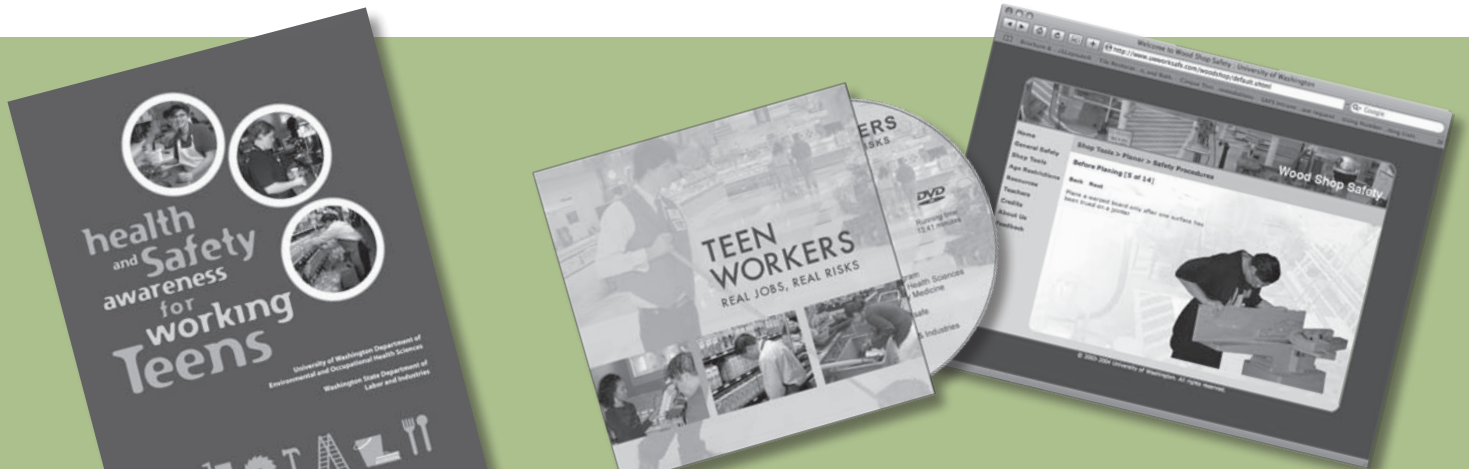
In 2008, the National Institute for Occupational Safety and Health funded Linker to produce an updated version of an award-winning safety video, *Teen Workers: Real Jobs, Real Risks,* for national distribution. The video, originally funded in 2005 by the department's state funds, showcases real teens talking about their work.

Everyone involved in this effort agrees that the Young Worker Program has been successful. Miller references the decreased number of teens injured on the job today compared to when she first looked at the numbers in the mid 1990s. She also sees growing awareness on the part of employers. Both Miller and Linker have seen a renewed emphasis on the importance of career and technical education programs in the state's public schools, which has led to a new interest in providing workplace safety education to the state's high school students.

FOR FURTHER READING

Health and Safety Awareness for Working Teens, curricula available online at *www.uwworksafe.com*

Washington State Department of Labor and Industries' Help for Teen Workers: *www.TeenWorkers.lni.wa.gov* ■



Keeping Schoolchildren Safe

The Diesel Bus Study

In Spring 2003, the US Environmental Protection Agency (EPA) announced a nationwide voluntary initiative to retrofit diesel school buses with cleaner burning engines and fuels by 2008. More than 75% of Washington state's approximately 7,500 diesel school buses were retrofit using $25 million in funding provided by the 2003 Legislature, while still more were retrofit with funding from EPA's Clean School Bus USA program.

No studies had rigorously examined schoolchildren's exposure to diesel exhaust and its associated health effects. Research Associate Professor Lee-Jane Sally Liu proposed to assess the effects of diesel bus exhaust before and after the bus retrofits in the Puget Sound region. In particular, as buses were retrofit with cleaner engine emission systems and fuels, she wanted to find out how 6- to 11-year-old children with and without asthma were affected. Asthmatic children are often most susceptible to pollutants, and asthma symptoms, such as coughing and wheezing, increase with exposure.

If risk assessments are accurate, then bus retrofits are likely to have a significant public health impact, especially on children who ride school buses daily, reported Liu in 2004.

As a large urban community, the Seattle School District serves more than 46,000 children, with nearly 16,500 commuting by school bus. The Tahoma School District, located approximately 20 miles southeast of Seattle, in and around Maple Valley, serves a suburban community of 7,000 children, with approximately 4,300 school bus riders.

The UW Diesel Bus Study team led by Liu worked with 432 children from nearly 70 Seattle and Tahoma schools and monitored more than 200 school buses to find out how they contribute to children's daily exposures to air pollution. The team worked with the Puget Sound Clean Air Agency's Diesel Solutions program, and was supported with funds from the National Institute of Environmental Health Sciences, Washington State Department of Ecology, and DEOHS, and a gift from the International Truck and Engine Corporation.

"Go Diesel Bus," artwork by Holly, age 11

The research team put tracers in the buses' engine oil and the diesel fuel. Then they analyzed the resulting air samples to see how much air pollution in the bus came from the bus itself and how much various retrofit devices and cleaner burning fuels changed the buses' "self-pollution."

In the process, they developed a unique collaboration among young study participants, parents, school staff, teachers, school nurses, bus drivers, and transportation department staff, as well as other partner organizations, such as the American Lung Association of Washington. The UW Diesel Bus Study team rode the school buses with students and performed monthly school-based health checks for student participants at their respective schools, where they measured the children's lung function and asked the children questions about their health. The team deployed samplers that measured air pollution at school bus bases, people's homes, on utility poles, at schools, and near playgrounds around Seattle and Maple Valley to better understand the impact of traffic on the air quality in the participants' communities.

In order to determine students' exposure to air pollution in places other than on the school bus, the research team asked for a small number of participant volunteers to carry backpacks with personal air monitors. Research Scientist Mark Davey says, "the children were eager to volunteer" and thought carrying the backpack in the name of a science experiment was "cool."

Davey said the research helped students become interested in science and in their own health. They took away fundamental scientific concepts, as one second grader said: "The study has taught me that breathing clean air makes me more healthy."

For three years, from 2006 to 2008, the research team held annual open houses in the Diesel Bus Study laboratory and in Maple Valley, and also sent easy-to-understand study reports, complete with child-friendly learning exercises, to schools and participating families. Additionally, project staff conducted classroom presentations with air monitoring instruments so the children could see and use the same equipment that the research team did. These extensions of the study were used not only to maintain and grow the participant population but also to keep the children and their families informed and engaged in the research.

Research Study Assistant Emily Eppinger with a Diesel Bus Study participant

Jana Rone

"I enrolled the kids so they could gain an awareness of their surroundings and [of] things that can be harmful," one Maple Valley mother wrote.

Davey says, "the families' cooperation and dedication were incredibly important to our study, as the research team needed to collect enough data from the same students for several years in order for the research findings to be meaningful."

The results that have and will continue to come from the Diesel Bus Study will not only help us better understand how green technologies affect children in our state, continues Davey, but will also provide an opportunity for community members to be more aware of how air quality can affect them and how they can help protect their children's health.

From initial results, the team confirmed earlier published findings, reporting that "children are routinely exposed to a significant fraction of their daily exposure to particulate matter while in transit." School-aged bus riders who participated in the study were exposed to elevated levels of fine particulate matter ($PM_{2.5}$) during their commutes to and from school. $PM_{2.5}$ is about one-thirtieth the diameter of a human hair. Fine particulate matter exposure is linked to asthma, among other health problems. On average, concentrations of $PM_{2.5}$ were four times higher in the buses than ambient air concentrations measured around the neighborhoods, and nearly two times higher than levels measured on the roadways used in the bus routes.

The levels of $PM_{2.5}$ were affected by a number of factors, including air concentrations outside the bus and the presence of a diesel oxidative catalyst in the tailpipe of the bus. Diesel oxidative catalysts are pre-installed in newer buses and were installed in older buses as part of the retrofit program. The catalyst has a porous ceramic honeycomb-like structure that uses a chemical process to break down pollutants in the exhaust into less harmful components, significantly decreasing emissions of particulate matter, as well as hydrocarbons and carbon monoxide. Buses with diesel oxidative catalysts had lower concentrations of $PM_{2.5}$ in the bus cabins than those that didn't.

"We are continuing to analyze the data from the study, to determine whether there is a significant health impact associated with higher in-cabin concentrations of $PM_{2.5}$," says Davey. "We're looking for the progressive improvement of health effects that tells us that the money put into the retrofit programs is making a difference."

FOR FURTHER READING

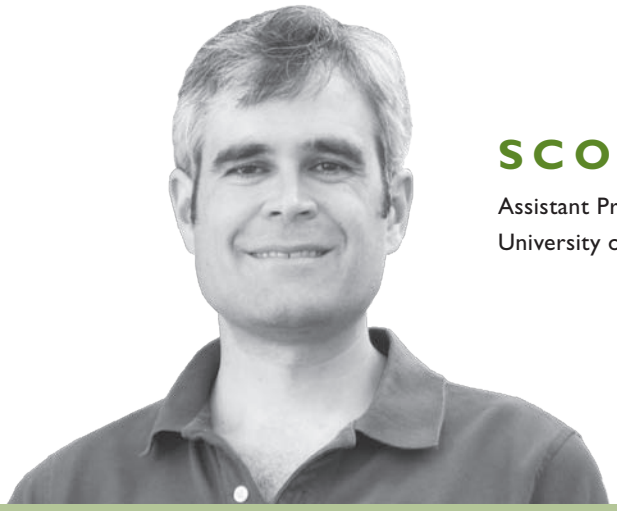
Adar SD, Davey M, Sullivan JR, Compher M, Szpiro A, Liu L-JS. Predicting airborne particle levels aboard Washington state school buses. *Atmos Environ* 2008;42(33):7590–7599.

Diesel Bus Study: *http://depts.washington.edu/uwbus/*

Zielinska B, Campbell D, Lawson DR, Ireson RG, Weaver CS, Hesterberg TW, Larson T, Davey M, Liu L-JS. Detailed characterization and profiles of crankcase and diesel particulate matter exhaust emissions using speciated organics. *Environ Sci Technol* 2008;42(15):5661–5666. ■

Diesel Bus Study team (l to r): Melissa Symon, Nina Bort, Jim Sullivan, Chris Warner, Tom Malamakal, Erin Corwine, Mark Davey, Nichole Real, Kris Hartin, and Peggy Coburn

Kathy Hall



Courtesy of Scott Bartell

SCOTT BARTELL

Assistant Professor, College of Health Sciences,
University of California, Irvine

ENVIRONMENTAL HEALTH TECHNOLOGY

MS 1996

ALUMNI PROFILE

Environmental Health Epidemiologist

Scott Bartell's research centers on environmental health issues, an interest he says started at the UW while he was a student in our department. He teaches courses in epidemiology, epidemiological methods, data analysis, and risk assessment at the University of California (UC), Irvine.

"It's really an amazing job if you like to be challenged and to constantly continue learning," says Bartell.

His primary research projects concern exposure assessment and environmental epidemiology, such as studies of populations exposed to the environmental contaminants, polychlorinated biphenyls and perfluorooctanoate, in Alabama and West Virginia. Polychlorinated biphenyls, which were widely used for more than 50 years in industrial and commercial applications, were banned from production in 1979 due to their adverse health effects. But the compound doesn't easily break down and continues to be found in soil and fish. Perfluorooctanoate has wide-spread applications, including use as a water and oil repellent in fabrics and leather.

Bartell received his undergraduate degree in environmental sciences at UC Berkeley, and in 1994, he moved to Seattle to enroll in our graduate program in Environmental Health Technology, which is now called Environmental Health. After graduating and spending a summer working as an intern at the Centers for Disease Control and Prevention, Bartell returned to the UW to work for Professor Elaine Faustman as a research scientist.

"Although I never would have imagined becoming a professor when I started studying at UW," Bartell says, "it was my mission by the time I left. My UW experience was truly transformational."

Bartell describes his interest in the mathematical and statistical models used in environmental health. So, while working full time, he continued to take classes in the statistics department.

"The turning point came when I started working on some of my own research ideas, developing statistical models to explain the amount of variability in biomarker measurements contributed by day-to-day variations in chemical exposures," explains Bartell. Faustman had received a small grant from UW's National Research Center for Statistics and the Environment, which funded Bartell's research. "At that point, I became excited about research, and eventually decided to go back to graduate school, with the goal of becoming a professor."

Bartell also received an MS degree in Statistics and a PhD in Epidemiology at the UW. He took a faculty position in the Rollins School of Public Health at Emory University. In 2006, he accepted a faculty appointment at UC Irvine.

He credits DEOHS Professors Faustman and John Kissel, who "did a lot to encourage me to develop my own research ideas and approaches—key skills in my current job."

His advice to students: "Take as many good courses as you can. You may have a plan, but it's difficult to know for sure what you'll be doing 5 or 10 years from now. Second, learn concrete skills like using statistical software, GIS, and specific laboratory methods. All forms of knowledge are valuable, but some are esoteric and harder to explain to potential employers! Finally, take the time to get to know your fellow students and professors. They will constitute a distinguished professional network, and some may become your closest friends." ■

Determining Sources

of Air Pollution in Puget Sound

In Tacoma and Seattle's Duwamish Valley, various community groups expressed concern about air pollution in and around their neighborhoods. Then in December 2008, the Puget Sound Clean Air Agency's (PSCAA) monitors showed air quality in Tacoma violated the daily Environmental Protection Agency's (EPA) standard for fine particulate matter of 35 micrograms per cubic meter.

Fine particulate matter refers to tiny particles or droplets in the air that are 2.5 microns or less in width. They can reduce visibility and cause the air to appear hazy when their levels are elevated. Long-term exposure to fine particulate matter has been linked to cardiovascular and respiratory illnesses.

"If you know the source, you can fix it," says Mike Gilroy, manager of Meteorological and Technical Services at PSCAA. Gilroy applied for funding from the EPA to identify sources contributing to the high levels of fine particulate matter in Tacoma's neighborhoods communities and to evaluate different methods of measuring source contaminants in the air.

Gilroy looked to the expertise of UW researchers led by Professor Michael Yost, Assistant Professor Christopher Simpson, Adjunct Professor Timothy Larson, and colleagues in the Department of Civil Engineering and at Vancouver Island University.

COMMUNITY MONITORING

Diesel particulate matter and wood smoke are two sources of air pollution judged most critical to public health in Seattle and Tacoma.

Three temporary monitors were installed to sample air quality in Tacoma—at the port and in two residential neighborhoods. In January 2009, Simpson's team drove a truck outfitted with instruments to measure and detail properties of the fine particulates in the air at these locations. One measurement tool, a mass spectrometer, was used to detect and measure particular toxic compounds of concern to the EPA. "No other source apportionment study has tried to collect such rich data via a mobile platform," says Simpson. Source apportionment determines contributions of various pollution sources, such as diesel exhaust from cars or wood-burning fireplaces in homes.

The researchers hoped to learn how representative the air pollution data collected from the air monitors were to data they collected in the mobile unit.

The mobile unit aids in better understanding the sources of pollutants in different parts of the city, Simpson explains, "to be absolutely sure that x% of pollution is from diesel exhaust and y% is from wood smoke, and where in the city to focus the agency's efforts in improving air quality. Knowing what baseline concentrations of air pollutants exist, and the location of the city "hotspots" of air pollution, are important to understanding air pollution's effects on people's health."

Preliminary data on pollution sources in the winter study have confirmed researchers' expectations. "The wood smoke concentrations are highest in specific residential areas in South Tacoma; whereas, high levels of diesel exhaust are nearest the port and major freeways," explains Simpson.

The same mobile measurement process was repeated in August 2009, during the memorable heat wave that sent thermometers soaring into the triple digits. Analysis on the second data collection is underway.

The information from winter and summer will be used to develop a predictive computer model that may determine risk of exposure to fine particulate matter in urban areas and to

l to r: Nick Davey (Vancouver Island University), Morten Martinsen (visiting scientist from Norwegian University of Science and Technology), and DEOHS Assistant Professor Christopher Simpson and Research Scientist Robert Crampton discuss measurements from a mass spectrometer, an instrument used to detect and measure air pollutants

Elizabeth Sharpe

Determining maritime contributions to air pollution is particularly challenging

Rick Neitzel

assign risk assessments when the model is compared to rates of respiratory infection in highly exposed areas of the city.

METHODS DEVELOPMENT

Kathy Himes, who works in the Air Quality department at the PSCAA and is also a graduate of our department (MS, Environmental Health, 2003), explains that air pollution monitoring is complicated, "like peeling back layers of an onion." An air monitor doesn't determine how much diesel exhaust is in the air. The data comes from measuring chemical components or markers for diesel exhaust and then using a mathematical model to determine how much of the pollutant collected is due to diesel emissions.

Air monitor filters are collected every six days, and a lot of data has to be collected to make the results meaningful, explains Yost. Then it takes a while for the lab to analyze the samples to determine the chemical composition of the particles and to measure their concentrations. "We need more reliable, faster methods. The current method is slow and laborious," he says.

We know diesel is one of the major contributors, says Yost, who explains that determining how much different sources contribute to air pollution is not easy. Diesel particulate matter comes from a wide range of transportation modes, such as railroads, many types of heavy equipment, vehicles on the highway, and marine vessels that travel through the Puget Sound and moor at one of its many ports.

Maritime emissions are particularly challenging, explains Yost. The Puget Sound is a water highway. Ships are traffic. How frequently they travel, their size, their emission patterns, and in particular, the seasons can all affect which neighborhoods will be impacted and by how much.

Yost and Larson developed a traffic monitoring system for both cars and ships. Using this data collection in concert with different measurement methods, Yost is evaluating which method or combination of methods may be most reliable.

Yost explains that one of the methods they are testing is LIDAR or light radar that monitors diesel exhaust particles in the air emitted from ships to assess maritime emissions and their contribution to overall air quality. LIDAR uses laser light pulses to detect aerosols in the atmosphere, as the beam scattered back is detected with a telescope and sensitive detector. The intensity of the backscatter is proportional to the density of the particles in the air. Particle emissions observed from maritime vessels will be correlated with the data they are collecting on ships as well as seasonal weather conditions.

They hope to establish chemical signatures for each emission. Then, based on a mathematical construct built from all the data they collect, the computer model will detail how much each source emits. "What fraction of the emissions belongs to trucks and to ships? The answer to that will tell us what to focus on to reduce emission levels," Yost explains.

"This method could also work elsewhere to determine the air contaminants contributing to pollution," he says.

FOR FURTHER READING

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Keill L, Maykut N. Final report: Puget Sound air toxics evaluation. Puget Sound Clean Air Agency and Washington State Department of Ecology, October 2003. *http://www.pscleanair.org/airq/basics/psate_final.pdf* ■

Courtesy of the Food and Drug Administration

LYNNDA REID

Supervisory Pharmacologist,
Food and Drug Administration

TOXICOLOGY

PHD 1996

ALUMNI PROFILE

Protecting Public Health One Drug at a Time

Lynnda Reid works for the Center for Drug Evaluation and Research (CDER), America's watchdog when it comes to ensuring food and drugs are safe. CDER is part of the Food and Drug Administration (FDA), and Reid is a supervisory pharmacologist in the Division of Reproductive and Urologic Drug Products.

"I look at my job two ways," says Reid. "I'm proud of the drugs we put on the market, and I'm proud of the drugs we keep off the market. Our priority is to keep the public safe."

Reid heads a team of nine, who all have PhDs in toxicology or pharmacology. Together, they review new drug applications and investigate the data submitted by pharmaceutical companies, deciding if a drug is "reasonably safe to go into clinical trials based on studies in animals," explains Reid. Drugs intended to treat all aspects of reproduction as well as urological and bone diseases are reviewed by this division. Some of these drugs are household names. They include Viagra for erectile dysfunction, Flomax to treat benign prostatic hyperplasia, Vesicare for incontinence, Boniva for postmenopausal osteoporosis, and all contraceptives.

Reid graduated with a degree in Medical Technology from the University of Utah in 1983, followed by a stint in the Peace Corps from 1985 to 1987 as a professional health volunteer in Niger. She earned her master's degree in Industrial Hygiene in 1990 from the University of Arizona, Tucson. She came to DEOHS to do her doctoral studies because she wanted to work in the field of regulatory toxicology.

While a PhD candidate, Reid studied with Professor Terrance Kavanagh and helped mentor other students. She investigated the relationship between glutathione and its role in combating oxidative stress. "Glutathione acts like a molecular sponge," explains Kavanagh. "It soaks up the free radicals released from normal chemical reactions or oxidation in the body, and then helps process them so they can be excreted from the body." Everyone's cells vary in their production of glutathione, and exposure to chemicals can alter an individual's susceptibility to oxidative damage. Left unchecked, free radicals can cause mutations to DNA, and that damage may lead to disease. "What Lynnda was able to show is that the genes that control the creation of glutathione are important in determining how susceptible cells are to oxidative stress," says Kavanagh.

Reid said her interest in regulatory toxicology along with her medical background led her to the FDA. Reid sees her job as part and parcel to environmental health. She explains: "Environmental health includes a person's whole environment, not just the physical environment," such as the food he eats or water she drinks. So, the drugs people take as part of their daily regime or when they get sick are also part of their daily "environment," says Reid.

Kavanagh agrees. "Environmental health depends on the interaction of our genes with the environment. If we're willing to expose ourselves to drugs, even over-the-counter drugs with potential side effects, we are altering our environment." Of Reid, he says, "We're very proud of Lynnda. It makes me feel safer knowing that she's looking over things." ■

Ecogenetics: Understanding

Human Susceptibility to Injury and Disease

Our genes significantly influence how environmental exposures affect our health. One metaphor often cited is that our genetic makeup is a "loaded gun" and the environment "pulls the trigger." With each genetic "switch" set firmly in place from birth, an environmental exposure can "turn it off or on," leading to a cascade of reactions in the body. This is why some workers who have been exposed to beryllium show signs of berylliosis, an occupational lung disease, while others continue to have a clean bill of health, even with the same exposure.

Ecogenetics is the study of how a person's genes influence human ecology, which is the interaction of humans with their environment, explains Professor David Eaton, director of the Center for Ecogenetics and Environmental Health (CEEH). Scientists affiliated with CEEH are investigating genetic variations that cause people to react differently to environmental exposures. CEEH provides administrative and technical support to 99 scientists from a variety of disciplines. The center is supported by the National Institute of Environmental Health Sciences (NIEHS) and is part of the NIEHS Environmental Health Sciences Core Center program.

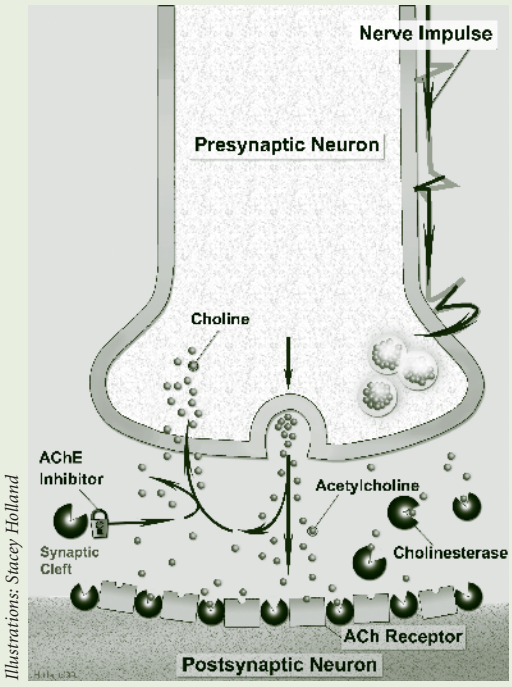
CEEH scientists share a commitment to improving human health by reducing the burden of disease. To identify and protect susceptible groups requires a better understanding of gene-environment interactions. These scientists also strive to involve the community in their work and to consider the ethical, legal, and social implications of their research endeavors.

ECOGENETICS AND PESTICIDES

Some researchers are studying what determines our susceptibility to the harmful effects of neurotoxic chemicals, such as certain pesticides. They are gathering data on population-wide genetic variations that may determine how the body handles exposures to organophosphorus (OP) pesticides, which are widely used across the United States and overseas.

Since 2004, Washington state has mandated cholinesterase monitoring of agricultural pesticide handlers to ensure they are not overexposed to OP pesticides. Washington and California are the only two states to mandate the monitoring. In this program, two forms of cholinesterase are measured in the blood: acetylcholinesterase (AChE) and serum cholinesterase.

Cholinesterase inhibition, or limited activity of the enzyme from a baseline measurement before exposure, suggests the handler has been overexposed. AChE, often referred to as "cholinesterase," is an enzyme essential for normal functioning of the nervous system. It regulates the transmission of nerve signals in the body. OP pesticides can interfere in this process. When AChE activity levels are low, acetylcholine accumulates



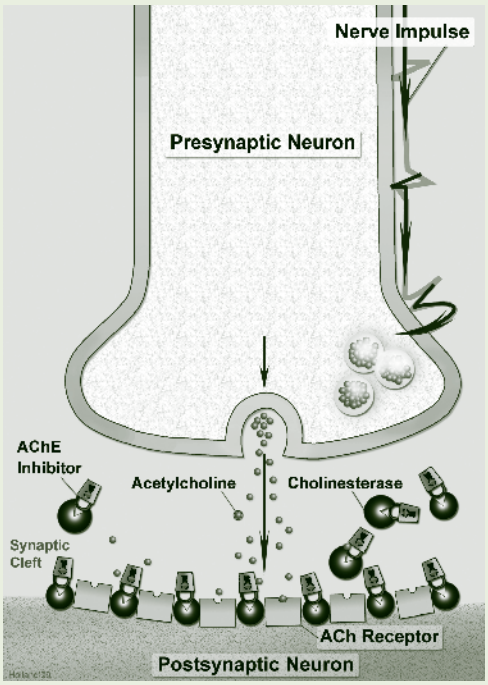
Illustrations: Stacey Holland

The acetylcholinesterase (AChE) enzyme regulates the transmission of nerve signals in the body. If a nerve signal were likened to a radio transmission, then AChE would be the "off switch" that ends the transmission after a message has been received. To transmit the nerve signal between neurons, the presynaptic neuron releases acetylcholine, which binds with acetylcholine (ACh) receptors on the postsynaptic neuron. AChE ends the transmission of nerve signals by breaking down acetylcholine into choline and acetate.

and causes continuous stimulation in the nervous system. Overexposure to OP pesticides might result in acute symptoms, such as headaches, muscle twitching, hypersecretion, and nausea. Studies have linked long-term chronic effects of overexposure to neurobehavioral performance problems and cancers.

Some individuals may be especially susceptible to health effects from exposure to OP pesticides. Paraoxonase 1 (PON1), an enzyme in our bodies that plays an important role in breaking down certain OP pesticides into less toxic forms, is of particular interest to CEEH researchers.

Everyone has PON1, but scientists have found that variations in PON1 levels exist in the population. Research suggests that PON1 levels and how efficiently the enzyme can detoxify reagents may be based on an individual's genotype, the genetic identity of an individual—somewhat like an architect's blueprint for a house.



OP pesticides "lock" the AChE enzyme. This prevents AChE from breaking down acetylcholine. Overexposure to OP pesticides inhibits AChE activity, interfering with normal nerve signaling. In the cholinesterase monitoring program, the activity level of this enzyme is measured in blood to determine if an agricultural pesticide handler has been overexposed to pesticides.

Although animal studies have suggested low PON1 activity is associated with depressed levels of acetylcholinesterase, not many population-based studies of PON1 status among OP-exposed individuals have been done, explains Jonathan Hofmann (MPH, Environmental and Occupational Health, 2004; PhD, Epidemiology, 2008). He wanted to see if the activity level of PON1 and the PON1 genotype were associated with serum cholinesterase inhibition among pesticide handlers. If there was a relationship, then Hofmann hypothesized that PON1 may be an important factor in determining someone's susceptibility to overexposure to OP pesticides.

With support from CEEH, the Pacific Northwest Agricultural Safety and Health Center (PNASH), and the Northwest Center for Occupational Health and Safety (an Education and Research Center), Hofmann evaluated the relationship between PON1 and cholinesterase inhibition among pesticide handlers exposed to OP insecticides. He worked with DEOHS Professors Matthew Keifer, Richard Fenske, Gerald van Belle, and Harvey Checkoway; Associate Professor Anneclaire De Roos (Epidemiology); and Professor Clement Furlong (Genome Sciences) to conduct an epidemiological study. Their study compared PON1 levels and PON1 genotype with serum cholinesterase levels in 163 volunteers recruited in the 2006 and 2007 spray seasons.

CEEH's Functional Genomics and Proteomics Laboratory, under the direction of Principal Research Scientist Federico Farin, processed these samples and developed an assay to characterize the PON1 genotype of study participants. This laboratory provides state-of-the-art technologies that can be used by researchers to investigate gene-environment interactions.

Comparing levels of PON1 and PON1 genotypes to the results of the cholinesterase monitoring, Hofmann found there were differences in the level of serum cholinesterase inhibition by PON1 genotype, suggesting that some pesticide handlers were better able to metabolize OP pesticides than others. He also found that people with high PON1 activity had less cholinesterase inhibition than those with low PON1 activity.

Hofmann, who is now a postdoctoral fellow in the Division of Cancer Epidemiology and Genetics at the National Cancer Institute, says the study's results suggest "we should account for differences in sensitivity to OPs between individuals, including increased sensitivity related to PON1 status, when performing regulatory risk assessments for these chemicals."

An agricultural worker applies pesticides

Kit Galvin

From a public health perspective, says Eaton, "laws and policies are designed not only to protect the average person, but also to protect sensitive populations." Environmental health laws enforced by the Environmental Protection Agency, he explains, specifically mandate that exposure limits should ensure even the most sensitive individual is protected.

ETHICAL & LEGAL CONSIDERATIONS

Genotyping is a revolutionary technology, but it raises ethical and legal considerations. Kelly Fryer-Edwards, director of the CEEH Community Outreach and Ethics Core and associate professor in the Department of Bioethics and Humanities in the School of Medicine, worked with the researchers involved in Hofmann's study. She advised them on ethical considerations, such as the kind of information that should accompany genetic results provided to study participants.

CEEH is one of two NIEHS Environmental Health Sciences Centers in the United States that have an ethics core to address the many complex issues that might arise from genetics research. Eaton wanted a group to work alongside the investigators as the research evolved and ethical issues arose.

Only a handful of studies involving genetic tests have included a follow up to investigate participants' impressions of test results, explains Fryer-Edwards. So, with support from PNASH, research team members interviewed the participants after they received the results of their PON1 genetic tests.

They found that the agricultural workers who were interviewed had some gaps in understanding what their test results showed. This led to the production of a video by two graduate students, Rad Cunningham (MPH student, Environmental and Occupational Health) and Coby Jansen (MPH student, Department of Health Services). The six-minute Spanish-language video addresses questions individuals may have about genetic tests, such as the difference between PON1 and an individual's cholinesterase status. Cunningham and Jansen will present a poster about the ethical dilemmas involved in communicating genetic results at the American Public Health Association's 2009 national conference.

In her CEEH role, Fryer-Edwards also works with a community outreach team to share information with outside groups. She describes these discussions as "a two-way conversation;" working together to better communicate the ethical issues keeps the public, our communities, and other stakeholders involved with CEEH research.

Fryer-Edwards and Jon Sharpe, Community Outreach and Ethics Core program manager, developed educational materials based on the PON1 study. An interactive lesson uses role-playing to teach participants about genetic susceptibility to environmental exposures and also give them a sense of the dilemmas involved in genetic testing: who gets to decide who is tested, what is the relationship between research findings and actual health effects, who has access to the results, and what are the consequences to any decision. In the role play, participants have a choice of getting or not getting a genetic test before starting a new job as a pesticide handler. If the test is positive, they will not be offered the job.

The activity sparks animated discussions about what risks are worth taking to feed their families, what responsibility employers have to protect their workers, and freedom of choice around health behaviors. When asked what they learned from the activity, one eighth-grade student wrote "the choices you make [with the information you have] about interacting with hazardous chemicals affect your health and life."

FOR FURTHER READING

Center for Ecogenetics and Environmental Health: *http://depts.washington.edu/ceeh/*

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Hofmann JN, Keifer MC, De Roos AJ, Fenske RA, Furlong CE, van Belle G, Checkoway H. Occupational determinants of serum cholinesterase inhibition among organophosphate-exposed agricultural pesticide handlers in Washington state. *Occup Environ Med* 2009 (in press). ■

Where we've been...
and where we're going








Photo credits (top row, l to r): Kathy Hall, Elizabeth Sharpe, Philip Dovinh, Kathy Hall; (bottom row, l to r): Jon Sharpe, Elizabeth Sharpe, Courtesy of Charles Mitchell, Courtesy of Labor and Industries

top row, l to r:

EH Lab helped identify best methods for testing breathing air quality in local fire and rescue operations

CE is developing a health and safety course for workers in green building and weatherization, such as wind and other sustainable technologies

Amy Sly (MS, Industrial Hygiene and Safety, 2006) was the first woman to be certified as a marine chemist

Pablo Palmandez (right), agricultural specialist in our Yakima field office

bottom row, l to r:

Professor Mike Yost develops tools for environmental and occupational exposure assessment

Professors Joel Kaufman and Sverre Vedal meet with a Japanese delegation of scientists to discuss air pollution issues

Hazardous Waste Operations and Emergency Response course, July 2007

DEOHS works to improve conditions for the aging workforce

Taking Stock

The Biennium in Review

The 2007–2009 biennium was at times challenging, given the economy in the United States and in particular, in Washington state. Our department faced similar challenges, so we worked extra hard to maintain our research and training programs, respond to needs raised by Washington state business and labor groups, and train current public health practitioners. Highlighted below are some of our challenges and accomplishments during the 2007–2009 biennium.

EDUCATIONAL PROGRAM DEVELOPMENT

In 2007, the UW Graduate School approved a revision of the Industrial Hygiene and Safety master's degree program. The newly reorganized program, renamed "Occupational and Environmental Exposure Sciences," included three new required core courses to ensure a common foundation for all entering students. The program provides more flexibility in the curriculum, allowing students to match their individual interests by choosing one of four learning emphasis areas: Occupational Hygiene, Ergonomics and Human Factors, Health and Safety Management, and Exposure Biomarkers. These areas reflect current specializations in professional practice. In this revised program, master's students also have the option of completing a research thesis or a professional project/portfolio. Seven students enrolled in the new degree program in 2007, and eight students in 2008.

Through a recent American Recovery and Reinvestment Act (ARRA) supplement granted in 2009, our 10-week summer internship for undergraduates, the Environmental Health Research Experience Program, will expand. The additional funding allows us to support more students as well as guest faculty during the next biennium, 2009–2011. Talented undergraduates who express a strong interest in environmental health research are selected from a national pool of applicants, and they are paired with faculty mentors. Students from populations traditionally underrepresented in the sciences are encouraged to apply. Participants have come from the UW, Stanford University, University of Minnesota, Spelman College, as well as China Medical University.

FACULTY, STUDENTS, AND STAFF

Our department was fortunate to have very little faculty turnover during the 2007–2009 biennium, evidence of the quality of research and strong collaborations. Both Evan Gallagher and Matthew Keifer were promoted from associate professor to full professor in 2008.

We have strengthened our multidisciplinary collaborations with other UW departments. We participated with the School of Medicine in a joint search for Dennis Shusterman's replacement as residency director in our Occupational and Environmental Medicine program (OEM), and hired an alumnus from our program, Victor Van Hee, as residency director. He accepted a permanent position as assistant professor in our department in August 2009, with a primary appointment in the Department of Medicine. Assistant Professor Sarah Adar (primary in Department of Epidemiology) also received a joint appointment. She has worked closely with our Multi-Ethnic Study of Atherosclerosis and Air Pollution (MESA Air) and the Diesel Bus Study. Joellen Lewtas changed her appointment from research professor to affiliate professor.

Training grants and other federal and state funding support our graduate students, one of our most valuable assets. They are our future academicians, policymakers, researchers, and public health practitioners. This funding support, the reputation of our faculty, and our research continue to attract top-rated students to our academic programs and allow us to graduate well-qualified professionals. During the biennium, we accepted a total of 55 graduate students, and 84 undergraduates enrolled in the major. In 2008, we implemented an undergraduate competitive admission process, which has not deterred students from applying, and, in fact, has resulted in a high caliber of entrants. During the two academic years, we granted 56 BS, 28 MS, 9 PhD, and 15 MPH degrees.

During the 2007–2009 biennium, the OEM MPH program enrolled three students in the Harborview residency program and seven in the Madigan Army Medical Center. An additional non-matriculated student participated in the Harborview residency program, and the OEM program was reaccredited by the Accreditation Council for Graduate Medical Education.

Our students continue to collaborate with faculty and staff

on articles submitted to academic and peer-reviewed publications. A full listing can be found on the website: *http://depts.washington.edu/envhlth/biennial_report/biennial_report_07_09/.*

Our department was fortunate to sustain funding for most of our staff during the economic downturn. We continued to employ approximately 150 staff members, many of whom are supported on research grants and contracts. During the biennium, we hired about 30 new staff members, and saw a few leave—for retirement, new opportunities and challenges, or project conclusions.

Faculty have received recognition for excellence in research, service, and teaching. For example, in 2008, Professor Michael Morgan received the Meritorious Achievement Award from the American Conference of Governmental Industrial Hygienists. The award recognized Morgan's long-term contributions to the field of occupational health and industrial hygiene. A number of our students have received awards and scholarships in recognition of their academic achievements, research, conference posters and presentations, and community service. PhD student Richard Neitzel received a scholarship from the American Industrial Hygiene Foundation in 2007, and in 2009, he received the UW School of Public Health's Gilbert S. Omenn Award for Academic Excellence for a Doctoral Student. Our staff, too, have been recognized for their hard work, volunteer efforts, and research. One such staff member, Graduate Program Manager Rory Murphy, received the UW Graduate School's first annual Graduate Program Assistant Service Award. (For more awards and honors, see pages 40–42.)

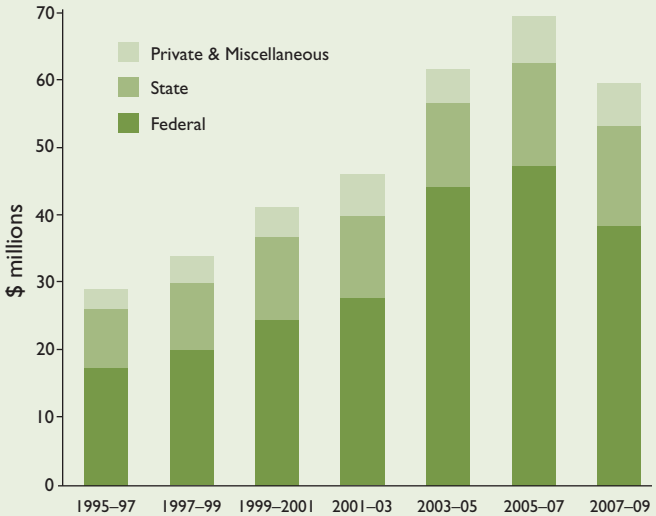
RESEARCH, TRAINING, AND SERVICE

Our faculty and staff pursue projects consistent with their expertise and conduct research on emerging and ongoing environmental and occupational health and safety priorities. Research grant and contract awards continue to provide the majority of our department's funding. So, we worked hard to renew competitive grants and to write new proposals in support of innovative research in the next decade and beyond.

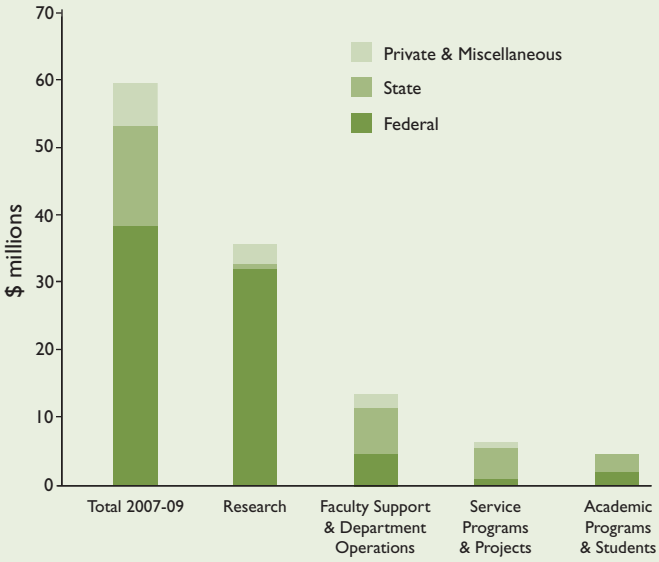
These efforts, however, were impacted by the fluctuations in grant and contract priorities set by federal, state, and private organizations and a highly competitive funding environment. We experienced an 8% drop in federal, state, and private grant and contract revenue. In keeping with the overall UW reduction in state support, our department's funding through the Medical Aid and Accident Fund was reduced by 10% during this biennium. The undergraduate program, supported by UW general operation funds, had a limited cut in FY 2009. Further reductions are predicted over the next two years.

During the biennium, faculty and research staff submitted approximately 138 proposals (including new submissions, competitive renewals, and resubmissions), which resulted in

DEOHS FUNDING (BY BIENNIUM)



DEOHS SPENDING (2007–2009 BIENNIUM)



more than 60 awards. In addition, 82 non-competing progress reports were submitted. There were also six ARRA awards, which primarily supplemented existing National Institutes of Health-funded projects.

We received continuing and new federal funding for large research centers and studies, and faculty and research scientists were also awarded individual federal grants. Approximately 25 new federal grants were received and the Pacific Northwest Agricultural Safety and Health Center and the Superfund Research Program submitted competitive renewals and were each refunded for another five years. Professor Elaine Faustman and colleagues were successful in obtaining additional funding for the Pacific Northwest Center for the National Children's Study. This center, along with other centers across the United States, will track the health of 100,000 children from womb to adulthood in order to better understand how disease may be influenced by environmental factors and genetics. The funds will support, in addition to a study location in King County, a new one in Grant County, Washington.

Faculty also received state funding for projects. For example, with funding support from the Washington State House of Representatives, the Washington State Department of Health contracted with our department to measure air concentrations of organophosphorus (OP) pesticides used in Washington agriculture during the 2008 growing season. The purpose of the monitoring was to examine whether off-target movement of OP pesticides during and following pesticide applications posed a potential risk to nearby residents or bystanders. The project was headed by Professor Richard Fenske.

Several researchers also partnered with Washington state business and labor to conduct service and outreach efforts. Funded through the L&I Safety and Health Investment Projects (SHIP), DEOHS researchers produced an educational video for welders to safeguard against exposure to chrome 6, identified best methods for testing breathing air quality in local fire and rescue operations, identified best practices for safe patient handling among health care workers, evaluated a cleaning protocol used to reduce methicillin-resistant *Staphylococcus aureus* (MRSA) exposure among fire station personnel, and developed a variety of curricula, including an aging workforce train-the-trainer curriculum and a young worker safety and health Occupational Safety and Health Administration (OSHA) training curriculum for the Washington State Restaurant Association's ProSafety students.

Our Continuing Education Program (CE) expanded training opportunities in Alaska, Washington, Oregon, and Idaho. In total, CE offered 410 courses and enrolled 10,874 students. The Pacific Northwest OSHA Education Center increased its revenues from the 2005–2007 biennium by 62% in the 2007–2009 biennium, and the increase in revenue corresponds with an approximate 21% increase in enrollment. The increase in student numbers points to the relevance of OSHA training in our region, even in a down economy. The center also established an agreement with South Korea-based Samsung Engineering Co. Ltd. to deliver OSHA-certified health and safety education in its Saudi Arabia training facility.

Business, labor groups, and the general public continued to raise concerns about environmental and occupational health issues. In the 2007–2009 biennium, our department worked diligently in the field and in the lab to find solutions to these concerns and to improve the health and safety of Washington state workers through consultations, laboratory testing, and clinical services.

Our Field Research and Consultation Group (Field Group), which provides workplace health and safety consultation services, responded to 113 requests from 90 different companies.

Our Environmental Health Laboratory (EH Lab) responded to 887 requests, which included analyzing samples for the Field Group in support of 74 different external clients as well as direct requests from 88 different agencies and businesses. The EH Lab also fielded departmental faculty requests for assistance in the areas of nanomaterials, exposure monitoring, and methods development for industrial hygiene analyses and environmental assessment. Lastly, the EH Lab secured continuation of its accreditation by the American Industrial Hygiene Association with the completion of the final site visit in 2009.

By the numbers...

15 + 54 @ 28

15 graduate students participated in an internship; 54 undergraduates interned at 28 locations

410 → 10,874

10,874 students took 410 Continuing Education courses

69%

of our graduates work in Washington state (2009 alumni survey)

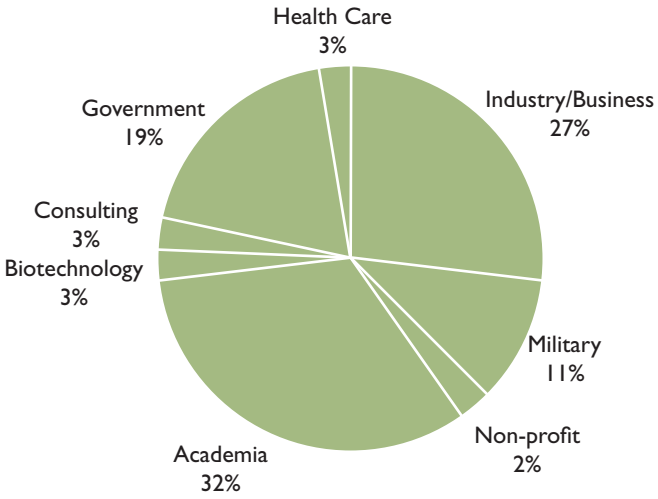
Our OEM Clinic continued to serve injured workers from across Washington state, providing care for nearly 1,000 patient visits each year. The most common occupational illnesses seen at the clinic were lung diseases (asthma and asbestosis), skin conditions (contact or allergic dermatitis), and various neuropsychiatric conditions related to chemical exposures. As the anchor of Harborview's Center of Occupational Health and Education (COHE), the clinic provided opportunities for hands-on, clinic-based education for more than 25 clinical trainees from various disciplines, including Occupational Medicine, Neurology, Internal Medicine, Family Medicine, and Nursing. Through the COHE collaboration with L&I, the clinic helped develop and implement an L&I policy for the care of workers with catastrophic injuries, which has now been extended throughout Washington state. The clinic has also been promoting occupational health best practices to other medical service units at Harborview.

LOOKING AHEAD

Several important developments will affect our department in the next biennium. DEOHS will continue to manage its financial resources with care, given the uncertain future in research funding and state support. Our department is also participating in the UW's exploration of a new budgeting model, Activity Based Budgeting, currently being used at several universities, to determine if it is more effective at managing resources.

Several large projects will face renewal, and we will continue to explore opportunities for new endeavors. This fall, we received the good news that the Center for Child Environmental Health Risks Research will be funded for another five years. Also, this fall, the Centers for Disease Control and Prevention awarded researchers in our department and in the Department of Health Services a three-year grant to evaluate the impact of climate change on human health in the Pacific Northwest. However, we were disappointed to learn that the Center for Ecogenetics and Environmental Health (CEEH) was not successful in its competitive bid for refunding. CEEH will resubmit an application for consideration next year.

WHERE ARE OUR PHD AND MASTER'S GRADUATES?



Academically, our department will continue to recruit top-tier students for its graduate and undergraduate programs. We are undergoing a 10-year academic program review by the UW Graduate School. This review, conducted by external reviewers and UW faculty, will be completed in Winter 2010 and may result in recommendations for changes to our graduate and undergraduate programs. We are also waiting to hear the results of a competitive renewal for our large training grant, the Northwest Center for Occupational Health and Safety, Education and Research Center, which should be announced in Spring 2010.

More than 200 alumni and friends gathered March 6, 2008 to celebrate the 60th anniversary of our department, which has come a long way since its origins. See photos of the event at *http://depts.washington.edu/envhlth/about/anniversary.php.*

In 2009, the School of Public Health and Community Medicine changed its name to the School of Public Health. Our department will also experience change as the school has initiated a search for a new dean. We anticipate this search will generate the interest of several qualified candidates, and our department will join with others to identify a new leader.

Given all the changes, the next two years should prove to be interesting. Stay in touch! ■

90 → 113

The Field Group responded to 113 requests for workplace health and safety consultation services from 90 different companies

162 → 887

EH Lab conducted analyses in response to 887 requests from 162 different agencies and businesses

1,000

patients visit the Occupational and Environmental Medicine Clinic each year

How we measure... accomplishments

Photo credits (top row, l to r): Karen West, Sarah Fischer, Mary Levin, Elizabeth Sharpe; (bottom row, l to r): Kathy Hall, Courtesy of Darren Linker, Sarah Fischer

top row, l to r:

Laura Denovan (MS, IH, 1996) with her father, James Denovan (BA/BS, 1965), at our department's 60th anniversary celebration

Professor Michael Morgan received the American Conference of Governmental Industrial Hygienists' Meritorious Achievement Award

Research Industrial Hygienist Venetia Runnion received a Distinguished Industrial Hygienist Award from the Pacific Northwest Section of AIHA

Professor Matthew Keifer and Associate Professor Peter Johnson at the Health & Safety in Western Agriculture–New Paths conference, sponsored by PNASH

bottom row, l to r:

2008 graduates: Jannette Kibogy (MS, IH), Devasmita Chakraverty (MPH, EOH), and Danielle Parette (MS, IH)

Young Worker Safety and Health Program Manager Darren Linker

2009 award winners: Laurel Jennings (MS student, EH), Tingting Li (PhD student, Tox), and Michael Rommen (BS, 2009)

Degrees Granted

Bachelor's, Master's, and Doctorate

UW commencement 2009, l to r: Undergraduates Natasha Curren-Mah, Kevin Aranas, My Dung Nguyen, and Zarina Morrill

Charles Treser

UNDERGRADUATE

Summer 2007

Cheryl De Aguiar
Joseph Nelson
Kim-Uyen Nguyen
Christine Santiago
Jackelin Tran

Autumn 2007

Angela Abbott
Azita Afshar
Quynh Bui
Trieu Dang
Fadumo Mohammad
Shukri Mohammad
My-Dung Nguyen
Christina Rohlik

Spring 2008

Abebe Aberra
Nitasha Beri
Breyan Blackett
Christopher Diangco
Conor Foley
Anisa Ghadrshenas
Anh-Thu Le
Harry Luu
Kazuhiro Okumura
John Palacio
Amelia Shaw
Misti Smith
Renee Sutton
Daniel Tseng
Megan Turner
Nichole Waiss
Christina Wong

Summer 2008

Katie Fellows
Trinh Hoang
Daniel Ormeni
Tiffany Spencer
Christopher Tung

Autumn 2008

Julia Claussen
Jonathan Im
Gurman Kaur
Nassir Kowdan
Robert Reed
Christine Snelson
Retta Taffesse
Stephanie Wong
Wilson Yu

Winter 2009

Alexis Jensen
Michael Rommen

Spring 2009

Kevin Aranas
Elise Buchholz
Natasha Curren-Mah
Wei-Lun Huang
Ngoc Huynh
Karen Masakane
Zarina Morrill
Nathan Ng
My Dung Nguyen
Eric Tanenbaum

GRADUATE PROGRAMS

Degrees: Master of Science (MS), Master of Public Health (MPH), Doctor of Philosophy (PhD)

Programs: Industrial Hygiene and Safety (IH), Occupational and Environmental Exposure Sciences (ES), Environmental Health (EH), Environmental and Occupational Hygiene (EOHy), Environmental and Occupational Health (EOH), Toxicology (Tox), and Occupational and Environmental Medicine (OEM). Faculty preceptors in (*parentheses*).

Note: The Industrial Hygiene and Safety program officially changed its name to Occupational and Environmental Exposure Sciences in Fall 2007. However, students admitted prior to that date graduated with a degree in Industrial Hygiene. Students admitted in 2007 graduated with an Exposure Sciences degree.

Summer 2007

Li Li, MS (Tox) Carbachol prevents oxidative stress-mediated apoptosis induced by domoic acid in cerebellar granule cells (*Lucio Costa*)

Alison Scherer, MS (EH) Fish consumption risk communication: A comparative analysis of fish consumption advisories to pregnant women and women of childbearing age (*Elaine Faustman*)

Autumn 2007

Robert Crampton, PhD (EOHy) Transmission quantification for open path Fourier transform spectroscopy with temperature compensation (*Michael Yost*)

Christopher David Miele, MS (IH) Applying optical remote sensing techniques to monitor community air particulate pollution (*Michael Yost*)

Erin O'Brien, MPH (EOH) The renin-angiotensin system, traffic-related air pollution, and cartoid distensibility: Gene-environment interactions in the Multi-Ethnic Study of Atherosclerosis and Air Pollution (*Joel Kaufman*)

Michael Paulsen, MS (EH) Measurement of diesel exhaust biomarkers of exposure by HPLC/MS/MS and GC/MS (*Christopher Simpson*)

Leah D. Tivoli, Master of Public Administration/MS (EH) *Clostridium perfringens*: A reservoir of antibiotic resistance genes in the environment? *(J. Scott Meschke*)

Ming-Yi Tsai, PhD (EOHy) The Washington Spray Drift Study: Understanding the broader mechanisms of pesticide spray drift (*Michael Yost*)

Winter 2008

Lisa Marie Corey, PhD (Tox) Cardiovascular effects of diesel exhaust in a mouse model of cardiovascular disease (*Daniel Luchtel*)

Clarita Lefthand, MS (EH) Detection of F+ RNA coliphage and bacteroides 16s rRNA gene in Tulalip Bay (*J. Scott Meschke*)

Spring 2008

Enass Awad A Rahman, MPH (OEM) The natural history of opiate use among workers with low back injuries in the Washington state workers' compensation system (*Gary Franklin*)

Ryan Patrick Blood, MS (ES) Whole body vibration exposure among transit workers in King County, Washington (*Peter Johnson*)

Bradley Gardiner, MPH (OEM) Survival analysis of new military recruits requiring waivers for scoliosis (*Jordan Firestone*)

Janessa M. Stream Graves, MPH (EOH) Employing a simple research protocol to investigate a children's environmental health concern: Fluoride and fluorosis among San Juan Island children (*William Daniell*)

Seong Hyun Hwang, MS (IH) Race, gender and finger anthropometry: Implications for computer input device design (*Peter Johnson*)

Aaron L. Jacob, MPH (OEM) Recruits requiring waivers for pes planus have a higher level of attrition than fully qualified (*Matthew Keifer*)

Karen L. Jansen, MS (Tox) Role of paraoxonase (PON1) in modulating toxicity of mixtures of organophosphorus compounds (*Lucio Costa*)

Loren Kaehn, MS (ES) An occupational exposure assessment at a petroleum refinery (*Michael Morgan*)

Christine Lang, MPH (OEM) Weight at enlistment predicted enrollment in the Army Weight Control Program 15 months later (*William Daniell*)

Lesley A. Leggett, MS (EH) Inactivation of human adenovirus type 2 by sequential disinfection with UV irradiation and free chlorine (*Gwy-Am Shin*)

Jennifer K. Parker, MS (EH) Whole genome amplification as a pre-PCR step to improve detection of pathogens in drinking water (*J. Scott Meschke*)

David R. Shoaf, MPH (EOH) Usability: An important consideration for public health education on the Web (*Matthew Keifer*)

Melissa R. Winters, MS (EH) The Washington Aerial Spray Drift Study: A comparison of children's inhalation expo-

sures to methamidophos estimated using diary and personalized Global Positioning System data (*Richard Fenske*)

Benjamin R. Wischmeier, MS (IH) Evaluation of the efficacy of the BioSampler aerosol collection device for collection and retention of various particle sizes (*Michael Yost)*

Summer 2008

Oleg Antonchuk, MS (IH) Evaluation of local exhaust ventilation for welding (*Noah Seixas*)

Stephanie Carter, PhD (IH) Characterization of peak exposures in aluminum smelter potrooms (*Noah Seixas*)

Erica Frost Finsness, MPH (EOH) Association between neighborhood walkability and physical performance function in older adults (*William Daniell*)

Jannette Jepkoech Kibogy, MS (IH) Assessment of chlorpyrifos exposure in agricultural workers during airblast applications (*Richard Fenske*)

Nadia A. Moore, PhD (Tox) Characterization of the effect of ethanol on astrocyte-released proteins involved in neuronal development: Relevance to fetal alcohol syndrome (*Lucio Costa*)

Joshua Frederick Robinson, PhD (Tox) Differential sensitivity and response to metal-induced neural tube defects using a comparative mouse model (*Elaine Faustman*)

Rachel Roisman, MPH (OEM) Respiratory health effects among children in a pulp mill community (*Sverre Vedal*)

Kelly Lee Stumbaugh, MS (EH) Estimation of skin permeability of aqueous chloroform from human *in vivo* trials and relative contribution of dermal absorption to multi-route exposure to chloroform in drinking water (*John Kissel*)

Autumn 2008

Eva Browne, MS (Tox) The role of biotransformation in polybrominated diphenyl ether accumulation in Puget Sound Chinook salmon (*Onchorhyncus tshawytscha*) (*Evan Gallagher*)

Beibei Cai, PhD (Tox) P38 MAP kinase pathway regulates apoptosis through phosphorylation and up-regulation of bimEL (*Zhengui Xia*)

Devasmita Chakraverty, MPH (EOH) An evaluation of potential risk factors for cancer and non-cancer health effects associated with heavy metal exposure (*James Woods*)

Sarah Lowry, MPH (EOH) Possibilities and challenges in injury surveillance of day laborers (*Noah Seixas*)

Isaac Mohar, PhD (Tox) Gender and glutamate cysteine ligase modifier subunit expression as determinants of acetaminophen-induced liver damage in mice (*Terrance Kavanagh*)

Winter 2009

Stephen Krival, MS (Tox) Principle components characterization of liver tissue metabolites in glutamate cysteine ligase transgenic mice treated with acetaminophen (*Terrance Kavanagh*)

Danielle M. Parette, MS (IH) Particle size distribution and bioavailability of hexavalent chromium exposure in various industries (*Michael Morgan*)

Kenneth A. Scott, MPH (EOH) Preparing for an aging workforce: A formative evaluation of an action plan development workshop (*Michael Silverstein*)

Kathryn VanDeMark, PhD (Tox) Ethanol inhibits muscarinic receptor-simulated neuronal differentiation and signaling in pyramidal hippocampal neurons (*Lucio Costa*)

Spring 2009

Jacob Braden, MS (ES) Modeling the fate of diesel particulate matter emissions from selected marine vessels using CALPUFF View (*Michael Yost*)

Timothy L. Carter, MS (ES) Particle size distribution and bioavailability of chromium VI compounds in electroplating and spray-painting (*Michael Morgan*)

Eric Coker, MS (ES) Measurement of gasses by UV-DOAS for a reference spectral library (*Michael Yost*)

Travis Cook, MS (IH) Identification of chlorpyrifos adducts in rat blood plasma by mass spectrometry based proteomics (*Christopher Simpson*)

Lauren Dunbar, MS (ES) Endotoxin collection and electrochemical detection method for use in bioaerosol personal sampling device (*J. Scott Meschke*)

Cassandra Fok, MS (Tox) The effect of antioxidants on lipopolysaccharide-induced and hydrogen peroxide-induced toxicity on MES23.5 cells (*David Eaton*)

Suping Huang, MS (Tox) Neurotoxicity of polybrominated dipheyl ether (PBDE) congeners in mice cerebellar neurons (*Lucio Costa*)

Edwin Long, MPH (OEM) Diver thermal exposure as risk factor for venous gas emboli in US Navy divers (*Sverre Vedal*)

Erin Stamper, MPH (EOH) Characterizing community responses to environmental injustice in South Park: Resources and recommendations (*William Daniell*)

Jackelin Tran, MS (ES) Effects of glove material and thickness on permeation by solvents commonly used in the auto painting industry (*Michael Morgan*)

Randy Treadwell, MPH (EOH) Introduction of a portable cholinesterase monitoring kit into clinical practice: A normalization process model approach (*Matthew Keifer*)

Honors and Awards



Environmental Health (EH)
Environmental and Occupational Health (EOH)
Environmental and Occupational Hygiene (EOHy)
Occupational and Environmental Exposure Sciences (ES)
Occupational and Environmental Medicine (OEM)
Toxicology (Tox)

STUDENTS

Abebe Aberra, undergraduate student
Washington State Environmental Health Association Cind M. Treser Memorial Student Scholarship, 2007

Ryan Blood, PhD student, EOHy
National Safety Council Congress and Exposition National Safety Council Congress and Exposition Best Poster Award, Anaheim, California, 2008

Emily Cane, undergraduate student
Washington State Environmental Health Association Cind M. Treser Memorial Student Scholarship, 2008

Diana Ceballos, PhD student, EOHy
Department's Outstanding Graduate Student Award, 2008

Alexander Domesle, MS student, EH
UW Graduate School Top Scholar Award

Lauren Dunbar, MS student, ES
Association of Environmental Health Academic Programs/ National Environmental Health Association Student Research Competition Presentation Award, 2009

Janessa Graves, MPH student, EOH
School of Public Health's (SPH) Gilbert S. Omenn Award for Academic Excellence for a Master's Student, 2008

Laurel Jennings, MS student, EH
SPH's Student Community Service Award, 2009

Kelly Jones, MS student, EH
National Oceanic and Atmospheric Administration's (NOAA) Dr. Nancy Foster Scholarship, 2008

Loren Kaehn, MS student, ES
Veterans of Safety Scholarship, 2008

Anh-Thu Le, undergraduate student
Washington State Environmental Health Association Cind M. Treser Memorial Student Scholarship, 2007

Clarita Lefthand, PhD student, EOHy
Bullitt Foundation's Environmental Prize, 2008; Environmental Protection Agency's (EPA) Science to Achieve Results (STAR) Fellowship, 2008

Lesley Leggett, MS student, EH
Association of Environmental Health Academic Programs/ National Environmental Health Association Student Research Competition Presentation Award, 2008

Tingting Li, PhD student, Tox
Department's Outstanding Graduate Student Award, 2009

Christine Loftus, MPH student, EOH
Achievement Rewards for College Scientists (ARCS) Foundation Fellow, 2008

Nadia Moore, PhD student, Tox
Research Society on Alcoholism Student Merit Meeting Award, 2007; Outstanding Student Poster Award, Pacific Northwest Association of Toxicologists (PANWAT), 2007

l to r: Christine Loftus, MPH student; undergraduate Emily Cane with Senior Lecturer Charles Treser; Professor Matthew Keifer receives a UW community service award; Associate Professor William Daniell, Graduate Program Manager Rory Murphy, and Graduate Program Coordinator Monica Leibrant; Diana Ceballos (PhD, EOHy, 2009); El Proyecto Bienestar logo; Kelly Jones, MS student; Professor Elaine Faustman (left) and IRARC staff members

Photo credits (l to r): Monica Leibrant, Ned Therien, Sarah Fischer, Letty Limbach, Jeanne O'Connell, Courtesy of El Proyecto Bienestar, Monica Leibrant, Jennifer Gill

Richard Neitzel, PhD student, EOHy
National Health Conservation Association President, 2009–2010; SPH's Gilbert S. Omenn Award for Academic Excellence for a Doctoral Student, 2009; American Industrial Hygiene Foundation's American Industrial Hygiene Association (AIHA) Scholarship, 2007

Kazuhiro Okumura, undergraduate student
Department's Jack Hatlen Scholarship, 2008; National Sanitation Foundation (NSF) International NSF Scholar Award, 2008

Christina Rohlik, MS student, EH
Association of Environmental Health Academic Programs/ National Environmental Health Association Student Research Competition Presentation Award, 2009

Michael Rommen, undergraduate student
Department's Jack Hatlen Scholarship, 2009; Collegiate Leaders for Environmental Health Program Inaugural Class Participant, 2008

Misti Deanna Rashelle Smith, undergraduate student
Department's Outstanding Undergraduate Student Award, 2008

Eric Tanenbaum, undergraduate student
Department's Outstanding Undergraduate Student Award, 2009

Melissa Winters, MS student, EH
EPA's National Network for Environmental Management Studies Fellowship, 2007; EPA's Presidential Management Fellows Program, 2008

Stephanie Wong, undergraduate student
UW Mary Gates Scholarship, 2008

GROUPS

Alison Cullen, Mark Corrales, C Bradley Kramer, Elaine Faustman. The application of genetic information for regulatory standard setting under the Clean Air Act: A decision-analytic approach. *Risk Anal* 2008;28(4):877–90.
Named one of the "top ten publications" demonstrating an application of risk assessment, Society of Toxicology Risk Assessment Specialty Section, 2008

El Proyecto Bienestar (Well-Being Project)
Environmental Protection Agency Community Action for a Renewed Environment (CARE) Award, 2007

Julia Gohlke, Bill Griffith, Elaine Faustman. Computational models of ethanol-induced neurodevelopmental toxicity across species: Implications for risk assessment. *Birth Defects Res B Dev Reprod Toxicol* 2008;83(1):1–11.
Teratology Society James G. Wilson Publication Award for Best Paper Published in Birth Defects Research, 2009

Josh Robinson, Xiaozhong Yu, Sungwoo Hong, Bill Griffith, Elaine Faustman and co-authors R. Beyer and E. Kim. Cadmium-induced differential toxicogenomic response in resistant and sensitive mouse strains undergoing neurulation. *Toxicol Sci* 2009;107(1):206–19.
Society of Toxicology Toxicological Sciences Best Paper Finalist, 2009

Judith Turner, **Gary Franklin, Deborah Fulton-Kehoe, Lianne Sheppard, Bert Stover, Rae Wu, Jeremy Gluck,** Thomas Wickizer. Early predictors of chronic work disability: A prospective, population-based study of workers with back injuries. *Spine* 2008;33(25):2809–2818.
DePuy Spine International Society for the Study of the Lumbar Spine (ISSLS) Prize, 2008

Janessa Graves (MPH, EOH, 2008) led a hand-washing project in Kenya supported by the American Public Health Association Health Grant (sponsored by Colgate-Palmolive)

Sitnah Faith

ALUMNI

George Astrakianakis, PhD, EOHy, 2005
Michael Smith Foundation for Health Research Career Investigator Award, 2008

Bradley Evanoff, MPH, OEM, 1993
Member, Committee to Review the Research Programs of the National Institute for Occupational Safety and Health

Jon Hofmann, MPH, EOH, 2004
Health and Safety in Western Agriculture–New Paths Conference Best Poster Award, Cle Elum, WA, 2008

Yolanda Sanchez, MS, EH, 2007
Associated Schools of Public Health Fellowship, 2007

STAFF

Brian High, Computing Support Specialist
Department's Outstanding Staff Award, 2009

Sung Woo Hong, Research Scientist
Department's Outstanding Staff Award, 2008; SPH's Kenneth J. Anderson Staff Award, 2008

Darren Linker, Program Manager
Washington Association for Career and Technical Education's Outstanding Service Award, 2008

Rory Murphy, Graduate Program Manager
UW Graduate School's First Annual Graduate Program Assistant Service Award, 2009

Venetia Runnion, Research Industrial Hygienist
Pacific Northwest Section of the American Industrial Hygiene Association Distinguished Industrial Hygienist Award, 2007

FACULTY

Scott Barnhart, Professor
Named among "Top Doctors" in the field of occupational medicine, Seattle Magazine, 2008

William Daniell, Associate Professor
Rohm & Haas Endowed Professor in Public Health Sciences, 2009

Elaine Faustman, Professor
SPH's Outstanding Teacher Award, 2008

Richard Fenske, Professor
2006 National Institute for Occupational Safety and Health (NIOSH) Director's Award for Scientific Achievement in Occupational Safety and Health, awarded in 2007; International Society of Exposure Analysis (ISEA) Jerome J. Wesolowski Award, 2007

Timothy Gilmore, Clinical Associate Professor
Named among "Top Doctors" in the field of occupational medicine, Seattle Magazine, 2008

Peter Johnson, Associate Professor
Human Factors and Ergonomics Society User Centered Product Design Award for Work on the Microsoft Natural Ergonomic Keyboard, 2007; Working With Computer Systems Conference Top Scientific Paper, Stockholm, Sweden, 2007

Terrance Kavanagh, Professor
Department's Student Advisory Committee Outstanding Faculty Mentor Award, 2009

Matthew Keifer, Professor
UW's Health Sciences Dr. Martin Luther King, Jr. Tribute Community Volunteer Recognition Award, 2009

J. Scott Meschke, Assistant Professor
Department's Student Advisory Committee Outstanding Faculty Mentor Award, 2008

Michael Morgan, Professor
American Conference of Governmental Industrial Hygienists' Meritorious Achievement Award, 2008

Kate Stewart, Lecturer
Fulbright Scholarship, 2008

Our Donors

Thank You for Your Generosity

We sincerely appreciate your gifts to the department. Your contributions support the innovative science being done in our department to better protect our communities from environmental and occupational health hazards. Thank you also to those who have contributed to student scholarships, such as the Jack Hatlen Scholarship.

The individuals, corporations, foundations, and family foundation donors listed on these pages contributed to the Department of Environmental and Occupational Health Sciences between July 1, 2007 and June 30, 2009.

UP TO $1,000

Individuals

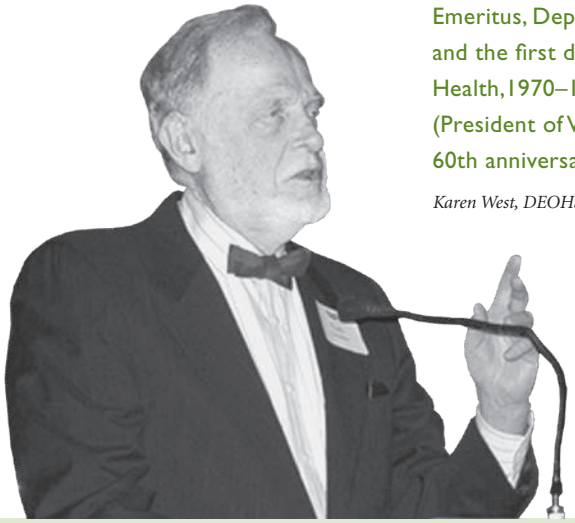
Anonymous
Angela Abbott*
Nancy Beck*
Mark and Carolyn Boatsman*
Miriam Bowers*
Michael Box* and Kristen Mitchell
Douglas Briggs*
Carl Brodkin*
Eva Browne*
William Budd* and Marty Bishop
Janice Camp* and Steven Gilbert
Michelle Catlin*
Ruth Cernera
Harvey and Anne Checkoway
Loribeth Coker
Walter* and Billie Cothran
Theodore and Ann Doege
Andrew Doyle
Samual Dreyer
Charles and Nancy Jean Easterberg
Aran Enger*
Elaine Faustman
Richard Fenske and Carol Jackson
Bethany French*
Donald* and Debra Garvey
Rick Gleason*
Anthony Gomez*
Michael and Marjory Gouthro*
Angelika Grossmann and Terrance Kavanagh
Rolf and Carolyn Hahne
Karen Hanson
Robert and Claribel Hurd
Gary* and Christina Irvine
Barry* and ML Jenkins
Matthew John*
Peter Johnson
Kimball* and Elaine Jones
Joel Kaufman* and Anna Wald
Matthew Keifer* and Susan Kline
Joy Keniston-Longrie* and Mark Longrie
John Kissel
Michael* and Alice Krause
Timothy and Donna Larson
Stanley and Betty Lee
Steve* and Naoko Magasis
Lee and Gretchen Monteith
J. Paul Newell
David* and Mary Noguchi
Doris Mae Rolander
Pastor Oscar Rolander+
Alan and Susan Schulkin
John and Ruth Sechena*
Marguerite Seeley*
Noah Seixas and Dana Standish
Aniela Sidorska

* *DEOHS Alumnus*
\+ *Deceased*

The Jack Hatlen Scholarship fund supports outstanding undergraduates in Environmental Health. Yearly tuition and fees for undergraduate education continues to increase. In 2007, a year of classes cost $6384. In 2009, the cost increased to $7125.

Kazuhiro Okumura (BS, 2008) received the department's Jack Hatlen Scholarship from its namesake Associate Professor Emeritus Jack Hatlen

Jennifer Gill



l to r: Thomas Grayston (UW Professor Emeritus, Department of Epidemiology and the first dean of the School of Public Health, 1970–1971) and Bruce Kelman (President of Veritox) at the department's 60th anniversary celebration

Karen West, DEOHS Archives

Lindsay Smith*
Sean Sweeney*
Peggy Timm and Tim Drangsholt*
Terry and Minnie Van Wormer
Whitney Webber*
Michael and Nancy Yost

Corporations and Foundations

3M Foundation
Achievement Rewards for College Scientists (ARCS) Foundation
The Boeing Company
Eye MDs of Puget Sound
KC Employee Charitable Campaign
Simpson Investment Company
The Starbucks Foundation

$1,000 OR MORE

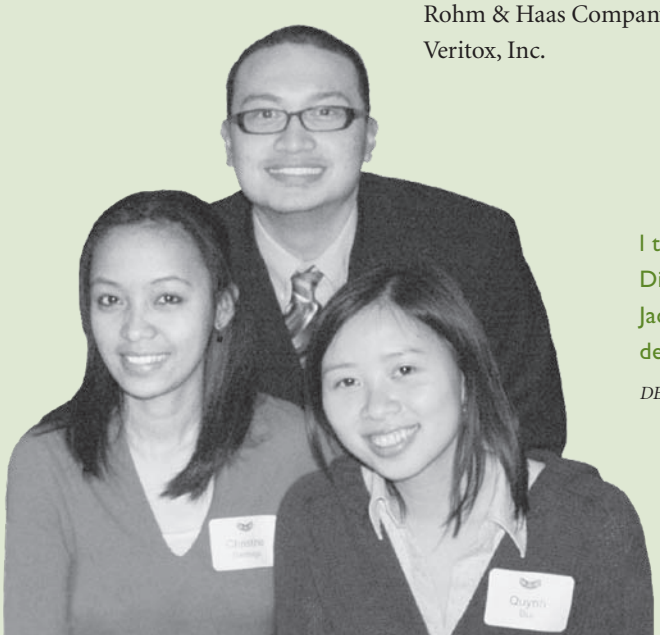
Individuals

Russell Castner* and Svanhild Swasand
David L. and Janet Lane Eaton+
Roger and Barbara Erickson
Thomas and Nan Grayston
Jack* and Betty Hatlen
Chao-Lin Hsieh*
David Kalman and Cecilie Hudson
Thomas* and Michelle McHugh
Charles Treser

Corporations and Foundations

American Public Health Association
Chevron Corporation
Office Ergonomics Research Committee
Rohm & Haas Company
Veritox, Inc.

We regret any misspellings, inadvertent omission, or incorrect placement in giving categories of an individual or organization that gave to the Department of Environmental and Occupational Health Sciences in the 2007–2009 biennium. Please advise us if you have found any errors by contacting the editor at esharpe@u.washington.edu. We appreciate the opportunity to correct our records.



l to r: Alumni Christine Santiago (BS, 2007); Christopher Diangco (BS, EH; BS, Biology, 2008), first recipient of the Jack Hatlen Scholarship; and Quynh Bui (BS, 2007) at our department's 60th anniversary celebration

DEOHS Archives

Our Faculty

Primary, Emeritus, Adjunct, Clinical, and Affiliate+

PRIMARY FACULTY

Faculty name, faculty title, followed by affiliated academic degree program

Sara Dubowsky Adar, MHS, ScD, Assistant Professor
Occupational and Environmental Medicine
(primary with Department of Epidemiology)

Scott Barnhart, MD, MPH, Professor
Occupational and Environmental Medicine
(primary with Department of Medicine)

Thomas M. Burbacher, PhD, Professor
Toxicology

Janice E. Camp, MSN, MSPH, Senior Lecturer
*Occupational and Environmental Exposure Sciences**

Harvey Checkoway, PhD, Professor
Occupational and Environmental Medicine

Lucio G. Costa, PhD, Professor
Toxicology

William E. Daniell, MD, MPH, Associate Professor
Occupational and Environmental Medicine

Charles D. Easterberg, MS, Lecturer
Undergraduate

David L. Eaton, PhD, Professor
UW Associate Vice Provost for Research
Toxicology

Elaine M. Faustman, PhD, Professor
Toxicology

Richard A. Fenske, PhD, MPH, Professor and Associate Chair
*Occupational and Environmental Exposure Sciences**

Gary M. Franklin, MD, MPH, Research Professor
Occupational and Environmental Medicine

Evan M. Gallagher, PhD, Professor
Toxicology

Richard J. Gleason, MSPH, Lecturer
*Occupational and Environmental Exposure Sciences**

Steven F. Hecker, MSPH, Senior Lecturer
*Occupational and Environmental Exposure Sciences**

Peter W. Johnson, PhD, Associate Professor
*Occupational and Environmental Exposure Sciences**

David A. Kalman, PhD, Professor and Chair
Environmental Health

Joel D. Kaufman, MD, MPH, Professor
Occupational and Environmental Medicine

Terrance J. Kavanagh, PhD, Professor
Toxicology

Matthew C. Keifer, MD, MPH, Professor
Occupational and Environmental Medicine

John C. Kissel, PhD, Professor
Environmental Health

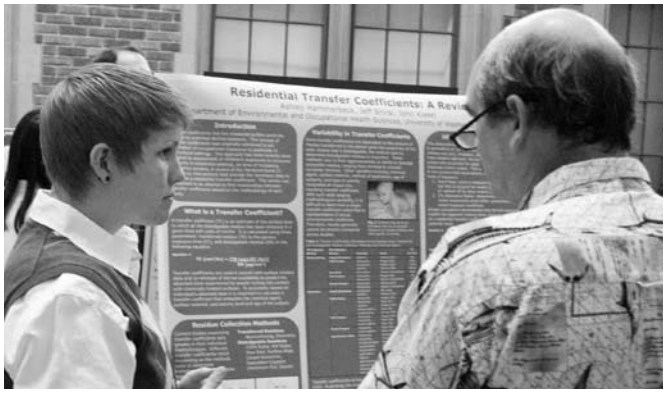
Jane Q. Koenig, PhD, Professor
Toxicology

Lee-Jane Sally Liu, ScD, Research Associate Professor
Environmental Health

Daniel L. Luchtel, PhD, Professor
Toxicology

J. Scott Meschke, PhD, Assistant Professor
Environmental Health

Michael S. Morgan, ScD, Professor
*Occupational and Environmental Exposure Sciences**



Ashley Hammerbeck, a summer undergraduate intern, presents her research poster to Professor Terrance Kavanagh

Sarah Fischer

+ Faculty titles as of June 30, 2009
** Formerly Industrial Hygiene and Safety*

Marilyn C. Roberts, PhD, Professor
Environmental Health

Michael E. Rosenfeld, PhD, Professor
Toxicology

Noah S. Seixas, PhD, Professor
*Occupational and Environmental Exposure Sciences**

Lianne Sheppard, PhD, Professor
Occupational and Environmental Medicine
(primary with Department of Biostatistics)

Gwy-Am Shin, PhD, Assistant Professor
Environmental Health

Christopher D. Simpson, PhD, Assistant Professor
*Occupational and Environmental Exposure Sciences**

Kate A. Stewart, MS, Lecturer
*Occupational and Environmental Exposure Sciences**

Charles D. Treser, MPH, Senior Lecturer
Environmental Health

Sverre Vedal, MD, Professor
Occupational and Environmental Medicine

James S. Woods, PhD, MPH, Research Professor
Toxicology

Zhengui Xia, PhD, Professor
Toxicology

Michael G. Yost, PhD, Professor
*Occupational and Environmental Exposure Sciences**

EMERITUS FACULTY

An appointment given to a retiring faculty member whose scholarly, teaching, or service record has been meritorious and who has had at least 10 years prior service on the faculty.

Peter A. Breysse, MPH, Associate Professor Emeritus

Theus L. (Lee) Doolittle, PhD, Associate Professor Emeritus

Stanley H. Freeman, MS, Senior Lecturer Emeritus

Jack B. Hatlen, MS, Associate Professor Emeritus

Kenneth L. Jackson, PhD, Professor Emeritus

Goldy D. Kleinman, MA, Lecturer Emeritus

Lee E. Monteith, MS, Senior Lecturer Emeritus

Sharon L. Morris, Senior Lecturer Emeritus

Carl S. Osaki, RS, MSPH, Clinical Associate Professor Emeritus

Maurice Robkin, PhD, Professor Emeritus

Gerald van Belle, PhD, Professor Emeritus

John T. Wilson, MD, ScD, Professor Emeritus

ADJUNCT FACULTY

A title extended to a faculty member who holds a primary appointment in another UW department.

Anneclaire J. De Roos, PhD, MPH, Adjunct Assistant Professor
Department of Epidemiology

Alan Fantal, PhD, Adjunct Research Professor
Department of Pediatrics

Jordan A. Firestone, MD, PhD, MPH, Adjunct Assistant Professor
Department of Medicine

Kelly Fryer-Edwards, PhD, Adjunct Associate Professor
Department of Bioethics and Humanities

Catherine Karr, MD, PhD, Adjunct Assistant Professor
Department of Pediatrics

OUR FACULTY

back row, l to r: Christopher Simpson, Michael Yost, Terrance Kavanagh, Lianne Sheppard, Noah Seixas, Steven Hecker, Jane Koenig, Richard Gleason, Janice Camp, Charles Treser, James Woods, Michael Rosenfeld, Gwy-Am Shin, Evan Gallagher, Peter Johnson, John Kissel; front row, l to r: Thomas Burbacher, Harvey Checkoway, Marilyn Roberts, David Kalman, Richard Fenske, David Eaton

Mary Levin

Paul D. Lampe, PhD, Adjunct Professor
Department of Global Health

Timothy V. Larson, PhD, Adjunct Professor
Department of Civil Engineering

Brian Leroux, PhD, Adjunct Associate Professor
Department of Biostatistics

Thomas G. Martin, MD, MPH, Adjunct Associate Professor
Division of Emergency Medicine

Kenneth Thummel, PhD, Adjunct Professor
Department of Pharmaceutics

CLINICAL FACULTY

A title usually given to someone with a primary appointment with an outside agency or nonacademic unit at the UW, or in private practice.

Leonard C. Altman, MD, Clinical Professor
Department of Medicine (primary appointment), Oral Biology

David Bonauto, MD, MPH, Clinical Assistant Professor
Associate Medical Director, Safety and Health Assessment and Research for Prevention Program (SHARP), Washington State Department of Labor and Industries (L&I)

Carl A. (Drew) Brodkin, MD, MPH, Clinical Associate Professor
Department of Medicine

Paul Darby, MD, PhD, MPH, Clinical Instructor
Department of Family Medicine (primary appointment); Medical Director, Franciscan Occupational Health

Timothy M. Gilmore, MD, PE, Clinical Associate Professor
Medical Director, Occupational Medicine & Internal Medicine, Group Health Permanente

Pamela A. Girres, MD, MPH, Clinical Assistant Professor
Occupational Medicine, Group Health Permanente

John P. Holland, MD, MPH, Clinical Professor
Holland Associates

Philip J. Landrigan, MD, Clinical Professor
Professor and Chair, Department of Community and Preventive Medicine, Mt. Sinai School of Medicine

Michael J. Muhm, MD, MPH, Clinical Professor
Associate Technical Fellow, The Boeing Company

Janet Ploss, MD, Clinical Assistant Professor
Occupational Medicine Physician, Group Health Permanente

Michael A. Silverstein, PhD, MPH, Clinical Professor

Patricia J. Sparks, MD, MPH, Clinical Associate Professor
Clinical Associate Professor, Department of Medicine, University of British Columbia

Henry L. Stockbridge, MD, MPH, Clinical Assistant Professor
Associate Medical Director, L&I

Timothy K. Takaro, MD, MPH, Clinical Associate Professor
Associate Professor, Faculty of Health Sciences, Simon Fraser University

Michael Weiss, MD, MPH, Clinical Assistant Professor
Medical Director, Occupational Health Services, St. Luke's Regional Medical Center

Paul V. Williams, MD, Clinical Professor
Director, Resident Allergy Education, Children's Hospital

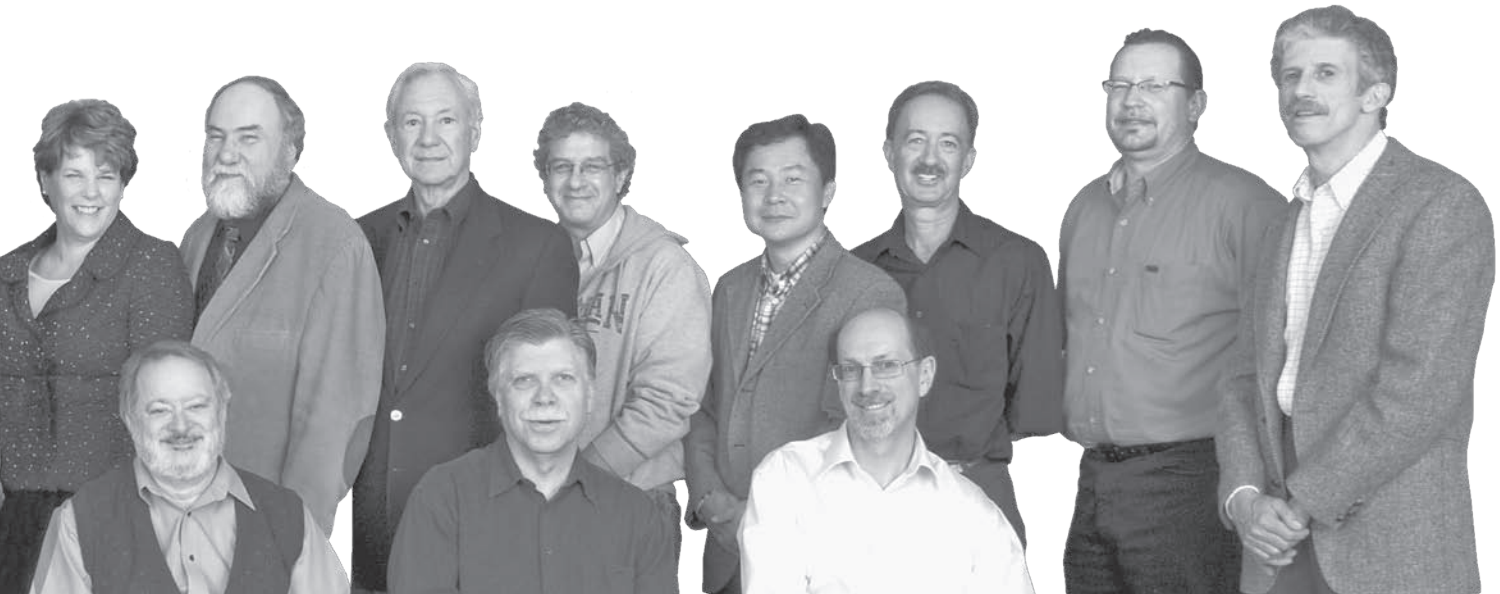
AFFILIATE FACULTY

An appointment that recognizes the professional contributions of those whose principal employment responsibilities lie outside the UW. In the listing below, auxiliary faculty's titles are followed by their outside affiliation.

Harriet M. Ammann, PhD, Affiliate Associate Professor
Toxicologist and Principal, Ammann Toxicology Consulting LLC

Stephen S. Bao, PhD, Affiliate Assistant Professor
Senior Research Ergonomist, L&I

David Boyle, PhD, Affiliate Assistant Professor
Molecular Epidemiologist, Washington State Department of Health



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T. Busch Consulting

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Stephen M. Cant, Affiliate Assistant Professor
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Foppe B. de Walle, PhD, Affiliate Professor
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Curtis J. Omiecinski, PhD, Affiliate Professor
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Acknowledgments

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The soulcatcher, logo of the School of Public Health, is a Northwest Coast Indian symbol of physical and mental well-being (artist: Marvin Oliver).

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