



2003-2005 BIENNIAL REPORT

Department of
Environmental and Occupational Health Sciences
SCHOOL OF PUBLIC HEALTH AND COMMUNITY MEDICINE UNIVERSITY OF WASHINGTON

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Cover photo: Washington state is highly dependent on its water resources.

Don Wilson, Courtesy of Port of Seattle

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These photos were altered to create a special effect using an Adobe®Photoshop® filter.



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HO WE ARE...

PEOPLE AND PROGRAMS

Organizational Chart

Chair
Assistant Chair for Outreach
Administrator

ACADEMIC PROGRAMS

Environmental Health
Industrial Hygiene and Safety
Occupational and Environmental Medicine
Toxicology



STUDENT SERVICES

Graduate Program Office
Undergraduate Program Office

SERVICE PROGRAMS

Environmental Health Laboratory
Field Research and Consultation Group
Occupational and Environmental Medicine Clinic

CENTERS, INSTITUTES, AND RESEARCH PROGRAMS

Center for Chemically Related Illnesses
Center for Ecogenetics and Environmental Health

- *Community Outreach and Education Program*

EPA Northwest Research Center for Particulate Air Pollution and Health
Institute for Risk Analysis and Risk Communication

- *Center for Child Environmental Health Risks Research*
- *Center for the Study and Improvement of Regulation*
- *Pacific Northwest Center for Human Health and Ocean Sciences*

International Scholars in Occupational and Environmental Health
MESA Air Pollution Study
Northwest Center for Occupational Health and Safety
Occupational Epidemiology and Health Outcomes Program
Pacific Northwest Agricultural Safety and Health Center
Pacific Northwest OSHA Education Center
Pediatric Environmental Health Specialty Unit
Policy Analysis and Program Evaluation Initiative
Superfund Basic Research Program
Toxicogenomics Consortium



Photos, pages 2 and 3: Devon DeLapp, Janice Camp, Kathy Hall, DEOHS Archives, Courtesy of Laura McLaughlin, EH Lab

Assessing, Managing,

COMMUNICATING RISKS

Working, playing, breathing—life presents us with risks every day. Some risks are worth taking—think of the exhilaration of skiing in fresh powder. Other risks, such as the use of chemicals in the workplace that have hazardous properties or the potential for prenatal exposures to toxic substances, require much more effort and understanding in order to arrive at valid policy decisions and individual choices.

The science of risk assessment and risk communication underlies many of our educational and research initiatives in the Department of Environmental and Occupational Health Sciences.

In this, our fourth biennial report, you will learn about a predictive tool that can identify injured workers who are at risk of chronic disability. You will read about a win-win solution to a neighborhood noise problem that also reduces risks to workers.

You will learn how technology can be applied to identify farmworkers whose risk of pesticide-related symptoms may be higher than average and to reduce the risk of waterborne illness.

You can ponder the risk trade-off of a class of fire retardants. You will learn how a new, interdisciplinary center is working to uncover some of the mysteries in the human-ocean relationship. And you will learn how departmental research is helping inform decision-making about lead in the drinking water in the Seattle public schools.

In short, almost all of the research, teaching, and service work in our department is related to risk assessment, risk management, and risk communication in some way.

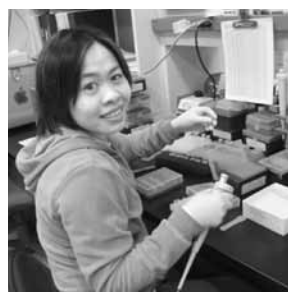
You will read about six of our alumni and how their education translates to the workplace. We know

that our graduates are increasingly required to participate in and perform risk analysis or risk management projects. For more than 20 years, our faculty has taught a multidisciplinary risk assessment course, which was the first of its kind in the United States. In 1997, this course became the foundation of our department's Risk Emphasis certificate program.

Our Institute for Risk Analysis and Risk Communication (IRARC) is committed to improving public health through research that strengthens the scientific methods used in risk assessment and risk communication. IRARC conducts molecular and cellular laboratory research, develops mechanistic models of toxicity, and translates findings into effective education and intervention programs.

For all of us in the department, our ultimate goal is to improve public health outcomes through sound science that is translated 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

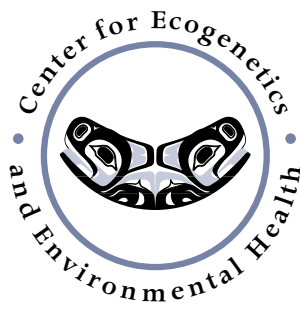


Our Department

PROGRAMS, CENTERS, & INSTITUTES

In the Department of Environmental and Occupational Health Sciences, 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



Center for Ecogenetics
and
Environmental Health



Pacific Northwest
Agricultural Safety
and Health Center



Pediatric Environmental
Health Specialty Unit

ACADEMIC PROGRAMS & DEGREES

Environmental Health students learn to identify major sources of contamination in water, air, soil, and food, and take appropriate prevention, control, and communication measures. Students may earn a Master of Science (MS) or a Doctor of Philosophy (PhD) degree.

Industrial Hygiene and Safety students study health hazards found in the workplace, such as chemicals, airborne particles, noise, vibration, ergonomic factors, and safety hazards. They learn to recognize these hazards, evaluate the possible health risks, and implement effective control measures. The program offers a PhD degree and two MS tracks: industrial hygiene and safety/ergonomics.

The Occupational and Environmental Medicine residency trains physicians through clinical, classroom, and practicum components. The program is accredited by the Accreditation Council for Graduate Medical Education and leads to a Master of Public Health (MPH) degree and board eligibility in Occupational Medicine.

The Toxicology program focuses on the adverse effects of chemical exposures on human health. It engages in basic and applied research on the molecular, genetic, and biochemical mechanisms underlying these effects, together with the behavioral consequences and risk analyses associated with toxic exposures in the environment and workplace. Both master's (MS) and doctoral (PhD) degrees are offered.

The Master of Public Health in Environmental and Occupational Health degree is designed to enhance communication and understanding between the scientific and health policy worlds. In contrast to the MS degree programs, which are measurement-oriented and specialized, the MPH degree provides a broader perspective on environmental and occupational health, with emphasis on applications and policy implications.

Through our **Bachelor of Science** program in Environmental Health, students learn to identify, prevent, and control environmental factors that can damage human health. The program is flexible, providing a grounding in environmental health sciences and an emphasis in one of four interest areas: biological sciences, physical sciences, medical professions, or environmental health practice.

SERVICE PROGRAMS

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.

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, coordinate medical examinations, and make recommendations for controlling workplace exposures. Priority is given to serving small businesses whose problems are not readily addressed by the private sector.

The Occupational and Environmental Medicine Clinic provides care to patients with illness or injury caused by occupational or environmental exposures. The multi-disciplinary group includes experts trained in occupational medicine, occupational health nursing, internal medicine, family medicine, neurology, pediatrics, industrial hygiene and toxicology, epidemiology, and public health. Through an association with the Department of Labor and Industries, the clinic plays a key role in evaluating clusters of occupational illness. Physicians provide consultation services on a wide range of medical, legal, and regulatory issues.

CENTERS, INSTITUTES, AND RESEARCH PROGRAMS

The Center for Chemically Related Illness, part of the Occupational and Environmental Medicine program, seeks to offer the best diagnosis and treatment for patients with chemically related illness, improve public understanding of such illness, and conduct research. Patients may be referred through the Washington state workers' compensation system or by their personal medical provider.

The Center for Ecogenetics and Environmental Health (CEEH), funded by the National Institute of Environmental Health Sciences (NIEHS), studies how environmental factors interact with genetics to influence diseases. A key focus is to understand how different people metabolize drugs and chemicals, which can affect their susceptibility or resistance to disease. The center, in collaboration with the Institute for Public Health Genetics, also addresses the ethical, legal, and social issues related to genetic information.

Within the CEEH, the **Community Outreach and Education Program** (COEP) is working to address environmental health issues in the most affected communities in the Pacific Northwest, and to increase public understanding of how individual susceptibilities such as genetics and age interact with environmental factors to produce disease.

COEP's projects include:

- using environmental health sciences as a framework to integrate science, social studies, and English in secondary school curricula
- statewide distribution of a School to Work curriculum, to raise awareness of health and safety issues for working teenagers
- community partnerships, including the Environmental Justice Needs Assessment project, which identifies the environmental health concerns that are most relevant to recent immigrants and refugee populations and explores the best solutions

The EPA Northwest Research Center for Particulate Air Pollution and Health is one of five in the country funded by the Environmental Protection Agency (EPA) that address health effects of particulate air pollution. The grant is in its seventh and final year. The focus is on publication as the center finishes its work in May 2006.

The Institute for Risk Analysis and Risk Communication (IRARC), which works to improve risk assessment methods and the scientific foundations supporting risk assessments, has three research programs:

- **The Center for Child Environmental Health Risks Research** is funded by the US EPA and NIEHS to further knowledge of children's susceptibility to toxicants
- **The Center for the Study and Improvement of Regulation** is funded by Carnegie Mellon University to merge the study of pollution, risk, public health, technology, economics, organizations, and history to improve environmental health and safety regulations
- **The Pacific Northwest Center for Human Health and Ocean Sciences** investigates how genetic and environmental variability defines the toxicity and dynamics of harmful algal blooms, the retention of toxin by shellfish, and the impact this has on human populations that are susceptible to toxicological impacts. The center is funded by the NIEHS and the National Science Foundation. Researchers come from the College of Ocean and Fishery Sciences and the School of Public Health and Community Medicine.

The International Scholars in Occupational and Environmental Health program is based in the Occupational and Environmental Medicine program and is funded by the National Institutes of Health through the Fogarty International Center and NIEHS, and by the National Institute for Occupational Safety and Health (NIOSH). It supports research and training partnerships with faculty and scientists in Vietnam, Thailand, Nicaragua, and Costa Rica.

The MESA Air Pollution Study is investigating the relationship between air pollution exposures and the progression of cardiovascular disease over time, looking at participants in six states, representing diverse areas of the country. Funded by a grant from the EPA, the study is sited at the University of Washington, and 14 other institutions are involved in the study. The air pollution study builds on the Multi-Ethnic Study of Atherosclerosis (MESA), funded by the National Heart Lung and Blood Institute of the National Institutes of Health.

The Northwest Center for Occupational Health and Safety is one of 16 education and research centers funded by 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.

The Occupational Epidemiology and Health Outcomes Program conducts research to improve medical care, update treatment guidelines, and provide information on treatment outcomes to injured workers, their physicians, and regulatory agencies.

The Pacific Northwest Agricultural Safety and Health Center (PNASH) conducts research, develops interventions, and provides education to improve the safety and health of Northwest workers in farming, fishing, and forestry. Center researchers work closely with colleagues at northwestern universities and with employers, labor, community organizations, and government agencies. The PNASH center is funded by NIOSH and the state of Washington.

The Pediatric Environmental Health Specialty Unit has assembled a team of pediatricians, emergency medicine physicians, toxicologists, and other environmental health specialists to consult with health care providers, government officials, educators, and families on health risks associated with pediatric environmental exposures.

The Policy Analysis and Program Evaluation Initiative worked closely with the state Department of Labor and Industries, and with business and labor to improve the quality of occupational safety and health policies and programs in Washington. It evaluated the understanding and implementation of selected WISHA rules, completing work in June 2005.

The Superfund Basic Research Program is an NIEHS-sponsored, interdisciplinary program among our department, Civil Engineering, Biochemistry, Forestry, and Epidemiology. Its goals are to develop biological markers to assess people's exposure to toxicants and susceptibility to disease, assess physiological damage in people and wildlife, and develop technology to clean up contaminated sites. Its outreach core is engaged in activities with communities affected by hazardous waste sites. Additionally, the outreach core has developed educational materials related to the health effects of hazardous waste.

The Fred Hutchinson Cancer Research Center/University of Washington **Toxicogenomics Consortium** uses microarray technology to study the ways that toxic substances can affect how genes are expressed in cells. Changes in gene expression are thought to be important events in many environmentally related diseases. The consortium supports research to develop and refine microarray analysis techniques, and conducts studies on the health effects of specific toxicants, including methylmercury and organophosphate pesticides. It is supported by NIEHS.

The Pacific Northwest OSHA Education Center offers hands-on training on standards mandated by the federal Occupational Safety and Health Administration (OSHA) and state agencies in Washington, Oregon, and Alaska. Training is offered through traditional classroom and distance learning technologies. ■



*W*HAT WE DO...
AND WHOM WE SERVE



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Repetitive

Repetitive Stress Injuries

PREVENTING INJURY, PREDICTING DISABILITY

measuring exposures

PREVENTING THE INJURY

Most backaches are cumulative—the result of thousands of movements that add up to overuse and strain. Old diagnostic tools made it hard—or expensive—to identify which movements pushed the back beyond its limits.

In the past, the continuous assessment of physical exposures was too costly and too time consuming, said Peter 8, PhD, whose ergonomics lab specializes in measuring occupationally related physical exposures. With advances in technology, “a new age in musculoskeletal exposure assessment is developing,” he said.

Observation, even by a trained ergonomist, misses many of the body’s clues, especially isolated, infrequent events. Other methods, such as muscle electromyography (EMG) and lumbar motion monitors, can be invasive and can cost up to \$20,000. Johnson sought to develop a simple and relatively inexpensive device to measure a worker’s posture and torso movements over the course of a work shift.

Johnson helped develop the Virtual Corset™, a new research tool to better understand and ultimately reduce work-related musculoskeletal disorders. The

pager-sized unit, strapped to a worker’s back, arms, or chest, can collect a continuous record of the worker’s changing posture.

He worked with Vermont-based Microstrain, Inc., to develop a system that can cost less than \$1,000 and be small and sturdy enough to be used in the field. Its two megabytes of memory can collect a day’s worth of data, opening up new avenues for ambulatory exposure assessment. This can help researchers better understand the relationship between cumulative postural exposures, load patterns, and musculoskeletal disorders.

Johnson’s team developed the device for our department’s Pacific Northwest Agricultural Safety and Health center as part of a project to create tools to measure physical exposures during agricultural and forestry work. In cooperation with the Field Research and Consultation Group, the team wants to use the Virtual Corset™ to compare two tree fruit harvesting methods, using the traditional ladder and using mobile platforms.

Mobile platforms are four-wheel, self-guided, all-terrain vehicles that move slowly down a row of fruit trees and carry up to eight workers. The Washington tree fruit industry is experimenting with them as a way to improve harvest productivity and fruit quality, while reducing ladder-related injuries. An unknown is how the mobile platforms will affect the physical loads on the upper arms, shoulders, and back.

Also, a team from the University of British Columbia is using the Virtual Corset™ in a study of low back strain in five heavy industries.



Photos: Courtesy of Peter Johnson

The pager-sized device can record a day’s worth of postural data.



Tree thinners work from a mobile platform.



Courtesy of Good Fruit Grower



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Stress

PREDICTING THE DISABILITY

Back and neck sprains aren't the most serious workplace injuries, but they are the most costly, as revealed by a measurement system developed by the Occupational Epidemiology and Health Outcomes Program. When calculated by time lost from the job, measured in "years of productivity lost" (YPL), back and neck strains yield a value more than five times higher than any other category of injury.

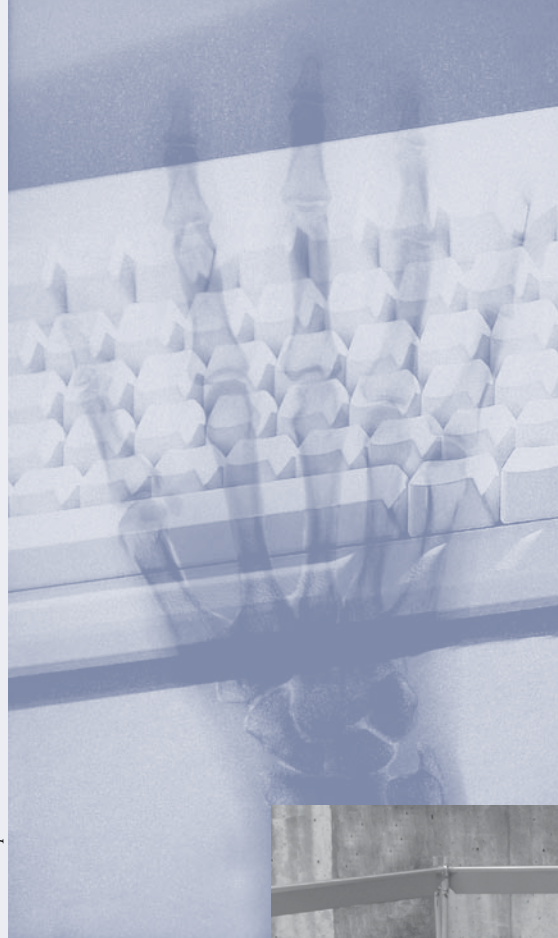
Back sprains, along with carpal tunnel syndrome—a repetitive strain wrist disorder—are among the less severe, nonhospitalized injuries that account for most of the disability costs in the workers' compensation system.

Gary Franklin, MD, MPH, research professor, director of the UW Occupational Epidemiology program, and medical director of the state Department of Labor and Industries, wants to find out how such relatively minor injuries can cause major disability. His team is in the fourth year of a five-year grant from the National Institute for Occupational Safety and Health (NIOSH) to identify risk factors so workers can be helped before they become disabled.

"This is the biggest prospective study ever done on injured workers in the country," Franklin said, calling it the "Framingham study of workers' compensation" in comparison with the landmark epidemiological study on cardiovascular disease begun half a century ago.

Back injuries and carpal tunnel syndrome are the "two giant issues in workers' comp," he said. "Whoever figures these two out has the cure for the comp system."

His population-based study is looking for the factors that predict chronic disability. Although most injured workers return quickly to work, a substantial number do not. Franklin's team is developing an



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Lori Winnemuller

Ergonomic keyboards (top left) and lifting devices (right) can help reduce strain.

early warning system to identify workers most at risk for chronic disability. Those workers can be targeted for early support and intervention with a goal of returning them to work. "We can try to predict which workers are more likely to become disabled," Franklin said, "then we can deliver care differently."

FURTHER READING

Turner JA, Franklin G, Fulton-Kehoe D, Egan K, Wickizer TM, Lymp JF, Sheppard L, Kaufman JD. Prediction of chronic disability in work-related musculoskeletal disorders: a prospective, population-based study. *BMC Musculoskeletal Disord* 2004; 24(5):14. ■

Consulting

Ballard Brass & Aluminum

CONSULTING, RESEARCH, AND SERVICE LEARNING

bridging the gap

When neighbors complained about the loud noise coming from the Seattle-based Ballard Brass & Aluminum foundry, owner Steve Morel turned to the industrial hygienists at the Field Research and Consultation Group (Field Group) for help.

Ballard Brass produces parts of diesel engines, cooling systems for boats, loudspeakers for stadiums, and wheel hubs for sprint racing cars, among other things. These items are made in molds formed of sand hardened with a chemical binder. The binder allows the sand to retain the fine details of the piece to be cast.

The work the 18 production employees do in this small foundry would be familiar to a foundry worker from five hundred years ago—many of the steps in the casting process are still done by hand. A worker packs sand into the molds and rams it down with a hand-held pneumatic tamper. Two men lift a crucible full of molten metal and pour it into the molds. Another worker breaks the mold casings apart with a sledgehammer.

NOISE LEVELS

When Gerry Croteau, a certified industrial hygienist with the Field Group, assessed community noise levels during foundry operations, he observed the obvious: noise levels in the neighborhood were considerably lower when the foundry doors were closed. However, the seemingly simple solution to Ballard Brass's neighborhood noise problem—shut the doors—wasn't acceptable for the foundry workers.

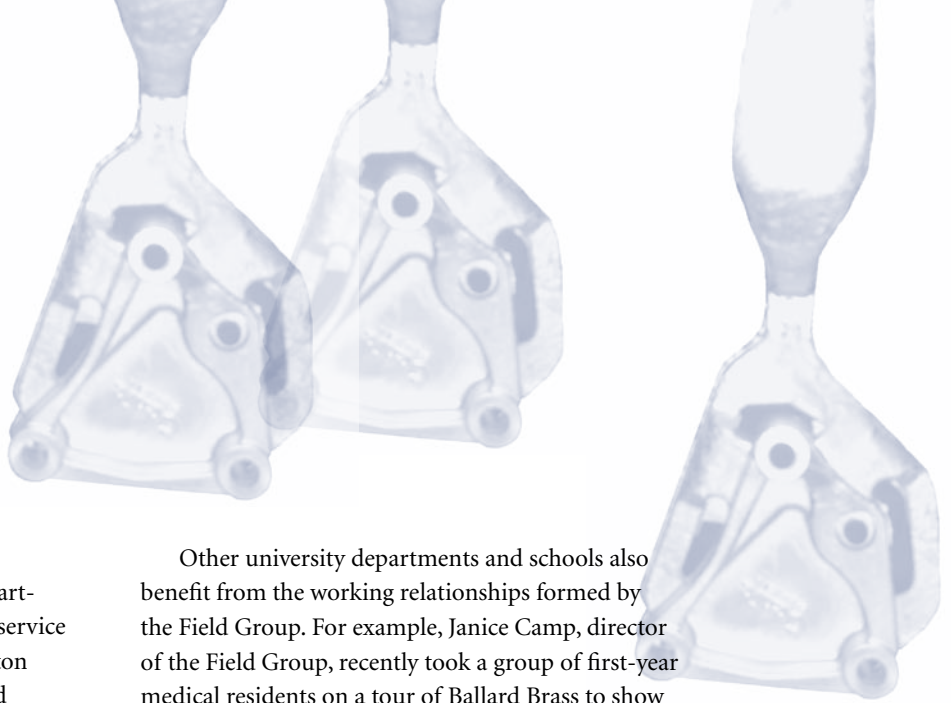
The workers needed the doors to remain open to release heat and remove the unpleasant odors released when the molds were broken down. Worker exposures to an irritating component in the binder were especially a concern to Croteau. When workers become sensitized to irritating gases, they can develop asthma. A severe sensitivity means the worker would no longer be able to work in that environment.

Ballard Brass faced a conundrum, needing to be both a good neighbor and a good employer. Croteau proposed that the company use a technique called dilution ventilation to exhaust building air to a rooftop stack 20 feet above roof level, and developed a conceptual design and cost estimate for Ballard Brass.

The installed system pulls air from an exhaust hood located over a hopper where sand is removed from the mold castings. The vapors, previously released from the building at ground level, are now diluted with building air and are exhausted at a high velocity into the atmosphere, where they are further diluted. This solution, which cost approximately \$15,000 to implement, has provided a noticeable improvement in both the work and community environments. With the doors closed, community noise and odor levels are substantially lower. Inside, workers can breathe more easily.



Workers pour molten metal into sand molds.



THE FIELD GROUP

The Field Group, a service component of our department since 1956, provides a no-cost consultation service on workplace health and safety issues to Washington businesses such as Ballard Brass, labor groups, and governmental agencies. The Field Group's funding comes in part from employers and workers in the state through their contributions to the Medical Aid and Accident Funds.

The Field Group responds to individual company and worker requests for workplace assessments. It also works with specific industries on longer-term research projects such as studies of exposures to solvents and noise in auto body repair shops, wood dust in sawmills, cobalt and cadmium in saw filing shops, pesticides in tree fruit orchards, and musculoskeletal injuries in apple packing warehouses.

The benefits the Field Group provides, however, extend beyond business and industry. The relationships built with businesses that consult with the Field Group can also lead to research and internship opportunities for graduate students.

Data the Field Group collects during service projects can spark the interest of faculty and students and may help in writing federal research grants. Grants are reviewed more favorably when some preliminary data has been collected and a partnership at a data collection site is already established.

The foundry has already helped Croteau with data collection for a dust exposure project in Vietnam. When he needed comparison data for two different air-sampling methods (personal, collected near a worker's mouth, and area, collected from static locations in the work site), he called on his past working relationships at Ballard Brass and gained permission to collect air samples there.

Other university departments and schools also benefit from the working relationships formed by the Field Group. For example, Janice Camp, director of the Field Group, recently took a group of first-year medical residents on a tour of Ballard Brass to show them real workplace challenges.

"The Field Group bridges the gap between science and the field," said Croteau. "As industrial hygienists, it's important that we never lose sight that we're serving the workers. The aim of industrial hygienists is to reduce worker exposure to workplace hazards. The Field Group is working on how best to help employers find and fix occupational hazards."

FOR FURTHER READING

Croteau G, Guffey S, Flanagan ME, and Seixas N.

The effect of local exhaust ventilation controls on dust exposures during masonry activities. *AIHAJ* 2002; 63:458-467.

Field Research and Consultation Group

<http://depts.washington.edu/frcg/>. ■

**Workers
at Ballard
Brass.**



Photos: Ly Pham; Illustration: Ballard Brass & Aluminum

Agriculture

Keeping Agricultural

WORKERS SAFE

identifying consequences

Clinical poisoning from organophosphate pesticides is relatively rare among Washington state agricultural workers. However, when it happens, the potential consequences are severe. There is a relatively small margin between a dose that produces symptoms and one that is life-threatening.

Environmental measurements are little help in identifying overexposures before they produce symptoms. One reason is that workers differ in susceptibility, partly because of their genetic makeup. Another is how they use protective equipment; significant exposures can occur even with very brief lapses of protection. The most commonly used way to find out whether a worker is being affected—

even before symptoms show—is with a blood test that uses the worker’s own cholinesterase levels as a baseline.

Cholinesterase is an enzyme that acts as the nervous system’s “off switch.” Many pesticides, known as carbamate and organophosphate pesticides, act by disrupting the function of this type of enzyme in insects (and in people), so the nervous system works overtime. Workers whose cholinesterase levels have been lowered by contact with these pesticides could become sick if they continue to be exposed. Monitoring workers’ cholinesterase levels can provide an early warning of overexposure, so steps can be taken to prevent further harm.

In February 2004, Washington State Department of Labor & Industries implemented a cholinesterase monitoring rule, which requires agricultural employers to provide blood testing to workers who handle certain pesticides. Our department is helping the state departments of Health and Labor and Industries develop a monitoring system to implement the rule.



PNASH Archives

Ofelio Borges of the Washington State Department of Agriculture trains pesticide handlers in the proper use of protective equipment.

TIMELINE OF THE WASHINGTON STATE CHOLINESTERASE MONITORING RULE

<p>1986–1997 Discussions between farm workers’ representatives and L&I about cholinesterase monitoring. UW involved with Technical Advisory Group</p>	<p>1997 Following a series of organophosphate pesticide poisonings in Washington state, two farmworkers sue L&I</p>	<p>2002 State Supreme Court decides that L&I must develop a rule for pesticide biomonitoring</p>	<p>2003 L&I rule is announced; Department of Health laboratory is selected to conduct year 1-2 monitoring; training materials developed for health care providers</p>	<p>2003–2004 PNASH training sessions for health care providers</p>
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Farmworkers spray an orchard with pesticide.



Matt Keifer; illustration: ©2006 www.clipart.com

Faculty members have been active on the scientific advisory committee formed to oversee data collection and analysis. Dave Kalman, PhD, is chair of the committee, and Matt Keifer, MD, MPH, Gerald van Belle, PhD, and David Bonauto, MD, MPH, are members. Keifer also serves on a stakeholder committee and works with the community clinics that collect the blood samples.

Kalman, who for 19 years directed the Environmental Health Laboratory, called this an example of “taking science out of the lab and into the regulatory world.” The idea behind the monitoring, he said, is to identify possible poisoning before symptoms develop, providing a margin of safety (see next page). Kalman’s committee is reviewing monitoring results to assist the state to determine whether the monitoring program is, in fact, protecting a significant number of workers.

Keifer described the goals of the monitoring program as preventing poisonings, identifying hazardous conditions and practices, increasing hazard awareness among workers and employers, and helping determine a safe time frame for returning to work after a poisoning event.

The rule requires employers to record all hours that a worker mixes, loads, or applies organophosphate or n-methyl-carbamate pesticides with the words “danger” or “warning” on the label. Examples

are azinphos-methyl (Guthion), chlorpyrifos (Lorsban), carbaryl (Sevin), diazinon, and phosmet (Imidan).

Growers whose workers handle these pesticides for 30 or more hours in any 30-day period are required to offer these workers an opportunity to participate in the cholinesterase-monitoring program. The workers will be directed to a clinician who will explain the program and the worker may decide to have the blood tests.

A blood sample will be taken before the growing season to determine the worker’s baseline cholinesterase level. Repeat tests will be made when he or she handles these pesticides for 30 or more hours in a 30-day period.

The depression of the enzyme activity is only understandable by comparing a blood test taken during or after exposure with one taken before exposure occurs, Keifer said. Since the range of normal values for cholinesterase is very broad, workers must have a personal unexposed baseline available for comparison.

A drop in cholinesterase level prompts a review of the workplace to find out how the overexposure happened—perhaps a wash station was not available or a respirator was improperly fitted.

In the relatively few cases where the cholinesterase level is very low, the worker will be reassigned to a job

—continued on next page

2003–2004

PNASH develops informed consent audiotape for Spanish-speaking workers

JAN–SEPT 2004

Year 1 monitoring

JAN–SEPT 2005

Year 2 monitoring

2006

PNASH field research on etiology of pesticide exposure. Comprehensive report due in September

—continued from page 13

without pesticide exposure until the cholinesterase returns to a safe level. This occurred in 10 cases in 2005—fewer than 2% of the total cholinesterase tests.

After two seasons of study, the screening found that nearly 20% of monitored workers sustained at least one cholinesterase depression of 20% or greater, Keifer said. A 20% depression prompts a workplace investigation, 30% a removal from work, and 50% constitutes poisoning. None of the workers had symptoms.

In most cases, decreases in cholinesterase of up to 50% do not cause illness. However, at some point an additional exposure could make the worker ill. Symptoms can include headaches, diarrhea, dizziness, blurred vision, difficult breathing, unconsciousness, and even death.

Because the purpose of the rule is to protect workers, results can't be interpreted in the same way as a population-based study, Keifer said. For example, individual workers aren't followed from year to year. Still, departmental researchers have found useful data.

The Pacific Northwest Agricultural Safety and Health (PNASH) center plans follow-up studies to investigate the causes for cholinesterase depressions and to evaluate a field test kit that clinics can use.

FOR FURTHER READING

L&I website

<http://www.lni.wa.gov/Safety/>

[Topics?AtoZ/Cholinesterase/default.asp](http://www.lni.wa.gov/Safety/Topics?AtoZ/Cholinesterase/default.asp).

Washington state cholinesterase monitoring rule, WAC 296-307-148 <http://www.lni.wa.gov/WISHA/Rules/agriculture/HTML/part-j-1.htm>.

Pacific Northwest Agricultural Safety and Health Center website <http://depts.washington.edu/pnash/>. ■

ANALYZING THE NUMBERS

It's more than a simple "yes or no" question to determine whether a farmworker's cholinesterase level has fallen enough to require action. Statistical evidence is tempered with ethical and policy considerations when setting a standard such as Washington state's new cholinesterase monitoring rule.

Professor Emeritus Gerald van Belle, one of the nation's leading biostatisticians and former chair of our department, helped assess the measures for action. He describes the state's dilemma as how to set a level that adequately protects workers, but doesn't unduly burden their employers.

Biostatisticians speak of "false negatives"—people who really have something wrong that doesn't show up in tests—and "false positives"—people whose tests suggest a problem that isn't borne out in further testing.

In cholinesterase testing, workers' levels are compared to their own baseline tests. The action level could be set high, perhaps at a 40% depression in cholinesterase. This would virtually eliminate false positives, but could put some workers near the threshold of serious harm. If the action level were low, perhaps at 10%, it would identify almost all of the true cases, but would remove many workers from the field unnecessarily.

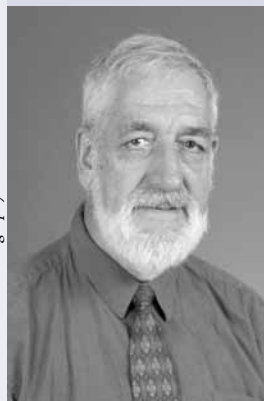
An agency such as Washington State Department of Labor & Industries (L&I) has a mandate to protect workers, and may build in a margin of safety, using what is called the "precautionary principle." The question is how large that margin should be. "Statistics tries to quantify the issue," van Belle said. "We try to describe what happens at each level, but it is up to the regulators to decide where to draw the bright line." After many discussions with the scientific advisory and stakeholder committees, L&I adopted action levels of 20%, 30%, and 40% (see main story, pages 12–14).

van Belle, who retired at the end of the biennium, considers the cholinesterase project one of his most interesting in a 31-year career at the university. His résumé includes many projects, including the Tacoma smelter arsenic study that first brought him to our department's attention. Though not part of the Environmental Health faculty at the time, biostatistician van Belle became the department's interim chair in 1990 and its permanent chair from 1991-1998. At the time of his appointment, he said he "knew little about the department, but I know good science when I see it."

FOR FURTHER READING

van Belle G, Fisher L, Heagerty P, Lumley T. *Biostatistics:*

A Methodology for the Health Sciences. Second edition. New York: John Wiley and Sons, 2004, 871 pages. ■



Health Sciences Photography

Microbes

Penetrating the Defenses OF THE TOUGHEST MICROBES

reducing waterborne disease

One of the greatest public health improvements in the past century has come from adding chlorine to drinking water. This is one of the main reasons for the dramatic decline of waterborne disease all over the world. However, some emerging waterborne pathogens are highly resistant to chlorine. UW researcher Gwy-Am Shin, PhD, is investigating the effectiveness of an ultraviolet treatment method that can break down the defenses of these toughest of microbes.

Despite the tremendous technical advances in water treatment processes during the 20th century, the burden of waterborne disease worldwide remains high. A World Health Organization study estimated that 4% of all deaths worldwide stem from diseases related to unsafe water, inappropriate sanitation, and poor hygiene.

Waterborne diseases are not just a problem for developing nations. A *Cryptosporidium* outbreak in Milwaukee, Wisconsin, in 1993 may have infected as many as 400,000 individuals and resulted in 100 deaths. *Cryptosporidium* is a small microscopic animal (protozoan) that is highly resistant to free chlorine.

Fortunately, chlorination isn't the only water treatment process. Shin, an assistant professor in our department, is studying the effectiveness of ultraviolet (UV) light in disarming these harmful microbes in water and wastewater.

CURRENT RESEARCH

His current research builds on his previous work, which identified the effectiveness of UV irradiation against *Cryptosporidium* and initiated the widespread use of UV disinfection in drinking water treatment processes in the United States. In UV disinfection, water flows past UV lamps submerged in the water. Although the contact time is only a few seconds, the high UV intensity can penetrate the thick cell wall of *Cryptosporidium* (the primary reason for the microorganism's incredible resistance to free chlorine) and destroy its ability to reproduce.

Shin has extended his UV research to other important waterborne pathogens. He is in the second year of a three-year research project, funded by the National Science Foundation, to examine the effectiveness of UV against *Giardia*. During the past 20 years, *Giardia* has become recognized as one of the most common causes of waterborne disease in the United States. Giardiasis may lead to weight loss and dehydration, although some people with the infection have no symptoms at all.

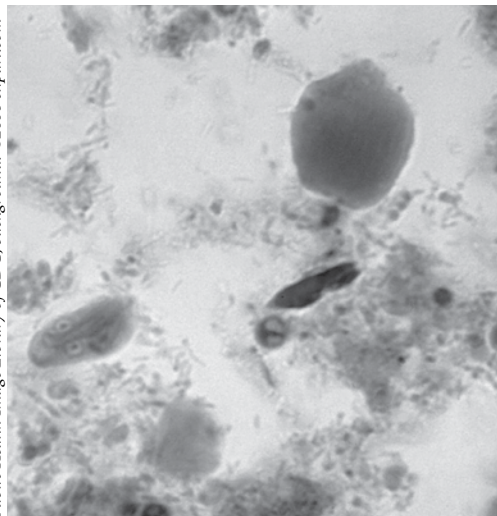
Shin collaborates with researchers at Duke University in North Carolina and McGill University in Montreal, Canada. He is working with McGill because it has the lab capacity to perform the animal infectivity assay for *Giardia*, and with researchers at Duke because of research relations he formed there while attending the University of North Carolina (UNC).

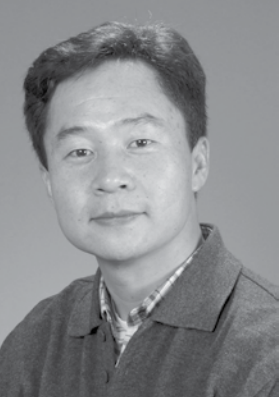
Shin earned his bachelor's and master's degrees in microbiology at Seoul National University in South Korea. He did his doctoral studies in environmental

—continued on page 16

**Photo-
micrograph
of a *Giardia
lamblia* cyst
seen using
a Trichrome
stain.**

Public Health Image Library of CDC, background: ©2006 clipart.com





Health Sciences Photography

Gwy-Am Shin

—continued from page 15

microbiology at UNC and stayed on for his post-doctoral work. He was a research assistant professor there when UW hired him in June 2004.

Shin has broadened his research interests to include community health interventions. He is involved—as co-principal investigator providing technical assistance—in a community water quality intervention study in North Carolina looking at the links between water quality and health. “Previous similar studies,” he said, “weren’t very successful because of lack of community involvement, so we made this project community-driven.”

The first step in the project was to hold a seminar to educate community leaders about the project and help them appreciate how water quality affects the community’s health. Then the community leaders educated local residents. “We didn’t lead them,” he said. “We just acted as advisers, showing them how to do water collection from wells and how to do community health surveys. It was much more effective than previous passive interventions.”

Shin’s interest in community water quality issues has expanded to those in developing countries, where the burden of waterborne disease is significantly higher than in developed countries. For example, he organized a water quality workshop in Hanoi, Vietnam, in June 2005 to train local health officials in microbiological assessment of water quality. He is planning to do further water quality projects with collaborators in Vietnam, Thailand, and China.

Water quality is still a problem in the United States, though most years the number of people affected by waterborne illnesses isn’t nearly as high as the Milwaukee outbreak. According to the Centers for Disease Control and Prevention, in 2001 and 2002, 19 states reported a total of 31 outbreaks associated with drinking water, causing illness among an estimated 1020 people, with 51 hospitalizations and seven deaths.

These figures may not reflect the true incidence of waterborne diseases in the US, because many people don’t become so ill from these diseases that they consult a doctor or they don’t connect their illness with their drinking water.



Courtesy of Gwy-Am Shin

One of Shin’s North Carolina collaborators examines *Cryptosporidium parvum* cysts on a fluorescent microscope.

RESOURCES

CDC’s drinking water site <http://www.cdc.gov/ncidod/dpd/healthywater/index.htm>.

Eisenberg JNS, Lei X, Hubbard AH, Brookhart MA, Colford JM Jr. The role of disease transmission and conferred immunity in outbreaks: Analysis of the 1993 *Cryptosporidium* outbreak in Milwaukee. *Am J Epidemiol* 2005; 1;161(1):62–72.

EPA’s Water on Tap: What you need to know about safe drinking water, http://www.epa.gov/safewater/wot/pdfs/book_waterontap_full.pdf.

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Linden KG, Shin G, Faubert G, Carns W, and Sobsey MD. Inactivation of *Giardia lamblia* cysts by low pressure UV radiation. *Environmental Science and Engineering* 2002; 36(11): 2519–2522.

Pruss A, Kay D, Fewtrell L, Bartram J. Estimating the burden of disease from water, sanitation, and hygiene at a global level. *Environ Health Perspect* 2002; 110(5):537–542.

World Health Organization. Drinking water website. http://www.who.int/topics/drinking_water/en. ■

GRADUATE STUDENT GOES TO ECUADOR

Drinking bacterially contaminated water is a leading cause of death in rural regions of the less developed world. Laura McLaughlin, a third-year graduate student in the Environmental Health program, is intent on preventing those deaths. She is working on double master's in Environmental Engineering and Environmental and Occupational Health, with a focus on drinking water, and is studying with John Scott Meschke.

In the summer of 2005 McLaughlin spent three months in Ecuador conducting a drinking water treatment project funded through the Puget Sound Partners for Global Health. The research she did there is part of her master's thesis.

McLaughlin grew up in Oxnard, California, a port city in Ventura County, halfway between Los Angeles and Santa Barbara. "I was sort of a science geek in high school, but I didn't really know what kind of work I wanted to do. My parents were involved in the Latino community in Oxnard, and my mom taught English as a Second Language (ESL), so I suppose that's how I got interested in Latin America."

After McLaughlin graduated from the University of California, Berkeley, with a bachelor of arts in environmental studies and a bachelor of science in civil and environmental engineering, she took time off to travel abroad. Her journeys took her to southern Africa, South America, and Mexico.

Before she returned to the United States, she volunteered in Mexico for three months on a UC Berkeley research project on ultraviolet light disinfection of drinking water. "After that I still hadn't worked out my travel bug," McLaughlin said, "so I volunteered to work on an ECODESS (Ecology and Development with Sustainable Sanitation) project in Ecuador."

As a result of her experience in Ecuador, she was successful in getting the Puget Sound Partners grant for her water treatment research project. McLaughlin worked in Colon Eloy, an Afro-Ecuadorian village in the northern coastal region of Ecuador. Most of the households in the village used a nearby stream for drinking water. McLaughlin's research compared the effectiveness of drinking water disinfection in households that did and didn't use chlorine to disinfect the water.

McLaughlin constructed a field lab to collect and process the water samples, and worked in the

Laura McLaughlin
samples water
in Ecuador.



Courtesy of Laura McLaughlin; background: PHIL, CDC

laboratory at the University at Quito to test for three disease-causing organisms (*E. coli*, enterococci, and somatic coliphages). Since her return to Seattle, she has been analyzing the data.

During the three weeks she spent collecting samples, she stayed with one of the families in the research project. "I really enjoyed talking to the people and hearing their perspective," McLaughlin said. "They were so fascinating. It was fun to hang out with them and find out details of their beliefs. For example the villagers distinguish between bacterial diarrheal diseases and those caused by something other than bacteria, like the evil eye or bad wind."

She didn't spend all her time in the village working though. "I like salsa dancing and playing soccer," McLaughlin said. "In the villages, there's always a *discoteca* and a soccer field. So I did get to dance a bit, but I didn't get to play soccer because there wasn't a women's or coed team."

McLaughlin will graduate in June 2006 and head to Finland for a year's study under the Valle Scholarship and Scandinavian Exchange Program. When she returns, she will complete her Environmental Engineering degree. ■

focusing on drinking water

Mysteries

Mysteries of the

HUMAN-OCEAN RELATIONSHIP

FIRE RETARDANTS: LIFE SAVING, LIFE THREATENING

In 1977, more than a million homes and businesses caught fire in the United States. By 2001 that figure had been cut by almost half, largely through the use of fire-retardant chemicals. Fire retardants are used in upholstered furniture, mattresses, building materials, carpeting, computers, and televisions. In other words, they are all around us.

The major group of fire retardants, called PBDEs (short for polybrominated diphenyl ethers), work by slowing the ignition of fires and the rate of their growth. This gives people more time to extinguish or escape the fire. Of the more than 175 different types of flame retardants, brominated flame retardants have been used the most frequently because of their effectiveness and low cost.

But this fire protection may have come at an environmental cost. Research has shown that these chemicals tend to bioaccumulate in fish, especially—for reasons still largely unknown—in Puget Sound Chinook salmon, which have some of the highest accumulation rates in the world.

Although many of these chemicals are no longer used, they are so resistant to breakdown that they persist for years, leaching into the soil and running off into the water. Animal studies have shown that as these chemicals accumulate, they can become toxic. In rats, for example, exposures during pregnancy can lead to neurodevelopmental abnormalities in offspring, affecting thyroid function and brain development.

Evan Gallagher, PhD, associate professor of toxicology in our department and principal investigator for a grant through National Oceanic and Atmospheric Administration (NOAA) Oceans and Human Health Initiative, is exploring the link between consumption of PBDE contaminated salmon and potential effects of these fire retardants

on human fetal development. Gallagher's grant examines the effects of exposures to PBDEs in pregnancy.

Although Gallagher's research project is ultimately geared toward human health, the project begins with experiments aimed at determining the potential for PBDE metabolism in salmon. Fish absorb the chemicals through water and food, and because of suspected slow metabolism and excretion, these chemicals tend to bioaccumulate in body tissues, including the muscle fillets that are consumed by humans.

BRIDGING THE GAP

Research grants rarely combine ecosystem and human health aspects, but Gallagher's partners are the National Marine Fisheries (NMFS) and Washington Department of Fish and Wildlife. The two natural resource organizations are looking in detail at the levels of the PBDEs in Puget Sound, largely based on concerns for the salmon and the Puget Sound ecosystem.

"One of the side benefits of this project," Gallagher said, "is that it builds partnerships with local agencies with considerable interest and expertise in the effects of pollutants in the Puget Sound ecosystem."

Although similar ties with these agencies have existed within other UW units (such as the School of Aquatic and Fishery Sciences), these partnerships are fairly new for our department and are largely a result of Gallagher's efforts. In particular, NOAA/NMFS scientists are well recognized for their expertise in salmon biology, reproduction and behavior, and for their use of analytical chemistry in the historical characterization of Puget Sound pollution. Our department contributes expertise in toxicology, human health, and genomics.



Jeanne O'Connell

Evan Gallagher

Before his academic career was underway, Gallagher worked as a field biologist for the US Fish and Wildlife Service. His experiences there gave him an understanding of the need to apply state-of-the-art scientific methodologies to examining and solving real-world environmental problems.

Gallagher's research will use genomic techniques and biochemical analyses to examine the effects of the most dominant Puget Sound fire retardant compounds in salmon liver cells and to examine the biochemical factors underlying their accumulation. In phase three of his research, he'll explore which chemicals are of most concern for potential toxicity to sensitive human cells such as liver progenitor cells, which are important for normal blood development.

Gallagher was a postdoctoral fellow at UW from 1991 to 1996. He returned to the faculty as an associate professor in 2004 after eight years at the University of Florida College of Veterinary Medicine, where he worked in human and aquatic biochemical toxicology and directed an aquatic toxicology laboratory. He returned to Seattle because, he said, "The Pacific Northwest has long been a hotbed for biotechnology research, and is now beginning to lead the way in the study of a number of critical marine and coastal toxicological issues.

"The Northwest is the home of a number of energetic researchers who are truly excited about using interdisciplinary approaches to address these environmental problems," he said. "The Department of Environmental and Occupational Health Sciences has traditionally had one of the strongest groups nationwide in biomedical toxicology. The timing was right for me to build a program drawing on the recent advances in genomics and departmental strengths in public health toxicology to help address the connection between human health and the environment."

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Fischer D (2005). It's In Us All. Flame retardants contaminate everyone but concentrate especially in children. *The Oakland Tribune*. 12/11/2005. http://www.insidebayarea.com/oaklandtribune/localnews/ci_3299744.

Moneypenny CG, Huisden M, Gallagher E. 4-Hydroxynonenal inhibits cell proliferation and alters differentiation pathways in human fetal liver hematopoietic stem cells. *Biochemical Pharmacology* 2005; 69(1):105-112. ■

Computer keyboards don't burst into flames, but there is an environmental trade-off to some fire retardants.



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Mysteries

Mysteries of the

HUMAN-OCEAN RELATIONSHIP

developing novel methods

NEW CENTER STUDIES INTERACTIONS

More than half the world's population lives in coastal areas. We depend on the oceans for food, transportation, and even medicines. Our ocean environment is intertwined with our lives, our economy, and our health in many ways. Surprisingly, there has been little scientific study about how humans affect the oceans or how the oceans affect human health.

Researchers at the Pacific Northwest Center for Human Health and Ocean Studies (H2O Center) aim to uncover some of the mysteries in the human-ocean relationship.

The H2O Center is one of four funded by the National Science Foundation (NSF) and National Institute of Environmental Health Sciences (NIEHS) in 2004. This center initiative is the first time the two agencies have jointly funded research. "This is an exciting development," said Elaine Faustman, PhD, director of the H2O center. "Public health and ocean sciences researchers rarely talk to each other, despite the obvious interconnections between human and ocean health." The center is co-directed by E. Virginia Armbrust, PhD, a professor in the School of Oceanography.

The UW H2O Center was awarded \$6.4 million over five years to focus on harmful algal blooms. Occasionally, algae grow very fast or "bloom" with potential consequences for health and the environment. One type of harmful algal bloom or "HAB" is caused by the *Pseudo-nitzschia pungens* algae, which can produce domoic acid.

Key questions addressed by center researchers include:

- What environmental factors lead to development of toxic blooms?
- Why do certain types of shellfish retain toxin?
- What are the biological processes of domoic acid toxicity?
- What populations are at greatest risk?
- How do dietary consumption behaviors contribute to exposure?

Domoic acid can accumulate as it passes through the food web, affecting shellfish, marine mammals, and marine birds. In exposed humans, the toxin can cause a syndrome known as amnesic shellfish poisoning (ASP). Amnesic shellfish poisoning was first identified in 1987, when more than 100 people became ill on Prince Edward Island, in eastern Canada, after eating contaminated mussels. Once researchers identified domoic acid, they realized that a number of other wildlife populations were affected, including sea lions and birds.

Razor clams with detectable levels of domoic acid have been identified from beaches in Oregon, Washington, British Columbia, and Alaska every year since 1991, prompting several shellfish harvest closures.

Shellfish harvesting and consumption are important aspects of Northwest culture and the coastal economy.

upper left: *Pseudo-nitzschia pungens* algae

WA Dept. of Fish and Wildlife; Background: H2O Center





**Ginger Armbrust
briefs Elaine
Faustman during
a training cruise.**



The H2O Center has four major research projects underway. One project studies toxic algae genetics and the dynamics of harmful algal blooms to learn what makes them produce toxins. Another project looks at how domoic acid is taken up and retained by shellfish such as razor clams. A third project examines the neurodevelopment effects of domoic acid exposure on humans. The fourth project considers dietary and behavioral aspects of human exposure, especially among vulnerable populations and consumers who eat a lot of shellfish.

The H2O Center fosters collaborative, multi-disciplinary partnerships. “People are interested in collaborating, and it is exciting and challenging to work across traditional boundaries,” said Armbrust.

An example is a pilot project co-led by Kathi Lefebvre, a scientist at the Marine Biotoxins Group of the National Oceanic and Atmospheric Administration’s (NOAA) Northwest Fisheries Science Center (NWFSC) and the University of Washington’s Evan Gallagher (see page 18 for a description of Gallagher’s fire retardant research project). The two researchers are studying how domoic acid affects both fish and humans. “In this project we’re looking for sublethal or subacute affects,” Lefebvre said. “We’re investigating what might be happening at the level of chronic exposure, for example.”

In addition to its research mission, the center is committed to training new scientists and translating research for a variety of audiences. It supports undergraduate education through an NSF Research Experiences for Undergraduates program and co-sponsors (with NWFSC) a bimonthly seminar series. The H2O Center plans to use research on domoic acid as a starting point for developing novel methods and collaborations that can be applied to a wide variety of public health concerns.

FOR FURTHER READING

H2O Center website <http://www.pnwh2o.washington.edu>.

Committee on the Ocean’s Role in Human Health (1999).

Monsoons to Microbes. National Research Council

<http://www.nap.edu/books/0309065690/html>.

Northwest Fisheries Science Center *Domoic Acid Poisoning*.

http://www.nwfsc.noaa.gov/hab/habs_toxins/marine_biotoxins/da/index.html.

Judd NL, Drew CH, Acharya C, Mitchell TA, Donatuto JL,

Burns GW, Burbacher TM, Faustman EM. Framing scientific analyses for risk management of environmental hazards by communities: Case studies with seafood safety issues. *Environ Health Perspect* 2005; 113(11):1502–1508.

Judd NL, Griffith WC, Faustman EM. Consideration of cultural and lifestyle factors in defining susceptible populations for environmental disease. *Toxicology* 2005; 198(1-3):121–133.

Ocean Studies Board of the National Research Council

<http://dels.nas.edu/osb/>.

Washington State Department of Health press releases regarding domoic acid closures:

http://www.doh.wa.gov/Publicat/2005_news/05-134.htm.

http://www.doh.wa.gov/Publicat/2005_news/05-118.htm. ■

**top right and right:
Center researchers
aboard the
research vessel
Thomas G. Thompson
in November 2004.**



Photos: Cedar McKay; background: ©2006 www.photos.com

Risk

A Risk Equation for Schools

REMOVING OLD PIPES—AN INVESTMENT IN CHILDREN

Is any risk acceptable when children's health is involved? What is the cost of reducing the risk as close to zero as possible? Will taxpayers agree?

Science can inform public policy on issues such as this. Several researchers in our department have been helping the Seattle Public Schools weigh the risk of lead in the water pipes of district schools.

Catherine Karr, MD, PhD, a pediatrician and epidemiologist who heads the University of Washington Pediatric Environmental Health Specialty Unit (PEHSU), authored a study on the potential health implications of the lead levels in the schools.

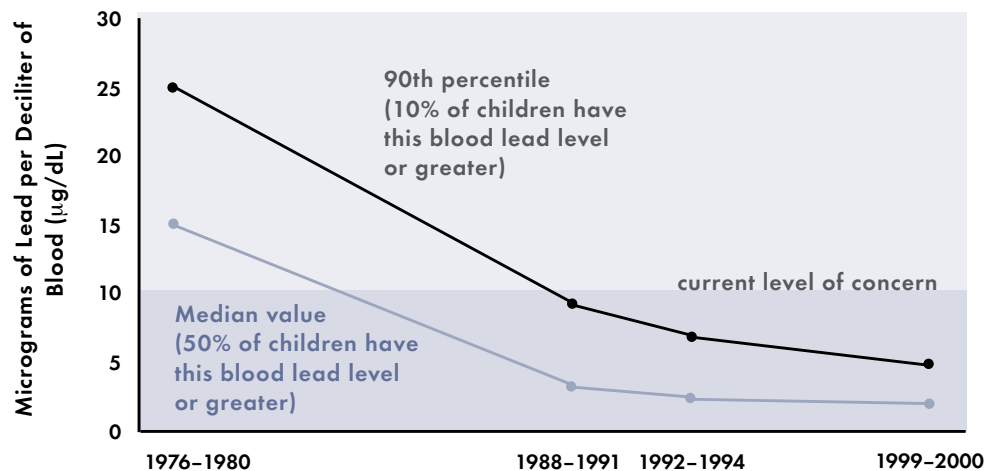
The risk to children from lead pipes is relatively low, Karr said, but it represents a possible exposure from an overlooked source that can be prevented. As a matter of policy, the school district's water oversight committee unanimously recommended replacing all

older water pipes in the schools and adopting a formal maintenance schedule. The \$11 million proposal will be considered as part of planning for an upcoming school levy.

John Scott Meschke, an assistant professor who specializes in microbiology of water, and Nancy Beaudet, an industrial hygienist with PEHSU and a district parent, serve on the oversight committee. Elaine Faustman, a professor of Toxicology, briefed a subcommittee of the school board about risk assessment, management, and communication. Dave Eaton, a professor of Toxicology, was a peer reviewer on an outside toxicology report, and Steve Gilbert, an affiliate associate professor, made presentations to parents and school board members. The university's involvement is important, Karr said, because it is a respected, neutral party.

applying risk communication

CONCENTRATIONS OF LEAD IN BLOOD OF US CHILDREN AGES 5 AND UNDER



Source: US Environmental Protection Agency, 2003. *America's Children and the Environment. Measures of Contaminants, Body Burdens, and Illnesses.*

Data: Centers for Disease Control and Prevention, National Center for Health Statistics, *National Health and Nutrition Examination Survey*



Young children are at particular risk for lead poisoning.

Catherine Karr



Karr and other child environmental health specialists typically worry about lead from paint in older houses, though Washington has less of this dilapidated housing stock than other parts of the country. But now that the nation has largely succeeded in taking lead out of paint and gasoline, water pipes have become more of an issue. Although most pipes are now lead-free, solder and drinking fountain components can introduce lead into the water.

The lead problem was brought to the Seattle school board's attention in 2003, when parents complained about discolored water at an elementary school. The district had tested the water in 1991–1993 and not publicized the result. Unfortunately, by not sharing these earlier findings with parents, the 2003 findings created an environment of outrage and distrust, noted Karr.

The school district responded by adopting the strictest policy in the country, mandating the testing of drinking water for lead at half the EPA level and for several other metals and bacteria, which is not required for schools at all. The policy also provides for publishing all samples on its website. "Our goal is to make sure every student and staff member has access to ample quantities of safe and aesthetically appealing water, with confidence that they can rely on the district's testing program," said Ron English, who is in charge of the district's drinking water quality program.

Karr got involved at a stage where little health information was being disseminated and parents were outraged. She helped explain what the lead levels meant for children's health.

"For me, it has been challenging to try to do risk communication in that context—the history had an important influence on parents' perceptions."

The Seattle school issue provides an example of the importance of good risk communication, she said. "It needs to be transparent and responsive, as soon as a problem is recognized. Involving the interested parties early on is also key, so they can help guide the process."

Karr is also working to educate fellow pediatri-

cians, pediatricians in training, and family practice physicians about lead risks. Last year she directed a continuing education course on pediatric environmental health, one of our department's best-attended continuing education courses.

FOR FURTHER READING

ATSDR Primer on Health Risk Communication

Principles and Practices <http://www.atsdr.cdc.gov/HEC/primer.html>.

CDC Childhood Lead Poisoning Prevention

<http://www.cdc.gov/nceh/lead/lead.htm>.

Gilbert, SG. *A Small Dose of Lead*

<http://www.asmalldoseof.org/toxicology/lead.php>.

Pediatric Environmental Health Specialty Unit (PEHSU)

Lead in Seattle school drinking water: A review of the health implications <http://depts.washington.edu/pehsu/reports.html>.

Public Health—Seattle & King County

<http://www.metrokc.gov/HEALTH/tsp/lead.htm>.

Schools water quality site http://www.seattleschools.org/area/facilities/WaterQuality/water_quality_update.htm.

Washington State Health Department

<http://www.doh.wa.gov/ehp/dw/Programs/lead.htm>.

US EPA Toolkit for reducing lead in school drinking water

<http://www.epa.gov/safewater/schools/guidance.html#3ts>. ■

**Catherine Karr
in the UW
pediatric clinic.**



Photos: Ly Pham



A LUMNI PROFILES...
WHERE THEY ARE NOW

CHEMICAL AND HEALTH RISKS

Ann Bradley was part of the first class to graduate in the Master of Public Health program in Environmental and Occupational Health Sciences. After graduation, she headed for Washington DC for a fellowship at the federal Environmental Protection Agency (EPA), funded through the Association of Schools of Public Health.

At the EPA's National Center for Environmental Assessment, she helped calculate the public health impact of various chemicals in the environment, study the uses and limitations of uncertainty factors in risk assessment, and develop a framework for assessing human variability.

"The fellowship was a great opportunity to get to know the inner workings of EPA," she said. She also had the opportunity to attend public meetings and conferences of EPA and other regulatory bodies in Washington DC.

After a year in the federal government, she wanted to try private consulting. She was hired at Mercer Island-based Integral Consulting in the summer of 2005. She works in human health risk assessment and environmental fate and transport of chemical compounds at its Maryland office. She is involved in analyzing data, conducting background research, and writing reports and other products.

We talked with her soon after she took the job, and she said, "In my new position at Integral, after only a week, I have to say the thing I am finding most exciting is the diversity of projects. It keeps the day exciting! I feel that the diversity of projects will also enable me to gain a number of new skill sets."

At UW, she studied risk assessment and risk communication with Elaine Faustman, PhD. She chose the MPH track because she wanted a grounding in the core areas of public health, with deeper study in environmental health, particularly health risk assessment. "Having an understanding of public health, regulation, and policy, in addition to

a set of technical skills in environmental health and human health risk assessment, has opened up many doors," she said.

She said her degree gave her a broad scope of health, economics, and policy. She found that the UW has a strong program in risk assessment. She completed her thesis project, *Impact and Policy Implications of Genetic Information in Regulation: A Case Study of Organophosphate Pesticides*, in the Institute for Risk Assessment and Risk Communication.

The UW program taught her how to approach problems. She learned that ideal data sets aren't often available in the real world, which limits the conclusions that can be drawn. The university environment exposed her to other disciplines such as public health genetics and policy.

She was attracted to consulting because of the diversity of projects and the possibility to learn skills at various levels. She describes "plenty of opportunity" for new graduates in the consulting field. ■

Courtesy of Ann Bradley



ANN BRADLEY

Scientist, Integral Consulting, Annapolis, MD

MPH 2004

**ENVIRONMENTAL AND
OCCUPATIONAL HEALTH SCIENCES**

ALUMNI PROFILES

OCCUPATIONAL AND ENVIRONMENTAL HEALTH POLICY

Hal Stockbridge has gone from clinician to policymaker. As associate medical director at the Washington State Department of Labor and Industries (L&I) he works with local, national, and international groups.

His job focuses on public health aspects of workers' compensation, including chemically related illness, prevention of long-term disability, and improvements in systems of rating disability, such as the system of the American Medical Association's *Guides to the Evaluation of Permanent Impairment*. He is also involved in policy development and implementation, technology assessment, education of health-care providers, and assistance to L&I's claims managers.

As a clinical assistant professor on our faculty, Stockbridge provides expertise in chemically related illness, multiple chemical sensitivity syndrome, brain

single-photon emission computed tomography in patients with cognitive complaints, evaluation of permanent impairment, prevention of long-term disability, and other topics. He also teaches in our continuing education courses and seminars.

Stockbridge came to the UW after an internal medicine residency at the University of Texas, Houston, and The Jewish Hospital, Cincinnati. He was drawn to occupational and environmental medicine because it offers opportunities for prevention of illnesses and injuries not often seen in other branches of medicine.

Working with Linda Rosenstock, now dean of the UCLA School of Public Health, and Bill Daniell of our faculty, he undertook a case-control study of immunologic, psychiatric, and neuropsychological aspects of multiple chemical sensitivity syndrome. He also did research on lead poisoning in Washington state.

After graduation, he went to Geneva, Switzerland, as a consultant for the World Health Organization. He edited a training manual on environmental epidemiology, which was published in 1991 and distributed worldwide.

In the mid-1980s, he was a volunteer physician at a hospital in rural Taiwan. He learned to speak Chinese and was able to teach local doctors about medicine as it is practiced in the United States. This gave him an appreciation of medical problems common in developing countries.

His job at L&I involves policy development and working with legislators, workers, business and labor representatives, attorneys, and the general public.

His advice for physicians considering a specialty in occupational medicine is to make connections with doctors through university programs or through national and regional organizations such as the American College of Occupational and Environmental Medicine and the Northwest Association of Occupational and Environmental Medicine, the American Public Health Association, and the Washington State Public Health Association.

Stockbridge said that a specialty in occupational and environmental medicine is rewarding because of its potential to have a positive impact on the health and safety of large numbers of people locally, nationally, and across the globe. ■



Ly Phann

HENRY (HAL) STOCKBRIDGE, MD

Associate Medical Director, Washington State Department of Labor and Industries

MPH 1990

OCCUPATIONAL AND ENVIRONMENTAL MEDICINE

LEADERSHIP ON EMERGING HEALTH THREATS

Robert Duff brings a passion to his work as head of the Washington State Department of Health team that assesses human exposure to environmental contaminants.

His team of toxicologists, epidemiologists, risk assessors, health educators, and other specialists investigates contaminants in fish, soil, and drinking water, and is becoming increasingly involved with air toxics. They provide guidance to the Health Department and other regulatory agencies.

Duff says he has found a job that is an ideal fit because he doesn't want to be boxed into a "bureaucratic rut of meeting statutory mandates, without the opportunity to provide some advocacy on emerging issues in environmental health." He relishes the opportunity to provide leadership on emerging issues.

For example, his unit is involved with the Washington State Department of Ecology's Persistent, Bioaccumulative Toxins Initiative that concerns health impacts of PBTs such as mercury and PDBE flame retardants (see page 18). Duff is also excited about implementing forward-looking programs such as an Environmental Public Health Tracking grant from the Centers for Disease Control and Prevention (CDC) that lays the groundwork for states to begin tracking environmentally related disease.

At the same time, the Washington State Health Department addresses important issues associated with human exposure to environmental contaminants at Superfund sites. Facilitated by the health department's long-standing cooperative agreement with the federal Agency for Toxic Substances and Disease Registry, these site-specific exposures are addressed under both federal and state law with a recognition that many communities living near hazardous waste sites share an unequal burden of exposure.

After getting his MS in 1993, Duff's first job was with the New Hampshire Division of Public Health Services. When his wife finished her graduate studies

back East, the couple toured Europe, then returned to Washington. Robert decided to do a second tour in Dr. John Kissel's lab at the UW.

That experience led him to jobs with the Washington State Department of Health as a public health assessor and a toxicologist, and eventually into management positions with the Site Assessment Section and the Office of Environment Health Assessments.

He says his UW coursework in toxicology and risk assessment gave him an advantage over other professionals who lacked this expertise. He urges graduate students to carefully select their thesis topic; his focus on exposure assessment made it easy for him to move into the workplace.

He advises graduates to seek opportunities, in their first job, to look forward and press the issues of the day. "Prevention is certainly a key to environmental health but it does not require that we be passive," Duff says. "It is up to us to wade through hype and fear and find the real emerging environmental health threats." ■



Ly Pham

ROBERT DUFF

Director, Office of Environmental Health Assessments, Washington State Department of Health

MS 1993

TOXICOLOGY

PROTECTING AIR QUALITY IN PUGET SOUND

Kathy Himes always knew she had a split personality. She likes to teach and she is drawn to technical work. At Puget Sound Clean Air Agency, she gets to do both.

She works on a team whose mission is to protect and improve air quality in the Puget Sound area. A typical day includes interpreting and summarizing data for different audiences, responding to questions, and generally supporting the agency's emissions reduction programs.

The job is technically challenging, and it gives her an opportunity to interact with a wide variety of people: engineers, scientists, planners, government officials, the media, health professionals, and community leaders and activists.

"It's exciting to work in this field when so much is going on both locally and globally right now," she said. Fuel and energy are hot topics that are directly relevant to her work.

Her background prepared her for the full range of job responsibilities. She has a strong interest in education, culture, and communities. She taught math and science in rural West Africa in the Peace Corps, and has worked as an outdoor education naturalist, museum docent, and horseback riding instructor.

Her technical résumé includes an undergraduate degree in engineering from the University of Michigan, volunteering with the United States Geological Service, fellowships with the Department of Energy (Pacific Northwest National Laboratory and Lawrence Berkeley National Laboratory), and private consulting as an environmental engineer and project manager.

A desire to explore how the environment affects us and how we affect the environment led her to environmental health—"a perfect fit in my search for a career that includes both aspects"—and to the UW. She studied with Rich Fenske and was "a frequent interloper" in John Kissel's lab.

Her thesis work involved pesticide exposures of children of agricultural workers in eastern Washington. She worked on one technical component of a much larger issue with "a very human component."

She graduated in 2003 and taught part-time at an international school in South America, traveled, and volunteered. She was always in search of a job that was technically challenging but also included a lot of interaction. And she wanted to put down roots in the Pacific Northwest. The job at the Clean Air Agency provides the fit she was seeking.

Her advice for current students is to explore courses outside of our department. "I got a lot out of some courses I took in other Public Health departments, as well as an oceanography course." She would also encourage them to take advantage of outreach opportunities. "The department's 'Tox in a Box' is a terrific program," she said.

The most valuable thing she learned at DEOHS was to quickly read a journal article and take away the main points.

She encourages other students to follow her footsteps. "There's a lot of energy (no pun intended) in this field right now." Our understanding of air quality is constantly changing and expanding, she explained, with more information on human health and global climate health. ■



Courtesy of Kathy Himes

KATHY HIMES

**Air Resources Specialist
Puget Sound Clean Air Agency**

MS 2003
ENVIRONMENTAL HEALTH

SERVING THE PUBLIC

Marc Marquis describes himself as a “self-motivated, accountability driven public health manager” with a background in water and wastewater, solid waste, hazardous materials, and air quality.

He obtained much of his technical knowledge from the department’s undergraduate program, plus two years of on-the-ground work with the Environmental Protection Agency in the Territory of American Samoa. Since 2004, he has managed the environmental health programs for the Chelan-Douglas Health District in Wenatchee.

After graduating from UW, he enrolled in Seattle University’s law school, focusing on environmental and administrative law. His degrees and experience provide the tools he needs to protect the public and help his community achieve its environmental goals.

As director of environmental health programs in the two central Washington counties, his responsibilities include land use, water and wastewater, solid waste, residential hazardous materials, food service, vector control, and community safety. He is responsible for a \$2.1 million budget.

He says he finds two aspects of his job particularly compelling. The first is the sense of accomplishment he derives from providing a necessary public service. “It really makes me feel good to know I’m working to protect our community vs. selling used cars or something.” The second is the diverse nature of his work. “I’m not the type of person who likes to focus on one subject area. My job challenges me to be knowledgeable about topics ranging from food service to wastewater treatment to toxicology.”

He studied with Chuck Treser. An undergraduate course in public health law spurred his decision to go to law school. He obtained his Registered Environmental Health Specialist credentials while attending law school, with a goal of using his combined legal training and technical knowledge in a future leadership capacity for public health.

The summer after law school, while he was studying for the bar exam, he took a seasonal job with the Tacoma-Pierce County Health Department. When summer ended, he was offered a permanent management position heading the methadone treatment program. Although he enjoyed seeing the personal health side of public health, his goal was always environmental health management.

Don Seabrook



MARC MARQUIS, ESQ., REHS

**Director of Environmental Health,
Chelan-Douglas Health District**

BS 1995
ENVIRONMENTAL HEALTH

He accepted an unexpected opportunity to work for the EPA in American Samoa. There he managed programs including solid waste, hazardous materials, air quality, pesticides, and underground storage tanks. The United Nations invited him to Nairobi, Kenya, to do a presentation concerning the state of environmental law in American Samoa.

“Although living conditions in Samoa were challenging at times for my family, we all benefited greatly from the cultural experience,” he said. After completing his two-year employment contract with the EPA, he accepted his current position with the Chelan-Douglas Health District.

“I think I have an advantage because my diverse experience has enabled me to better understand the comprehensive mission of public health and how the programs interrelate,” he said. He encourages current undergraduate students not to shy away from the tough science classes, because they help to develop critical thinking skills. The breadth of the undergraduate program prepares students for public and private sector employment opportunities in the areas of environmental science, regulatory consulting, industrial hygiene, solid and hazardous waste management, food safety, and other fields, he said. “Your opportunities are only limited by how creatively you can market your skills.” ■

SENDING WORKERS HOME...HEALTHY



Daniel Morris

GUY SILVEY

**Director of Safety and Health,
Western United States, Turner Construction**

MS 1994

INDUSTRIAL HYGIENE & SAFETY

BS 1992

Turner Construction's slogan is: "Every worker goes home from each of our jobs, every day."

In the western United States, it's Guy Silvey's job to make sure those workers go home healthy. He oversees all of Turner's environmental health and safety activities in the region. His wide-ranging scope includes employee and subcontractor safety, compliance with codes and regulations, industrial hygiene, fire protection, workers' compensation, environmental compliance, and loss control/risk management.

From an office in Portland, he directly manages safety directors in eight business units and oversees a professional safety organization of 50 managers. His job involves "solving a different problem every day." This includes providing leadership in health and safety in "a field that traditionally does not support this type of culture."

Before coming to Turner in 2003, Silvey worked for the computer chip manufacturer, Intel, starting in environmental health and moving into regulatory management. His first job after graduating was with the University of Washington Environmental Safety and Health department as a hazardous waste technologist. He was previously an environmental support technician with the Air Force.

The UW industrial hygiene graduate program appealed to him because of its emphasis on field-based research. He said this "allows students to get real-time experience outside the typical university environment." His thesis adviser was Dave Kalman.

He said the most important thing he learned in his undergraduate and graduate programs was that "communication between different parties is key to driving change in any organization."

He encourages current students to seek opportunities for "real-life" experience, including field trips, research studies, and internships. Instead of becoming narrow specialists, he encourages them to embrace the entire field, as "true EH&S professionals are educated in all aspects of the field, including industrial hygiene, safety, ergonomics, and toxicology."

Job opportunities are "wide open" in construction safety and health, he said. The emphasis has shifted from injury prevention to a broader concern for occupational health and prevention of exposures such as lead, silica, and noise. ■



*W*HERE WE'VE BEEN...
AND WHERE WE'RE GOING

The Biennium in Review

I am delighted to be reviewing the 2003–2005 biennium from a period of relative calm. The 2001–2003 biennium had been a tumultuous time for our department and for the country, and it is pleasing to see the progress we have made since then.

We enter the 2005–2007 biennium in good shape and with undimmed enthusiasm for the work we are doing and the challenges we aim to meet.

STUDENTS

We continue to enjoy success in attracting highly capable and accomplished graduate students. We admitted our largest class since the mid-1980s in 2004, and are discussing ways to expand our graduate and undergraduate programs.

During the past two years, students received 25 undergraduate degrees, 31 MS degrees, 12 MPH degrees, and 10 PhDs. The outstanding undergraduate students were Christine Clark in 2004 and Paige Beckley in 2005. The outstanding graduate students were Jon Hofmann in 2004 and Samir Kelada in 2005. The bibliography on pages 51–56 shows about 20 papers published by students in academic journals. About 80% of our master's students and 100% of our doctoral students publish in the scientific literature while in our programs or shortly after they graduate.

Our students have distinguished themselves in many ways, summarized on page 38. Two particularly notable achievements are the School of Public Health and Community Medicine's Magnuson Scholar award, given to Yupeng Wang, a PhD student in toxicology, in 2005–2006, and the national 3M scholarship, awarded to Maggie Trabeau, a master's student in Industrial Hygiene, in 2005.

EDUCATIONAL PROGRAM DEVELOPMENT EDUCATION AND RESEARCH CENTER RENEWAL

In 2005, the Northwest Center for Occupational Health and Safety was awarded \$1.285 million per year for the next five years. This training grant from the National Institute for Occupational Safety and Health (NIOSH) enables us to support graduate students and serve as a regional resource for education and research in workplace safety and health. We have served in this role since 1977 and are one of 16 centers nationwide.

During the past five years, the center has graduated an average of five students in industrial hygiene, two in occupational medicine, and six in occupational health nursing each year. The continuing education program reaches more than 1500 trainees annually, providing crucial health and safety information; in 2003–2005, this program trained almost 4000 professionals.

OEM PROGRAM

The Occupational and Environmental Medicine Program was fortunate to add two senior faculty. Sverre Vedal, MD, MSc, a pulmonologist and well-known expert in occupational lung diseases and air pollution epidemiology, was recruited as a professor. Dennis Shusterman, MD, MPH, an occupational medicine and family medicine physician, was hired to direct the Occupational Medicine residency program. Dr. Shusterman has succeeded Matthew Keifer as residency director. In addition, Jordan Firestone, MD, MPH, an occupational medicine physician and neurologist, joined the faculty as medical director of the Occupational and Environmental Medicine Clinic.

Our department strengthened its ties with the Preventive Medicine Residency program at Ft. Lewis and Madigan Army Medical Center, in Tacoma. This relationship has flourished, thanks to the work of UW faculty member William Daniell, MD, MPH.

UNDERGRADUATE PROGRAM

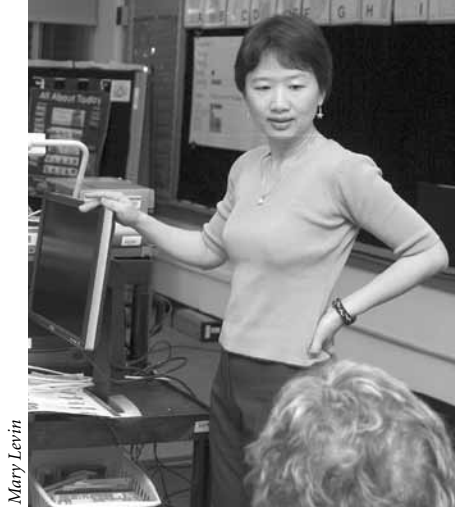
Our undergraduate program currently enrolls 37 students—seven more than winter quarter of the previous year and 13 more than were enrolled at the beginning of the previous biennium. The increase continues a growth trend that began in autumn 2002, when we made an increased commitment to outreach, such as a collaboration with Bellevue Community College, where faculty member Charles Treser taught an Introduction to Environmental Health course to prospective UW transfer students.

Environmental Health undergraduate students participate in an enhanced laboratory analysis sequence that provides them



(l to r): Betsy Gilbert, Rick Neitzel, and Susan Brower in a workshop about safety culture.

Barb Brooner



Mary Levin

Sally Liu reports findings of her school bus study to the community.

a yearlong introduction to the methods and testing equipment used by specialists in the field. This provides students a rigorous introduction to microbiological hazards in the environment and an advantage as they seek employment.

FACULTY

We hired eight new faculty members in the 2003–2005 biennium. Evan Gallagher, PhD, (associate professor, Toxicology) and Gwy-Am Shin, PhD, (assistant professor, Environmental Health) were recruited in the 2001–2003 biennium, and joined the UW in the spring of 2003. Dr. Gallagher is a molecular toxicologist who brings interests in ecological toxicology and the use of fish models to his research into environmental toxicants. Dr. Shin is an environmental microbiologist with a primary interest in ultraviolet disinfection of water and wastewater.

Our department also welcomed Joellen Lewtas, PhD, to the faculty, following her retirement as a senior scientist with the US Environmental Protection Agency. Her background in biochemistry and leadership at the EPA's Office of Research and Development in carcinogenicity and other hazardous properties of atmospheric particulates is a strong compliment to our expertise and ongoing research.

In addition to Vedal, Shusterman, and Firestone, the Occupational and Environmental Medicine program added two affiliate faculty: Catherine Karr, MD, PhD (adjunct assistant professor, primary in Pediatrics and head of the Pediatric Environmental Health Specialty Unit), and Michael Silverstein, MD, PhD (clinical professor, who has held an auxiliary appointment for several years, and is developing a research program at UW).

The 2003–2005 biennium saw the departure of some valued colleagues: Professor Gerald van Belle and Assistant Chair for Outreach Sharon Morris both retired, but in typical departmental fashion, they are still pursuing interests here at UW on a part-time basis.

STAFF

Our professional and classified staff continue to provide the support that allowed us to successfully compete for a record

amount of grants and contracts and to recruit and enroll a record number of students.

The departmental distinguished staff award went to Shannon Kirkpatrick, graduate program counseling coordinator, in 2004 and Namura Nkeze, undergraduate program manager, in 2005. Departmental outreach awards went to Chetana Acharya, Community Outreach and Education program manager, and Rick Neitzel, research scientist, for his exceptional efforts in noise reduction, teaching, and research. Raja Atallah, research scientist with our Environmental Health Laboratory, was the departmental nominee for the UW outstanding public service award in 2004 and Rory Murphy, manager of the graduate program, was the departmental nominee for the UW distinguished staff award that year.

RESEARCH

The 2003–2005 biennium saw increasing pressure on federal grant programs, and competition for these funds is at an all-time high. We have been very fortunate to have had our funding base increase slightly over the prior biennium. Two major center grants (in air pollution and toxicogenomics) failed to be renewed, but four others (the NIEHS Center for Child Environmental Health Risks Research and Center for Ecogenetics and Environmental Health, the NIOSH Education and Research Center, and the NIEHS Superfund Basic Research program) either have or likely will be extended for another multi-year term. Among the projects launched in the biennium are:

- Associate Professor Joel Kaufman received the largest grant ever awarded by the EPA for scientific research. The \$30 million, ten-year grant established the MESA Air Pollution Study to investigate the connection between air pollution and cardiovascular disease.



Barb Brouner

(l to r) Marianne Anderson and Michael Harris listen to a safety culture lecture.

- The Pacific Northwest Center for Human Health and Ocean Sciences was established with a five-year grant of \$6.4 million from the National Science Foundation and National Institute of Environmental Health. Professor Elaine Faustman co-directs the center with Ginger Armbrust, UW associate professor of Oceanography.
- Associate Professor L.-J. Sally Liu received a five-year, \$3 million grant from the NIEHS to study the effect on children's health as school districts in the Puget Sound area retrofit old diesel engines and take aging buses off the road.
- Professor Noah Seixas, Research Scientist Rick Neitzel, Associate Professor Bill Daniell, Associate Research Professor Lianne Sheppard, and Professor Hendrika Meischke (Health Services) were awarded a four-year grant from NIOSH to study the effectiveness of three modes of controlling noise exposures on construction sites.
- Professor Mike Yost received funding to develop a micro-fabricated aerodynamic lens array aerosol concentrator. Yost's team hopes to develop a new way to detect potentially hazardous low-level releases of toxic or virulent pathogens.

RECENT INITIATIVES

We have funded a number of projects that link directly to our workplace safety and health mission, including communicating pesticide health risks to agricultural producers, workers, and their families; training educators to work directly with teens

to reduce work-related injuries and illnesses; and supporting internships so our students can receive work experience at the Department of Labor and Industries.

To better disseminate our research findings to the affected industries, Noah Seixas, PhD, and Bill Daniell, MD, MPH, have published research reports from their hearing loss studies in construction and other industries. These reports, plus construction supervisor booklets and worker brochures, can be downloaded from <http://depts.washington.edu/ocnoise>.

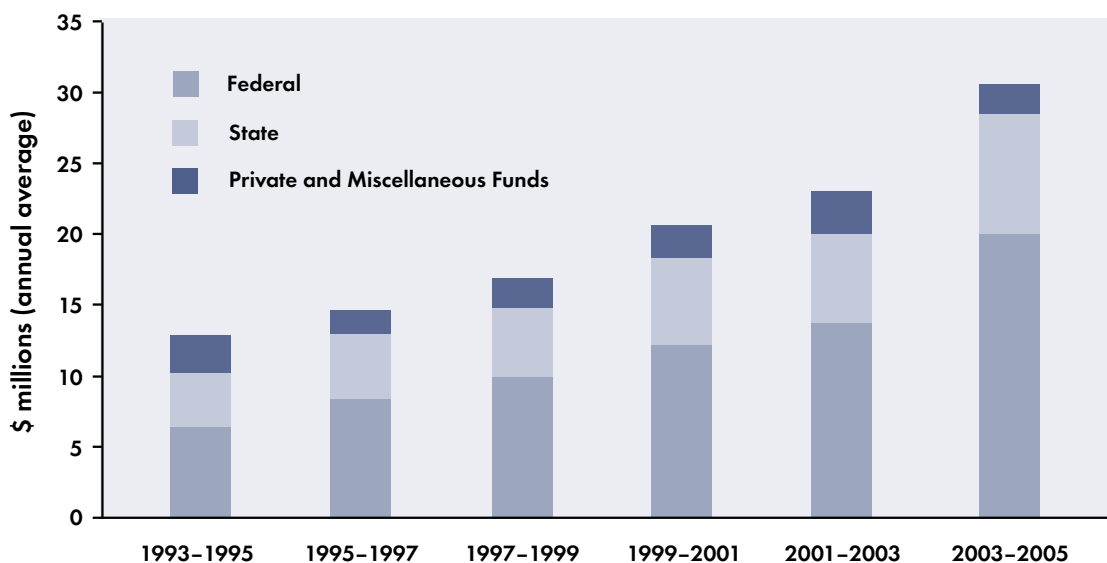
FACTS AND FIGURES

Several federal research grants contributed to a 32% increase in our overall budget from that of fiscal biennium 2001-2003. Our department ranked third on campus in grant and contract awards for fiscal year 2004–2005 with \$28 million in grants, exceeded only by the departments of Medicine and Pathology.

This continues the steady growth of the past decade. When combined with funds derived from indirect costs on grants, federal revenue accounts for about two-thirds of our total departmental support, up from about half in 1993–1995 (see figure 1). In 2003–2005, we saw a decline in private and miscellaneous support, which accounted for about 6% of our budget.

Our state funding consists of a combination of allocations provided directly by the Washington Legislature through the Medical Aid and Accident Funds (MA/AF), state research grants and contracts awarded to our investigators, and funds distributed by the UW central budget office. In 2003–2005, our

FIGURE 1. DEOHS FUNDING PER ANNUM



overall state funding increased by approximately 9%, driven by increases in return of indirect costs from federal grant activity. Other components of state funding remained flat or declined.

Our department's success relies on its ability to combine state and federal resources to fund our interrelated teaching, research, and service missions. During the 2003–2005 biennium, we tapped some new sources for student funding, such as an agreement with Madigan Army Medical Center and the UW's Graduate Opportunities and Minority Achievement Program (GO-MAP). As an example from figure 2, the cost of tuition, fees, stipends and assistantships for our graduate students is spread among faculty research grants, program training grants, state funds, and other sources.

The increase in our federal funding in the 2003–2005 biennium also reflects grants that Gallagher, Vedal, Shin, and Research Scientist Phillip Butterfield brought with them when they joined our department.

SERVICE ENVIRONMENTAL HEALTH LABORATORY

Our service programs continued to thrive in 2003–2005. Russell Dills, PhD, who had been overseeing the Environmental Health Laboratory (EHL) since 2000, was named its director in 2005. The laboratory provides sophisticated chemical analyses to industrial hygiene practitioners in the state, and to other departmental service, teaching, and research activities.

With matching funds from the School of Public Health

and Community Medicine, the EHL acquired an Inductively Coupled Plasma Mass Spectrometer with collision cell, which can analyze for nearly all of the elements in the periodic table at parts-per-trillion sensitivity. A High Performance Liquid Chromatograph has been combined with this machine to allow for speciation of elements such as arsenic by chromatography.

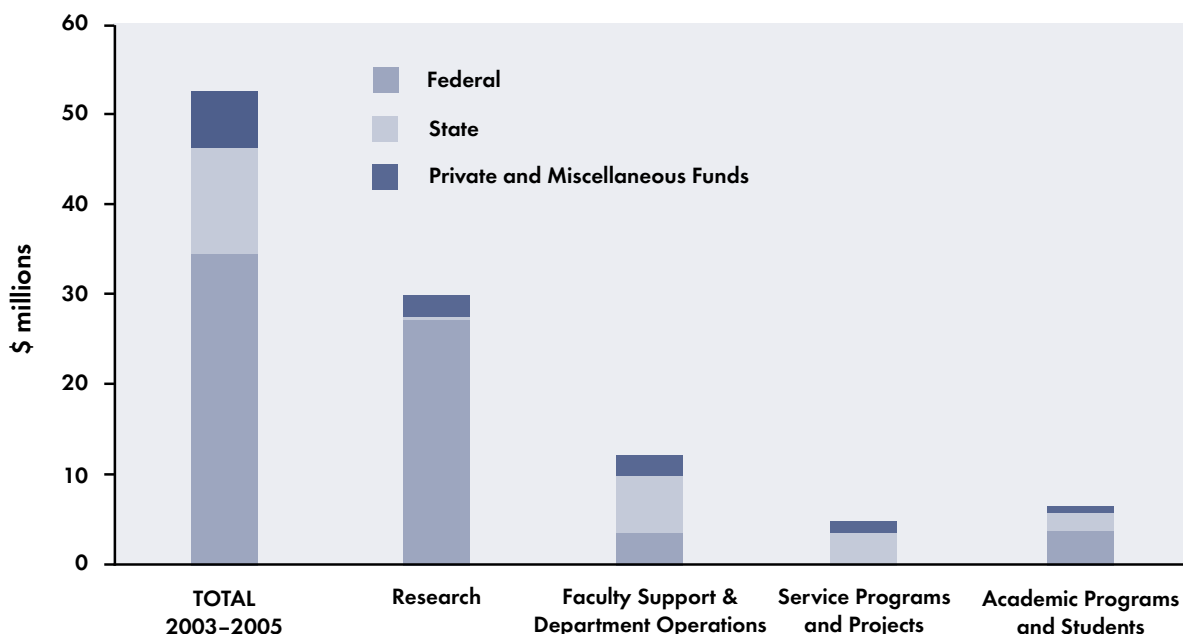
The EHL worked closely with the Field Research and Consultation Group (Field Group), consulting on chemical hazards, chemistry, and sampling and providing analytical services (819 analyses; 45 clients).

The support the lab has historically provided to firefighters and fire departments in Washington state was expanded to address additional research issues. The lab provided education, testing, and technical assistance to 76 fire departments and related agencies. The EHL provides the only certified breathing air analysis in Washington and was one of the pioneer groups in establishing the certification program. Last year, at the request of the Renton Fire Department, the EHL developed sophisticated measurement capabilities to evaluate the chemical safety of three fire extinguishing agents.

FIELD RESEARCH AND CONSULTATION GROUP

The Field Group performed 75 consultations for clients such as woodworking shops, sawmills, building contractors, battery manufacturers, and foundries. The Field Group provided research opportunities for students, such as Michael Harris, who compared fall protection training programs in several air-

FIGURE 2. DEOHS SPENDING PER BIENNIUM



craft maintenance facilities for his master's thesis. Field Group clients hosted 11 graduate student interns. Among the 15 Field Group research projects this biennium were collaborations with the Seattle Metal Arts Guild and the Washington Automotive Services Association.

OCCUPATIONAL AND ENVIRONMENTAL MEDICINE CLINIC

The Occupational and Environmental Medicine Clinic expanded its scope of practice by adding three new faculty physicians. The clinic continues to provide occupational health services for WISHA inspectors, Seattle firefighters, and UW HazMat responders, and comprehensive consultation services for patients, physicians, workers, and employers throughout the Pacific Northwest. In a typical year, the clinic sees about 700 patients, of whom about 40% are referred by the workers' compensation system.

The clinic has relocated from the main Harborview hospital to the new Pat Steel Building, which has an integrated service center, complete with radiology, lung function testing, and laboratory facilities. The clinic shifted from a paper-based system of billing, communication, and charting to computerized accounting, telecommunications, and record keeping. During the biennium, the clinic initiated a pulmonary challenge chamber for the diagnosis of occupational asthma, the first of its kind in Washington.

The clinic has begun a multidisciplinary collaboration with its colleagues in spine, neurosurgery, and rehabilitation medicine to provide consultation services for injured workers with complex orthopedic conditions. These consultations have strengthened the partnership with the Department of Labor and Industries, which includes the clinic's role as the state's Center of Excellence for Chemically Related Illness.

LOOKING AHEAD

The first few months of the 2005–2007 biennium offer reasons for cautious optimism. Our successes in recruiting faculty and winning grants give momentum to research initiatives in air pollution, Superfund research, and ocean sciences.

Our research funding base appears stable for the near future, but our faculty, like their colleagues across the country, are feeling the effects of shrinking availability of federal grant support and growing demand. We anticipate needing to work harder to stay even, and there will likely be some areas where long-standing lines of research experience interruptions.

Our graduate programs are working to maintain their relevance and efficiency by restructuring program requirements, reconfiguring courses, and offering new courses. We continue to build interdisciplinary collaborations with other divisions on campus, such as public policy and international health, and student interest is growing in these areas.

We are building capacity in our research, service, and educational outreach efforts. New laboratory technology in chemical and gene expression analysis has increased the capabilities of our service programs. We have nearly completed facilities redevelopment at our Roosevelt Way location, and will be fully occupying the space in the 2005–2007 biennium.

We have formed new partnerships for worker training and educational outreach with universities in California and Arizona, and with private sector training organizations. This has already enhanced our ability to identify and respond to educational needs in health and safety for populations not well served by existing training opportunities.

In the 2005–2007 biennium, we expect to continue progress in research and teaching while extending the scope and impact of our service work. There are clear opportunities for increasing dialogue with Washington employers and business organizations. Partnership with those groups, along with state agencies, labor groups, and public sector organizations, can achieve common objectives in improving occupational and environmental health in Washington state. We wish to thank those who have supported these initiatives along the way, and we would like to invite you to become engaged with our department as we continue into the 2005–2007 biennium.

—David A. Kalman, chair



Kathy Hall

Russell Dills (left) of the EH Lab and Marc Beaudreau (center) of the Field Group worked with Renton firefighters to compare the safety of fire suppressants.

The background of the page is a detailed, grayscale microscopic image of plant tissue, showing a grid of rectangular cells with prominent cell walls and dark, central nuclei. The image is oriented diagonally, with the grid lines running from the top-left towards the bottom-right. The overall color palette is a range of blues and greys, from light to dark.

*M*EASURES OF
ACCOMPLISHMENT 2003-2005



Honors and Awards

Oravo

STUDENTS, FACULTY, AND STAFF

STUDENTS

Paige Beckley, undergraduate student
department's outstanding undergraduate student, 2005

Parveen Bhatti, PhD student, Environmental & Occupational Hygiene
pre-doctoral fellowship with the National Cancer Institute, 2004

Heather Bost, MS student, Environmental Health
student paper award, National Environmental Health Association, 2004; \$500 travel award, National Environmental Health Association, 2005

Christine Clark, undergraduate student
department's outstanding undergraduate student, 2004

Lisa (Smith) Corey, PhD student, Toxicology
second place paper award, Pacific Northwest Association of Toxicologists, 2004

Jennifer Crowe, MPH student, Environmental & Occupational Health
Cind Treser Memorial Scholarship, Washington State Environmental Health Association, 2004

Nicole DeFrank, MS student, Toxicology
young investigator travel award, Teratology Society, 2004

Elizabeth Gribble, PhD student, Toxicology
young investigator travel award, Teratology Society, 2004; scholarship to attend RASS X (Risk Assessment Summer School) in Germany, 2004

Samir Kelada, PhD student, Toxicology
department's outstanding graduate student, 2005

Heather Klintworth, MS student, Toxicology
Society of Toxicology travel award, 2005

Helene LaVire, PhD student, Toxicology
ARCS fellow, 2003

Erin Peck, PhD student, Toxicology
ARCS fellow, 2004

Jon Hofmann, MPH student, Environmental & Occupational Health
department's outstanding graduate student, 2004

Raveena Pillay, undergraduate student
Cind Treser Memorial Scholarship, Washington State Environmental Health Association, 2004

Josh Robinson, PhD student, Toxicology
young investigator travel award, Teratology Society, 2004

Maggie Trabeau, MS student, Industrial Hygiene
3M scholarship, 2005

Yupeng Wang, PhD student, Toxicology
Magnuson Scholar, School of Public Health and Community Medicine, 2005–2006



DEOHSArchives

Yupeng Wang



Christine Clark in Antarctica.

Courtesy of Christy Clark; top: Health Sciences Photography

FACULTY & STAFF

Chetana Acharya
departmental outreach award, 2004

Raja Atallah
departmental nominee, UW outstanding public service award, 2004

Harvey Checkoway
distinguished lecture on occupational and environmental cancer at the National Cancer Institute, Division of Cancer Epidemiology and Genetics, 2004; Herman A. Tyroler Distinguished Alumni Award from the University of North Carolina's department of Epidemiology, 2004

Lucio Costa
advisory committee on polybrominated diphenyl ethers (PBDE) of the Washington state departments of Ecology and Health; expert panel on stimulants (methylphenidate and amphetamines) for the National Toxicology Program's Center for the Evaluation of Risks to Human Reproduction

David Eaton
Chair, National Academy of Sciences/National Research Council committee to review the recent Environmental Protection Agency dioxin risk assessment, 2004; National Associate, National Academy of Sciences, selected 2004 (lifetime membership); vice president of the Toxicology Education Foundation for 2005–2006

Evan Gallagher
Sheldon D. Murphy Endowed Chair in Toxicology, 2004–2006

Catherine Karr
Children's Environmental Health Excellence award for PEHSU, 2005



Devon DeLapp

Chetana Acharya

Matthew Keifer
outstanding mentor, School of Public Health and Community Medicine, 2004

Shannon Kirkpatrick
departmental distinguished staff award, 2004

John Scott Meschke
travel award for the NEHA Conference, 2004

Michael Morgan
distinguished faculty lecture for the School of Public Health and Community Medicine, autumn 2004; nominee for the UW Distinguished Teaching Award, 2004; first editor-in-chief of the Journal of Occupational and Environmental Hygiene, which began publication in January 2004

Rory Murphy
departmental nominee for the UW distinguished staff award, 2004

Rick Neitzel
departmental outreach award, 2004

Namura Nkeze
departmental distinguished staff award, 2005

Gilbert Omenn
president of the American Association for the Advancement of Science (AAAS), 2005–2006

Kate Stewart
Puget Sound Human Factors and Ergonomics Society Ergonomist of the Year, 2004

Tim Takaro
Children's Environmental Health Excellence Award for King County's Healthy Homes program, 2005

Charles Treser
nominee for UW Marsha L. Landolt Distinguished Graduate Mentor Award, 2005

Zhengui Xia
nominee for UW Distinguished Teaching Award, 2005



Mary Levin

Namura Nkeze



Mary Levin

Matt Keifer



Degrees Conferred

Graduates

BS, MS, MPH, PHD

UNDERGRADUATE

SUMMER 2003

Sakorn Marley
Laurie Young

WINTER 2004

Christine Clark
Jonathan Freed

SPRING 2004

Jenafer Halpin
Lucas Jordan
Peter Lang
Thao Le
Rena Saito

SUMMER 2004

Falahyah Rozaly

AUTUMN 2004

Thai Nguyen
Kevin Gallagher
Megan Yoshimoto

WINTER 2005

Raveena Pillay
Michelle Bradley
Shukriya Zarif

SPRING 2005

Paige Beckley
Diana Cortes
Nawo Fiamo
Daniel McClung
Neha Nariya
Selena Ngo
Aiza Redosendo
Yvonne Yuen
Elisa Truong



Photos: Joel Levin

GRADUATE

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

Graduate Programs: *Industrial Hygiene and Safety (IH&S), Environmental Health (EH), Environmental and Occupational Hygiene (EOH, PhD), Environmental and Occupational Health (EOH, MPH), Toxicology (Tox), Occupational and Environmental Medicine (OccMed).*

Faculty Preceptors: *(italics)*

SUMMER 2003

Erika Abel, PhD (Tox) The functional significance of genetic polymorphisms in human glutathione S-transferases (*David Eaton*)

Iyad Kheirbek, MS (EH) Development of a passive sampler to detect six aldehydes (*Sally Liu*)

Leah Mickelson, MS (IH&S) Comparison of fungal exposure methods used in the Seattle Healthy Homes Project (*Tim Takaro*)

Marilyn Nayan, MPH (OccMed) Predictors of outcome in surgically and nonsurgically treated work related cubital tunnel syndrome (*Gary Franklin*)

Kathleen Newhouse, MS (Tox) MAP kinase signalling mechanisms of rotenone-induced apoptosis in human, dopaminergic, SH-SY5Y cells (*Zhengui Xia*)

Jing Shao, PhD (Tox) Association of a trinucleotide repeat polymorphism in a glutamate cysteine ligase gene with fibrotic lung diseases (*Terrance Kavanagh*)

Lindsay Smith, MS (EH) Plausibility of direct exposure to paranitrophenol in the Chicago methyl parathion residential spraying case (*John Kissel*)

Craig Tin, MS (Tox) Alteration of gene expression induced by methylmercury in transgenic p53 fibroblasts (*Elaine Faustman*)

top (l to r): Daniel McClung, Kevin Gallagher, Diana Cortes, Chuck Treser, Raveena Pillay, Yvonne Yuen.

at left: Nitasha Beri and Neha Nariya at 2005 Commencement.

Christopher Wilkerson, MS (EH) Antibiotic resistance prevalence in *Escherichia coli* isolated from humans, wild and domesticated animals and environmental sources (*Mansour Samadpour*)

AUTUMN 2003

Helene LaVire, MS (Tox) Analysis of gene expression biomarkers of metal exposure in deer mice (*Peromyscus maniculatus*) from Anaconda Smelter Site, MT (*Terrance Kavanagh*)

Katherine Himes, MS (EH) Investigation of orchard proximity effect on organo-phosphorous pesticide exposures among agricultural workers and their families (*Richard Fenske*)

SPRING 2004

Heather Bost, MS (EH) A comparison of West Nile Virus vector mosquito populations in sites with and without storm water drainage ponds (*John Scott Meschke*)

Ann Bradley, MPH (EOH) Impact and policy implications of genetic information in regulation: A case study of organophosphate pesticides (*Elaine Faustman*)

Michael Compher, MS (EH) Children's exposure to diesel exhaust from school buses with different diesel engines—A pilot study (*Sally Liu*)

Eva Dale, MS (Tox) Effect of PM2.5 on exhaled nitric oxide: An intervention field study (*Jane Koenig*)

Kai Elgethun, PhD (IH&S) Global positioning system (GPS) tracking to characterize children's exposure to pesticides (*Richard Fenske*)

Yingying Guo, PhD (Tox) Characterization of global transcriptional responses and DNA repair following aflatoxin B1 treatment in *Saccharomyces cerevisiae* (*Helmut Zarbl*)

Jonathan Hofmann, MPH (EOH) Mortality among a cohort of DBCP-exposed banana plantation workers in Costa Rica (*Matthew Keifer*)

NaTasha Johnson, MS (IH&S) Permeation of various glove materials by a binary mixture under a temperature gradient (*Michael Morgan*)

Nicola Josephs, MS (EH) An evaluation of the utility of F+RNA coliphages for source tracking pathogens in environmental waters (*John Scott Meschke*)



George Astrakianakis, PhD, June 2005.

Anayi Norman, MS (EH) Use of PBPK models to characterize dermal absorption of volatile organic compounds from water (*John Kissel*)

Phoung Thi Nguyen, MS (IH&S) Silica exposure assessment of refractory brick workers in Vietnam (*Michael Yost*)

Kelly Marie Schumacher, MS (Tox) Toxicokinetic and toxicodynamic factors affecting chlorpyrifos developmental toxicity (*Elaine Faustman*)

Marley Shoaf, MS (EH) Dermal exposure to sediment: Field measurement of sediment loadings and unresolved issues in exposure assessment (*John Kissel*)

Helen Smith, PhD (Tox) Functional significance of polymorphic variants of CYP1B1 and COMT in estrogen metabolism and their relevance to endometrial cancer (*David Eaton*)

Lisa Marie Smith, MS (Tox) Effects and mechanisms of cardiopulmonary toxicity of Seattle particulate matter in the apolipoprotein E knockout transgenic mouse (*Dan Luchtel*)

Austin Sumner, MPH (OccMed) Glutathione S-transferase Mu 1 polymorphism and asbestos-related lung disease (*Tim Takaro*)

Alden Weg, MPH (OccMed) The impact of Army branch assignment on early medical disability in a cohort of Reserve Officer Training Corps (ROTC) cadets (*William Daniell*)

SUMMER 2004

Kathleen Bradley, MS (Tox) Effects of phytochemicals on AFB1-mediated genotoxicity in HepG2 cells (*David Eaton*)

Shengli Shi, PhD (Tox) Effects of enhanced glutathione biosynthesis on oxidative stress-mediated hepatocellular injury and gene expression in mice (*Terrance Kavanagh*)

Kathryn Ann Toepel, MS (EH) Determination of the dietary contribution to pesticide exposure in suburban children (*Richard Fenske*)

Lisa Younglove, MPH (EOH) Evaluation of exposure to chlorpyrifos and diazinon in pesticide applicators and their children in rural Nicaragua (*Richard Fenske*)

Wenjie Zhu, MS (IH&S) Application of GPS/GIS in Chinese farmers for assessment of potential organophosphate pesticide exposures from crop residues (*Michael Yost*)

AUTUMN 2004

Ryan Allen, PhD (EOH) The estimated contributions of ambient and nonambient particulate matter to indoor concentrations and personal exposures (*Sally Liu*)

Nicole DeFrank, MS (Tox) Computation model of radiation-induced abnormalities of the neocortex (*Elaine Faustman*)

Fabiola Estrada, MS (IH&S) An exploratory study of the incentives and disincentives for Latino farm workers in the State of Washington to participate in the workers' compensation system (*Matthew Keifer*)

Julia Gohlke, PhD (Tox) A quantitative examination of ethanol-induced neurodevelopmental toxicity using computational models (*Elaine Faustman*)

Marie Martin, PhD (IH&S) Comparison of three methods of breath sampling for biological monitoring of volatile organic chemicals (*Michael Morgan*)

WINTER 2005

Joshua Robinson, MS (Tox) Examination of metal-induced cell cycle alterations and apoptosis in C57BL/6 and SWV mouse embryonic fibroblasts (*Elaine Faustman*)

SPRING 2005

George Astrakianakis, PhD (EOH) Cotton dust, endotoxin exposure and the risk of lung cancer among female textile workers in Shanghai (*Noah Seixas*)

Heather Barr, MS (EH) Characterizing the performance of the 'smart' tripod orchard ladder (*Matthew Keifer*)

Bryan Berna, MS (IH&S) Occupational noise exposures aboard catcher/processors in the Bering Sea and Pacific Ocean (*Noah Seixas*)

Jing Chen, MS (Tox) Effect of ethanol on cholesterol synthesis and efflux in astrocytes (*Lucio Costa*)

Jennifer Crowe, MPH (EOH) Core group key informant perceptions of environmental and occupational risks for agricultural workers in Yakima Valley, Washington as a part of *El Proyecto Bienestar* (*Matthew Keifer*)

Kristin Cunningham, MS (EH) Disinfection of pathogens on environmental surfaces by spray application of a disinfectant (*John Scott Meschke*)

Emily Duffield, MPH (EOH) A modified method for viral and bacterial detection in oysters (*John Scott Meschke*)

Michael Haris, MS (IH&S) Organizational factors influencing the use of fall protection in aircraft maintenance (*Noah Seixas*)

Stephen Hunt, MPH (OccMed) Long-term health consequences of incarceration as a prisoner of war (*Tim Takaro*)

Sham Juratli, MPH (OccMed) Lumbar fusion outcome in Washington State workers' compensation (*Gary Franklin*)

David Klavens, MS (IH&S) HPLC analysis of 1-nitropyrene as a method for the measurement of diesel particulate matter (*Christopher Simpson*)

Heather Klintworth, MS (Tox) Mechanisms of Paraquat-induced cell death: A model for Parkinson's disease (*Zhengui Xia*)

Fiona Sands, MPH (EOH) The effects of exposure to diesel exhaust on endothelial function as measured by brachial artery reactivity (*Joel Kaufman*)

Christine Scott, MPH (EOH) Survival of the fittest: Does performance on a pre-employment fitness test predict injury in Army job training? (*Matthew Keifer*)



Faculty: Brief Bios

Faculty

Tushna Lehman



Scott Barnhart, MD, MPH, is a professor (primary appointment in the School of Medicine) and since 1999 has been medical director of Harborview Medical Center. He directed the Occupational and Environmental Medicine program from 1994 to 1999. One

area of research is the natural history of asbestos-related lung disease, including possible protective effects of beta-carotene and vitamin A. A second project is control of silicosis in developing nations. A third area of investigation is use of a public health approach to reduce occupational hazards on Department of Energy (DOE) sites.



Harvey Checkoway, PhD, is a professor in the Occupational and Environmental Medicine program. His research interests include occupational and environmental risk factors for cancer, dust-related lung diseases, and neurological disorders. Increasingly, his research has incorporated

biomarkers of exposure, response, and genetic susceptibility. Recent projects include a study of silica, silicosis, and lung cancer among diatomite industry workers; semen quality among lead smelter workers; environmental exposures and genetic variations in Parkinson's disease; and cancer risks among textile workers.



Thomas M. Burbacher, PhD, is an associate professor in the Toxicology program and deputy director of the department's Center for Child Environmental Health Risks Research. His research focuses on the effects of prenatal or early postnatal exposure to environmental

pollutants on central nervous system development. His projects include studies aimed at examining: the cognitive and sensory effects of prenatal methylmercury exposure in aged monkeys; the effects of prenatal exposure to methanol on sensory and cognitive development; and the effects of early pesticide exposure on brain development in rodents.



Lucio G. Costa, PhD, is a professor in the Toxicology program. His area of research is neurotoxicology, particularly the study of the cellular, biochemical, and molecular mechanisms involved when toxicants affect the nervous system. His laboratory uses *in vivo*, *in vitro*, and

cell culture systems, as well as biochemical, molecular, and imaging techniques. Research projects include the effects of alcohol and pesticides on brain cells, and studies on genetic predisposition to neurotoxicity. He has published more than 200 articles in peer-reviewed journals and contributed dozens of book chapters and other publications.



Janice Camp, MSN, MSPH, is a senior lecturer in the Industrial Hygiene and Safety program and director of the Field Research and Consultation Group. Her research interests include occupational exposure assessment, ergonomics, and program evaluation. Ms. Camp,

a certified industrial hygienist and certified occupational health nurse, is past president of the Pacific Northwest Section of the American Industrial Hygiene Association and the Washington State Association of Occupational Health Nurses.



William Daniell, MD, MPH, is an associate professor in the Occupational and Environmental Medicine program. His current research interests primarily involve noise-induced hearing loss and the utility of workers' compensation data for research and intervention purposes. Past research

includes neuropsychological consequences of occupational chemical exposures, particularly organic solvents, carpal tunnel syndrome, and multiple chemical sensitivity syndrome.



David L. Eaton, PhD, is a professor in the Toxicology program and associate dean for research in the UW School of Public Health and Community Medicine. He has published more than 100 research papers, contributed to 30 books, and written a dozen articles explaining toxicological principles to the general public. His research specialty is chemical carcinogenesis, focusing on how enzymes in the liver activate and detoxify carcinogenic chemicals and how components of the diet (e.g. plant-derived chemicals) modify cancer risk. He directs the Center for Ecogenetics and Environmental Health, which brings together more than 50 UW investigators to study how small differences in human genes (polymorphisms) can influence susceptibility to toxic substances in the environment. The center is funded by the National Institute of Environmental Health Sciences (NIEHS).



Elaine M. Faustman, PhD, is a professor in the Toxicology program and director of the Institute for Risk Analysis and Risk Communication and the Center for Child Environmental Health Risks Research. Her long-range aim is to identify biochemical and molecular mechanisms of

developmental and reproductive toxicity. Because 70% of human birth defects have an unknown cause, she wants to identify preventable causes, focusing on several types of pollutants including pesticides and metals such as lead and methylmercury. Recently, she chaired a National Academy of Sciences panel that developed approaches for incorporating new genomic, molecular, and developmental biological findings into risk assessment. She is an elected fellow of the American Association for the Advancement of Science and the Society of Risk Analysis. Dr. Faustman has published more than 90 papers in peer-reviewed journals and 25 book chapters and other publications.



Richard A. Fenske, PhD, MPH, is a professor in the Industrial Hygiene and Safety Program and has served as director of the NIOSH-supported Pacific Northwest Agricultural Safety and Health Center since its establishment in 1996. His research interests include exposure

assessment and intervention studies in the workplace and in communities. His current studies include reducing children's exposure to pesticides in agricultural communities, using fluorescent tracers for pesticide safety education, improving risk communication methods, and developing novel exposure assessment methods. He teaches courses in environmental sampling and analysis, and environmental risk analysis. He is

a member of the US Environmental Protection Agency's Science Advisory Board, and a member of the National Academy of Sciences/Institute of Medicine Committee to Review the Health Effects in Vietnam Veterans of Exposure to Herbicides. From 1994–2004 he served on the National Advisory Panel of the National Cancer Institute's Agricultural Health Study, a prospective epidemiological study of pesticide applicators and their families.



Gary M. Franklin, MD, MPH, is a research professor in the Occupational and Environmental Medicine program and in the Department of Neurology, and is the medical director of the Washington state Department of Labor and

Industries (L&I). His research interests include the epidemiology and outcomes of treatment for occupational injury, occupational and environmental diseases of the nervous system, health services research, and health policy.



Evan Gallagher, PhD, is an associate professor in Toxicology and holds the Sheldon D. Murphy Chair in Toxicology and Environmental Health. He came to UW in 2004 from the University of Florida in Gainesville, where he was an associate professor in the College of Veterinary Medicine,

Department of Physiological Sciences. He was a postdoctoral fellow in our department from 1991–1996. Dr. Gallagher earned his Master of Environmental Management and his PhD in Toxicology from Duke University. His areas of research interests are in molecular environmental toxicology and environmental health. These studies involve the role of detoxification and oxidative stress protective pathways as determinants of susceptibility of different fish species, such as salmon, to environmental chemical injury. His human health studies focus largely upon the role of exposures to environmental chemicals during pregnancy in the development of childhood leukemias. In both his aquatic and human health research, biochemical and the molecular mechanisms of cell injury are explored using a number of approaches and *in vivo*, *in vitro*, and cell culture techniques.



Jack Hatlen, MS, is an associate professor emeritus in the Environmental Health program. His research specialties include environmental sanitation practices in public health agencies, food safety, and workforce education and development. Another interest is the collection,

treatment, and disposal of community wastewaters.



Peter Johnson, PhD, is an assistant professor in the Industrial Hygiene program, specializing in ergonomics. He earned his doctorate in Bioengineering from the University of California-Berkeley and has worked as a researcher at the national institutes of occupational health in the

United States, Sweden, and Denmark. He is developing and validating an exposure assessment system for measuring multiple physical risk factors during computer work, working on a large-scale study to measure and characterize office workers' exposure to upper-extremity hazards, and developing tools for exposure assessment of physical risk factors. He is also developing methods to measure occupationally related muscle fatigue using electrical stimulation of the muscle.



David A. Kalman, PhD, is department chair and a professor in the Environmental Health program. His research focuses on chemical issues, such as hazardous properties of materials, environmental fate and transport, environmental quality assessment, hazard management, and

occupational and community exposure assessment, especially using biomarkers of exposure. Active research areas include assessment of exposures to atmospheric particulates, including wood smoke, and exposures and effects of arsenic in drinking water, diet, and soil.



Joel Kaufman, MD, MPH, is professor and director of the Occupational and Environmental Medicine program. He has a joint appointment with General Internal Medicine and an adjunct appointment in Epidemiology. His research activities fall into three areas: occupational and

environmental factors in cardiovascular disease; epidemiology of occupational and environmental asthma; and surveillance and prevention of occupational illnesses and injuries, including lead poisoning and occupational skin disorders. He is past-president of the Northwest Association of Occupational and Environmental Medicine. He directs a research facility studying health effects of diesel exhaust, focusing on cardiovascular and pulmonary effects, and an epidemiological study of cardiovascular disease and air pollution.



Terrance J. Kavanagh, PhD, is a professor and director of the Toxicology program. His research interests include free radical biology and oxidative stress, and the effects of chemicals on diseases of aging, including cancer, atherosclerosis, pulmonary fibrosis, Parkinson's disease,

and Alzheimer's disease. His laboratory assesses the role of the free radical scavenger glutathione (GSH) and the enzymes involved in its synthesis in preventing free radical injury. Another research interest involves assessing the role of genetic polymorphisms in these enzymes in free-radical-mediated diseases.



Matthew C. Keifer, MD, MPH, is an associate professor and associate director of the Occupational and Environmental Medicine residency program and the graduate program coordinator for our department. He joined the faculty after serving as project epidemiologist for CARE in

Nicaragua, where he supervised health surveillance and development activities related to pesticide exposures and biological monitoring. His activities pertain to studies of agricultural and international occupational and environmental health and safety. He is co-director of the PNASH Center. He is also director of the International Scholars in Occupational and Environmental Health.



John Kissel, PhD, is a professor and director of the Environmental Health program. His research interests include pathways of human exposure to environmental contaminants in environmental media. Exposure factor data collected by Dr. Kissel and his students and staff

are cited in EPA guidance documents and used in cleanup decisions at Superfund sites. He also investigates community exposures to pesticides and currently serves on the EPA Science Advisory Panel for the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Dr. Kissel was president of the International Society of Exposure Analysis in 2002–2003. He has authored or coauthored about 30 papers in peer-reviewed scientific journals.



Jane Q. Koenig, PhD, is a professor in the Toxicology program. Her research interests are the respiratory health effects of air pollution, especially the responses of susceptible individuals, such as those with asthma or other chronic respiratory diseases. She is involved in three general areas of

research: controlled laboratory studies using human subjects, field or epidemiological studies evaluating respiratory health in populations exposed to fine particulate matter from wood smoke or other sources in their neighborhoods, and assessment of physical or chemical changes in cultured human epithelial cells after air pollutant exposure. She has published more than 80 peer-reviewed journal articles, and directs the EPA particulate matter research center.



Joellen Lewtas, PhD, is a research professor in the Environmental Health program. She retired from the EPA's Office of Research & Development, where she was affiliated with both the National Exposure Research Laboratory and National

Health and Environmental Effects Lab. A biochemist, her research interests are in air pollution and combustion emissions. Her research includes human exposure, biomarkers, dosimetry, and toxicology of these complex mixtures and their constituents. She has served on the faculty of the European School of Oncology and was formerly an adjunct faculty member in the School of Medicine at Duke University and later in the School of Public Health, University of North Carolina, Chapel Hill.



L.-J. Sally Liu, ScD, is a research associate professor in the Environmental Health program. She earned her doctorate in 1994 from Harvard University's School of Public Health and has published more than 20 papers in peer-reviewed journals and several book chapters. Her research

interests include air pollution exposure assessment in susceptible populations, air pollution epidemiology, and risk assessment. She is the principal investigator of several exposure assessment projects focusing on assessing hazardous air pollutants exposure and health effects among high-risk subpopulations in the Northwestern United States.



Daniel L. Luchtel, PhD, is a professor in the Toxicology program. His research projects include the effects of gaseous air pollutants (ozone, nitrogen dioxide, and sulfur dioxide) on cultured human nasal epithelial cells and primate bronchial epithelial cells; toxicology of

carbon/graphite fibers used in advanced composite materials by the aerospace industry; and mucociliary clearance as a defense mechanism in the lung. He has developed new ways of preserving and fixing mucous cells with ultrarapid freezing and freeze-substitution. He is also interested in the applications and techniques of microscopy. He has published more than 50 papers in peer-reviewed journals.



John Scott Meschke, PhD, is an assistant professor in the Environmental Health program, specializing in pathogens in the environment. He earned his doctorate in environmental microbiology from the University of North Carolina-Chapel Hill. His research focuses on

environmentally transmitted pathogens, sampling and analysis methods, environmental fate and transport, quantitative micro-

bial risk assessment, and engineered controls. He is involved in studies on the recovery and disinfection of a variety of Noroviruses on surfaces and the development of microarray-based methods for characterization of viruses.



Lee Monteith, MS, is a senior lecturer emeritus in the Industrial Hygiene and Safety program.

He is a certified industrial hygienist, a member of the Air Sampling Instruments Committee of the American Conference of Governmental

Industrial Hygienists (ACGIH) and the Gas and

Vapor Detection Systems Committee of the AIHA, and a liaison between the two committees. He is a Diplomate member of the American Academy of Industrial Hygiene. His research interests include the adsorption process in passive dosimeter badges, methods for the measurements of glove permeation, and methods for the detection and measurement of trace compounds in the environment. He is author of two chapters in *Air Sampling Instruments for Evaluation of Atmospheric Contaminants*.



Michael S. Morgan, ScD, is a professor in the Industrial Hygiene and Safety program. He holds adjunct appointments in Civil Engineering and Chemical Engineering. Dr. Morgan is a certified industrial hygienist. His main academic interest is in respiratory physiology and inhalation

toxicology. He measures and models the pharmacokinetics of industrial solvent exposures, and studies the performance of personal protective equipment used with solvents. He also studies lead exposures in the construction industry, particularly among demolition workers. He chairs the Biological Exposure Indices Committee of the ACGIH. In 1999, he was appointed to the National Research Council's Committee on Air Quality in Passenger Cabins of Commercial Aircraft. He has published more than 40 papers in peer-reviewed journals and currently serves as editor-in-chief of the journal *Occupational and Environmental Hygiene*.



Sharon L. Morris was a senior lecturer in the Occupational and Environmental Medicine program and our department's assistant chair for community outreach. She was granted emeritus status in the spring of 2005. Her research interests include occupational safety and health policy and

program evaluation, and she directed our department's Policy Analysis and Program Evaluation Initiative. She was involved in a study to evaluate the implementation of the Washington state ergonomics rule. She served on the Board of Scientific Counselors of the National Institute for Occupational Safety

and Health; the Innovations Task Force of the Washington state L&I; and the Governor's Industrial Safety and Health Advisory Board, among other committees.



Noah S. Seixas, PhD, is a professor in the Industrial Hygiene and Safety program. Dr. Seixas is a certified industrial hygienist and a member of the editorial board of the *American Industrial Hygiene Association Journal*. His interests are in the quantification of exposure for occupational epidemiology, and development of biologically relevant exposure metrics. His research efforts include a prospective study of noise-induced hearing damage among construction workers, assessment of irritant gas exposures during aluminum smelting, exposure assessment for women textile workers in Shanghai, China, and methods of controlling exposure to dust during construction tasks. Dr. Seixas also works closely with the local construction community evaluating the effectiveness of educational and organizational programs.



Elizabeth (Lianne) Sheppard, PhD, is a research associate professor in the Occupational and Environmental Medicine program with a joint appointment in Biostatistics. Her applied work focuses on air pollution health effects and occupational epidemiologic studies. Her biostatistical research interests emphasize estimation of health effects from environmental and occupational exposures, and incorporating group information in epidemiologic studies.



Gwy-Am Shin, PhD, is an assistant professor in the Environmental Health program. In 2004, he came from the University of North Carolina at Chapel Hill, where he was a research assistant professor. He earned his PhD in Environmental Microbiology at UNC, and his bachelor's and master's degrees in Microbiology at Seoul National University in Korea. His major research interests are the removal and inactivation of waterborne microorganisms by water and wastewater treatment processes, and development of molecular biological methods for treatment.



Dennis Shusterman, MD, MPH, is a professor in Occupational and Environmental Medicine, with a primary appointment in Medicine, and director of the Occupational and Environmental Medicine Residency training program. He came from the University of California, San Francisco, in 2004. His research interests include latex allergy, vocal cord dysfunc-

tion, and the effects of irritants on the upper airway. He has studied workplace hazards such as solvents and chlorine, and has published more than 60 research papers in peer-reviewed journals. He earned his MD degree at the University of California, Davis, and his MPH at the University of California, Berkeley.



Christopher Simpson, PhD, is an assistant professor in the Industrial Hygiene and Safety program. His research interests involve the application of analytical chemistry to the development and application of methods for assessment of human exposure to toxic chemicals in the workplace and the environment. Active research areas include development of biomarkers of exposure to wood smoke and diesel exhaust, use of organic molecular tracers for measurement and source apportionment of particulate air pollution, and measurement of biomarkers for reactive oxygen and reactive nitrogen species associated with exposure to particulate air pollution.



Charles D. Treser, MPH, is a senior lecturer in the Environmental Health program. His interests include administrative law and process applied to environmental health, and vector control and housing. He works with the Northwest Center for Public Health Practice to develop a regional network of state and local public health agencies and academic institutions focused on issues of public health workforce development. He has also participated in a national effort to revise the basic housing inspection manual for environmental health practitioners. He is a past president of the Association of Environmental Health Academic Programs (AEHAP), and principal investigator on a cooperative agreement between AEHAP and the Centers for Disease Control (CDC) National Center for Environmental Health, designed to improve environmental health practice through promoting and strengthening environmental health academic programs.



Gerald van Belle, PhD, a professor in the Environmental Health program (joint with Biostatistics), was department chair from 1990 to 1998. He was granted emeritus status in the spring of 2005. His research specialties include design of experiments, data characterization, and analysis with emphasis to neurodegenerative diseases and environmental studies. He also studies the effects of air pollution on health, particularly the link between daily fluctuations in air pollution levels and morbidity and mortality statistics. A current interest is the investigation of characteristics of cognitive tests in neuro-

degenerative diseases by means of item response modeling. He is the author or coauthor of more than 100 papers and several books, including *Statistical Rules of Thumb* (2002). He serves on the External Scientific Advisory Committees of the National Environmental Respiratory Center, the Harvard Particulate Matter Research Center, and the University of Southern California NIEHS Center. He is also a member of the Food and Drug Administration's Peripheral and Central Nervous System Drug Advisory Committee.



Sverre Vedal, MD, is a professor in the Occupational and Environmental Medicine program. He came here in 2004 from Denver, where he was a professor at the National Jewish Medical and Research Center and at the University of Colorado Health Sciences Center. He is an

epidemiologist and a pulmonary physician. His research interests are in health effects of air pollution, especially particulate matter, and occupational lung disease. He is investigating the role of specific sources of air pollution in contributing to ill health. He has 80 peer-reviewed publications and serves on EPA air pollution advisory committees.



James S. Woods, PhD, MPH, is a research professor in the Toxicology program. His research focuses on the molecular mechanisms of toxicity of heavy metals such as mercury, arsenic, and lead, with additional interest in changes in metabolism of porphyrins as biomarkers of metal

exposure and toxicity. He also conducts epidemiological studies of metal toxicity in human populations, including a study to determine the potential health risks to children of dental amalgam fillings containing mercury. He is past president of the American Board of Toxicology and is founding president of the Pacific Northwest Association of Toxicologists. He has served on numerous national and international advisory committees to evaluate human health risks from metal exposures. He has published more than 100 papers in peer-reviewed journals in addition to numerous book chapters and review articles.



Zhengui Xia, PhD, is an associate professor in the Toxicology program. She has published 44 papers, mostly on the mechanisms for regulating apoptosis, a form of programmed cell death. During development, apoptosis helps remove cells that are produced in excess, have developed

improperly, or are no longer needed. In adults, apoptosis removes cells that are potentially dangerous, such as viral infected cells, genetically damaged cells, or toxin-damaged cells. Dr. Xia

studies the role of chemical toxins such as sodium arsenite and pesticides (rotenone, chlorpyrifos, and paraquat) on apoptosis. Abnormal apoptosis has been implicated in various diseases, such as cancer, autoimmune disorders, Huntington's disease, Parkinson's disease, Alzheimer's disease, and stroke. Dr. Xia's research has been supported by the Sheldon Murphy assistant professor endowment and National Institutes of Health (NIH) grants. She is also a recipient of the Burroughs Wellcome new investigator award.



Michael G. Yost, PhD, is a professor and director of the Industrial Hygiene and Safety program. His research interests include optical remote sensing of chemicals in the environment, and physical agents in the workplace such as noise, vibration, and electromagnetic radiation. Dr. Yost is a member of the Bioelectromagnetics Society and the ACGIH. He is

developing new tools for exposure assessment, such as Optical Remote Sensing (ORS) methods that use electromagnetic radiation (lasers, UV, visible, or infrared light) to rapidly identify and measure contaminants. He founded and directs the optical remote sensing lab, which is engaged in several research projects that apply these tools to environmental monitoring problems.

FACULTY EMERITUS

Emeritus: an appointment given to a retiring faculty member whose scholarly, teaching, or service record has been meritorious. Usually at least 10 years prior service on the faculty.

Peter Breyse, MPH, Associate Professor Emeritus

Lee Doolittle, PhD, Associate Professor Emeritus

Stanley Freeman, MS, Senior Lecturer Emeritus

Jack Hatlen, MS, Associate Professor Emeritus

Richard Hibbard, Lecturer Emeritus

Kenneth Jackson, PhD, Professor Emeritus

Goldy Kleinman, MA, Lecturer Emeritus

Lee Monteith, MS, Senior Lecturer Emeritus

Sharon L. Morris, Senior Lecturer Emeritus

N. Karle Mottet, MD, Professor Emeritus (Joint with Pathology)

Maurice Robkin, PhD, Professor Emeritus

Gerald van Belle, PhD, Professor Emeritus

John Wilson, MD, ScD, Professor Emeritus

PART-TIME AND VISITING FACULTY

Theo Bammler, PhD, *Acting Instructor*

Tania Busch Isaksen, MPH, REHS, *Acting Instructor*

Richard Gleason, MSPH, *Lecturer*

Vincent Gregory, *Visiting Lecturer*

Rolf Hahne, PhD, *Lecturer*

Jin Kim, PhD, *Visiting Associate Professor*

David Lenning, *Lecturer*

Crispin Pierce, PhD, *Lecturer*

Janet Ploss, MD, *Acting Instructor*

Michael Silverstein, PhD, MPH, *Clinical Professor*

Kate Stewart, MS, *Lecturer*

AUXILIARY FACULTY

Adjunct Faculty: a courtesy title extended to faculty member who holds a primary appointment in another department

Clinical Faculty: a courtesy title usually conferred to someone with a primary appointment with an outside agency or nonacademic unit of the University, or in private practice

Affiliate Faculty: appointments that recognize the professional contributions of those whose principal employment responsibilities lie outside of the University

Leonard Altman, MD, *Clinical Professor*

UW Medicine (primary appointment), Oral Biology

Harriet Ammann, PhD, *Affiliate Associate Professor*

Washington State Department of Health, Office of Environmental Assessment Services

Stephen Bao, PhD, *Affiliate Assistant Professor*

SHARP, Washington State Department of Labor and Industries

David Bonauto, MD, MPH, *Clinical Instructor*

SHARP, Washington State Department of Labor and Industries

Rosa Borders, MD, *Clinical Assistant Professor*

Hanford Environmental Health Foundation

Denis Bourcier, PhD, *Affiliate Associate Professor*

Environmental Engineering, Boeing Defense and Space Group

William Brady, MD, *Affiliate Assistant Professor*

Hanford Environmental Health Foundation

Drew Brodtkin, MD, MPH, *Clinical Associate Professor*

Private practice

Jeanine Bussiere, PhD, *Affiliate Associate Professor*

Director, Pharmacology and Toxicology, Immunex

Stephen Cant, CIH, *Affiliate Assistant Professor*

Federal-State Operations Manager, WISHA Services Division, Washington State Department of Labor and Industries

Martin Cohen, ScD, *Affiliate Assistant Professor*

SHARP, Washington State Department of Labor and Industries

David Covert, PhD, *Adjunct Research Professor*

UW Civil Engineering, Atmospheric Sciences

Stanley Curtis, PhD, *Affiliate Professor*

Fred Hutchinson Cancer Research Center

Foppe de Walle, PhD, *Affiliate Professor*

Delft, The Netherlands

Frank Dost, DVM, ATS, *Affiliate Professor Veterinary Sciences,*

Freeland, WA

Robert Dreisbach, MD, PhD, *Clinical Professor*

Professor Emeritus (Pharmacology), Stanford University

Diana Echeverria, PhD, *Affiliate Assistant Professor*

Battelle Human Affairs Research Centers

Alan Fantel, PhD, *Adjunct Research Professor*

UW Department of Pediatrics

Romesh Gautom, PhD, *Affiliate Professor*

Washington State Department of Health Laboratories

Steven Gilbert, PhD, *Affiliate Associate Professor*

Director, Institute of Neurotoxicology and Neurological Disorders

Timothy Gilmore, MD, *Clinical Associate Professor*

Group Health Cooperative

Pamela Girres, MD, MPH, *Clinical Assistant Professor*

Group Health Permanente, Tacoma

Angelika Grossmann, DVM, *Affiliate Associate Professor*

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Timothy Takaro, MD, MPH, Clinical Assistant Professor

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Jude Van Buren, PhD, Clinical Assistant Professor
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Paul Williams, MD, Clinical Professor
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Michelle Braun

Sandra Chang

Hyunjung Choi

Won-Seok Choi

Kerstin Gross-Steinmeyer

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Lidong Liu

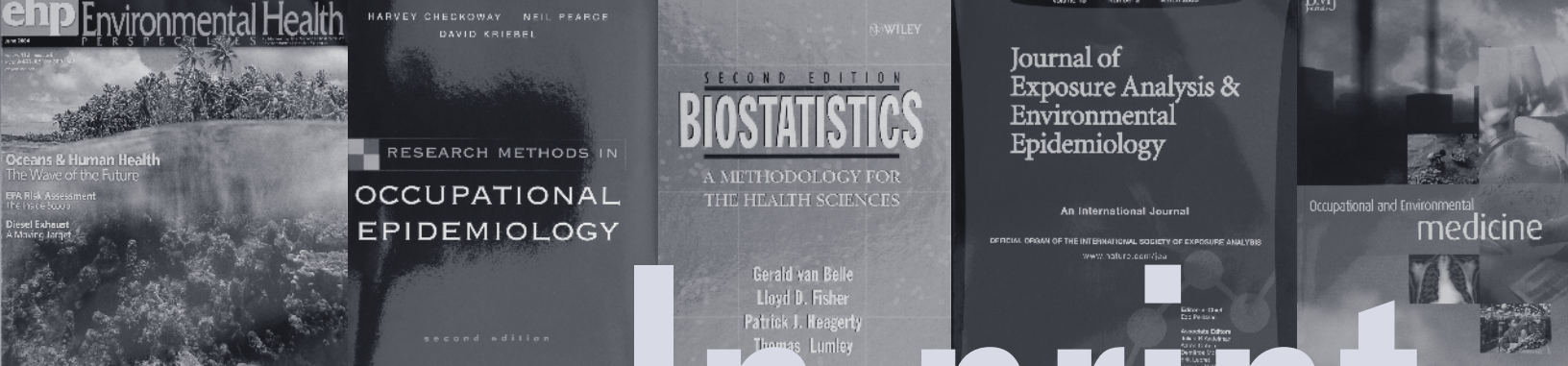
Craig Money Penny

Alon Peretz

Jing Shao

Brian Thompson

Akira Toriba



In print

Selected Publications

JULY 2003 – JUNE 2005

This list includes books, book chapters, articles, and reviews in professional journals. It excludes letters, technical reports, or conference presentations. Departmental investigators are bold-faced.

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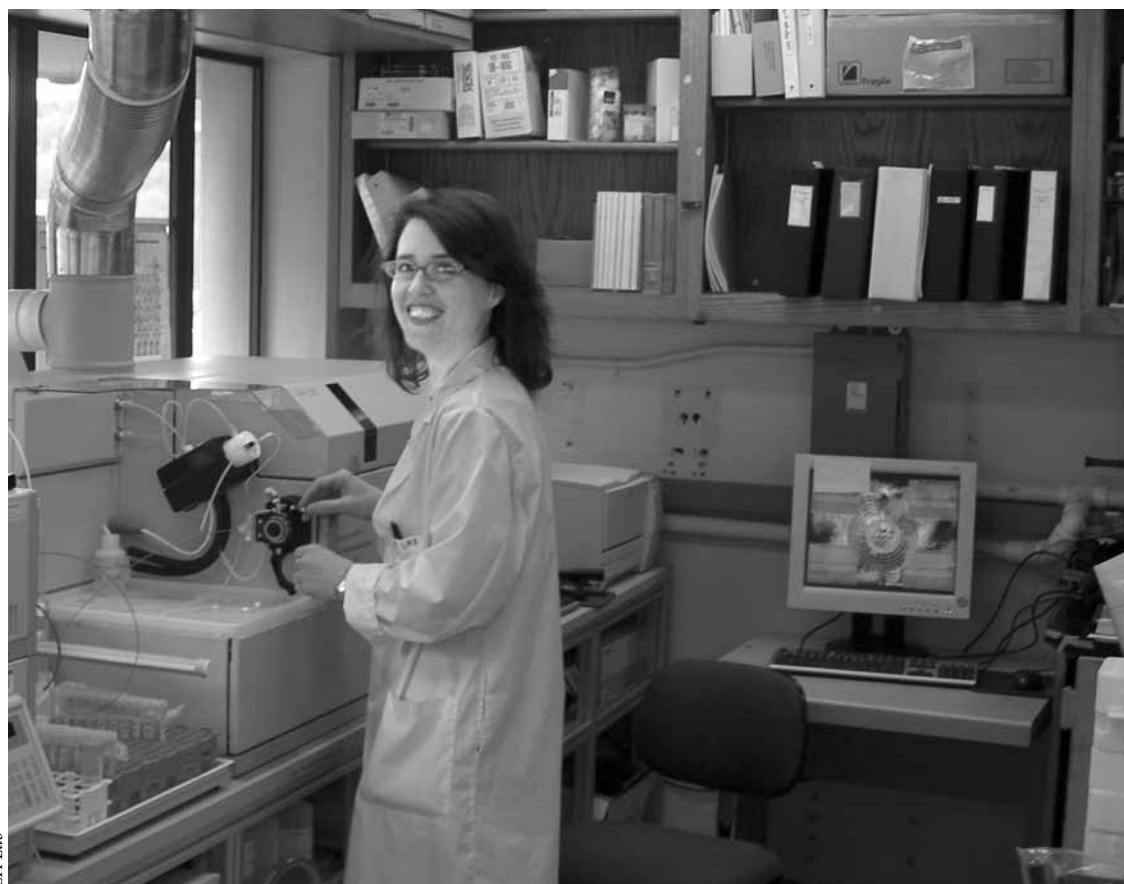
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