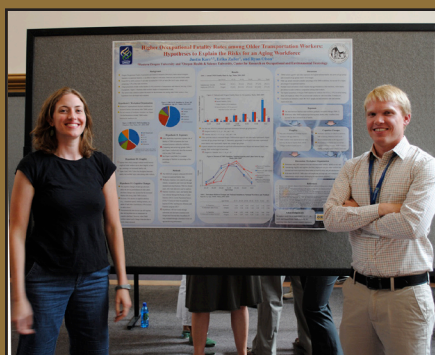


# CROET

Putting science to work for working Oregonians



CROET 2011  
ANNUAL  
REPORT



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# Mission, Purpose, and Mandate

CROET, the Center for Research on Occupational and Environmental Toxicology at OHSU, is dedicated to the promotion of health and safety in the workforce. Through basic and applied research, education, and outreach, CROET seeks to prevent disease and disability among working Oregonians and their families, during their employment years and throughout retirement.

# Message From the Director



Stephen Lloyd, PhD

Over the past two years, I have had the privilege of serving as the Interim Director of CROET, leading a remarkably talented group of faculty, staff and researchers whose collective focus is maximizing Oregon worker safety and health. Even during a time of unprecedented competition for federal funding of investigator-initiated research, our faculty have not only held their own in competing for these funds that greatly augment our state-mandated research, but also have significantly expanded our funding base to better serve Oregonians. To deepen these partnerships and to address these objectives, CROET uses a multidisciplinary approach, combining partnerships with working Oregonians, government organizations including Oregon OSHA, Universities, business and labor. We highly value these working relationships and that help shape and direct our research.

To highlight one of the stellar accomplishments of the previous year, I am extremely pleased to report that Dr. Anger organized and led a diverse team of research scientists, representing OHSU, PSU, UO and Kaiser Center for Health Research in competing for a Center of Excellence grant application to NIOSH (see p. 9). Although at the same time, several pre-existing Centers were submitting competing renewals, the OHSU application was so favorably reviewed in its first submission that it was one of only 4 awards made in the country. The grant, “Oregon Healthy

Workforce Center” was funded for three years, with 1st year annual total costs being over a million dollars. The Oregon Healthy WorkLife Center (ORhwc)’s theme is Intervention Effectiveness, focused on team-based and technology-based interventions to promote and protect health. These interventions are linked to a conceptual model that predicts they will lead to changes in psychological processes that are mediators of behavior change, focused particularly on improved social support and reduced job stress, that will in turn produce improved lifestyle choices, safer work practices, and better psychological and physical health. Interactive education programs will complement the research, and results will be broadly disseminated by ORhwc’s outreach. There is absolutely no question in my mind that this submission would never have happened without the tenacity and leadership of Dr. Anger in collaboration with numerous CROET faculty and staff. This is a testament to his contagious enthusiasm and scientific excellence and vision.

In addition to these accomplishments, over the past year, many of the CROET staff led by Dr. Kent Anger, Dede Montgomery and Dr. Fred Berman have worked with labor and management groups to promote worker safety and health education through seminars, health and safety symposia, worker training, fairs, Oregon OSHA and other local and regional conferences. CROET also continues to provide daily help and educational resources to Oregonians who have concerns about chemical and environmental toxicant exposure through our Toxicology Information Center led by Dr. Fred Berman, Chemical Risk Information Service led by Dr. Greg Higgins, and CROETweb.com led by Dede Montgomery.

CROET continues to be a national leader in research to reduce workplace fatalities through its FACE program led by Dr. Ryan Olson. Funding for these investigators has been competitively renewed in a nationwide competition, recognizing outstanding research that directly impacts the safety of many Oregonians, especially those whose occupations are associated with the highest risks of disabling and fatal injuries.

A significant portion of our faculty engage in basic, applied and translational research, that spans investigations understanding: 1) the fundamental mechanisms of disease including cancer, diabetes, neurodegeneration, hypertension, obesity and neuromuscular dysfunction, 2) regulation of circadian rhythms and sleep, 3) factors that promote safe working environments and on-the-job best safety practices. In support of these research efforts, all of the full-time CROET faculty members are funded through external sources. This is genuinely a remarkable achievement, since it requires applications to be reviewed in the top 5-10% of the national competition for grants and bodes well for ongoing discoveries that will advance the health and safety of all Oregonians.

All of us in CROET want to reiterate our gratitude to the citizens of this state for entrusting us to work with you to help make Oregon such a fantastic place to call home. This report is designed to elaborate on our progress and accountability to our mission during 2011.

Respectfully submitted,

R. Stephen Lloyd, Ph.D.  
Interim Director, CROET

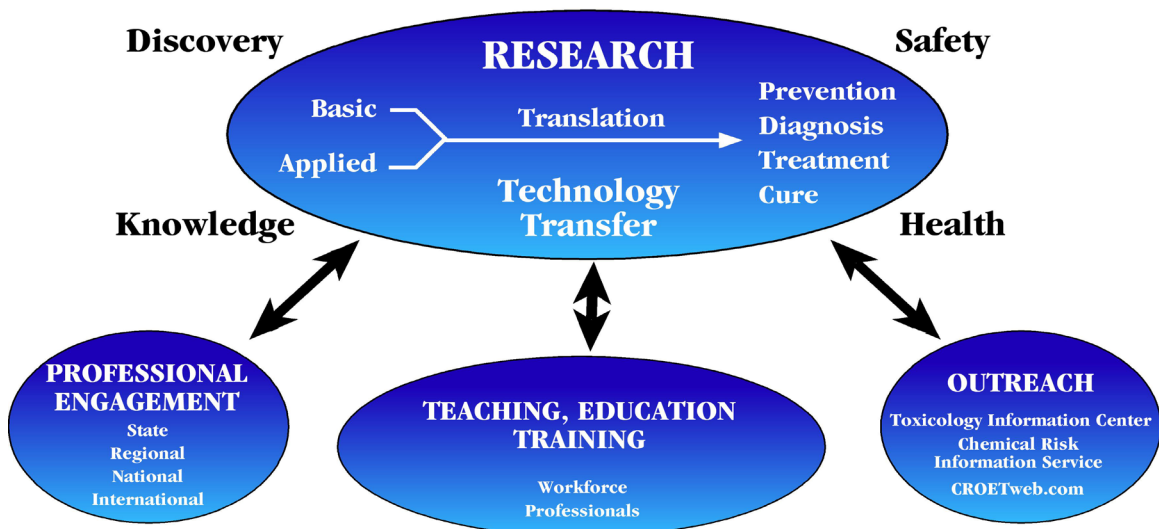
# CROET: a Resource for Oregon

CROET conducts research on the basic biology of workplace-related injury and disease as well as research related to workplace performance and occupational exposure. CROET also participates in doctoral and post-doctoral educational programs to train the next generation of scientists, and provides updates for health and safety specialists to ensure that the latest scientific advances are translated into enhanced workplace safety. Through its outreach efforts, CROET serves as an information conduit to Oregon workers, employers, labor, and the general public.

Applied research addresses workplace hazards, often spurred by specific safety issues of immediate concern to Oregon's workers. Research is focused on surveillance of workplace and environmental problems and on prevention of injury in agriculture, service industries, and construction. This research has short-term payoffs, including, but not limited to: (1) identifying unrecognized trends in Workers' Compensation claims, suggesting new prevention priorities; (2) implementing computer-based training to teach topics such as how to support employees who face abuse outside of work and prevent spillover at work, pesticide effects, and supervisor skills to people with severely limited education as well as very well-educated workers; (3) monitoring agriculture workers for exposure to pesticides and adverse nervous system health effects, and giving safety training to these groups; and (4) conducting wellness programs combined with safety & health objectives to improve worker health and safety in corrections, construction, government, homecare and transportation industries.

Basic research is focused on understanding the fundamental mechanisms of diseases or disorders that underlie cancer, diabetes, neurodegeneration, hypertension, obesity and neuromuscular dysfunction, and to identify the factors that regulate circadian rhythms and sleep. The vast majority of this research is funded through the National Institutes of Health and the National Institute for Occupational Safety and Health, and requires prolonged commitment and synergy among investigators, which ultimately has a long-term payoff. It is applicable to many diseases and disorders, including those that begin in the workplace and those that arise or are exacerbated by other causes (e.g., genetic, environmental) that plague Oregonians during their working years and into retirement. While this is important for Oregonians, it obviously has a wider impact. CROET's influence and impacts are depicted in the graphic below and in the report that follows.

***State Mandate:  
Conduct basic and applied research, outreach and education  
to address Oregon's occupational health needs***



# CROET's Areas of Emphasis

## Education and Outreach programs

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### CROET's Education and Outreach Programs have four goals:

- Provide scientifically accurate information on Oregon's occupational issues — continuously on the Internet and daily with scientific interpretation of complex issues through the Toxicology Information Center (TIC)
- Offer educational programs on Oregon's occupational needs to health and safety specialists, government, and medical providers
- Train health professionals who will investigate Oregon's occupational safety and health issues in the future
- Provide the scientific expertise to help Oregon industry and labor evaluate occupational safety and health questions

## Research

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### Applications and Outreach

- Cellular mechanisms that control sleep-wake cycles relevant to shift workers
- Computer-based and other training methods to enhance worker safety, health & wellness training
- Agriculture, construction, healthcare, high tech, office-related and transportation industries

### Mechanisms of Disease and Dysfunction

- The use of nanotechnology to enhance nerve growth
- Factors that govern the accuracy of nerve synapse formation
- Genetic models of nerve maldevelopment
- Toxicants that disrupt protein transport in neurons
- Biomarkers of pesticide exposures and assessment of pesticide effects on behavior, including attention and memory
- Ion channel mutations that underlie diseases
- Development of models of chronic disease including obesity, fatty liver disease, neurodegeneration and diabetes

### DNA Damage, Genetic Alterations, and Disease

- Role of DNA repair in protecting the nervous system from chemical exposures
- Gene silencing and cancer
- Mutations induced by ionizing irradiation, oxidative stress, and other genotoxins

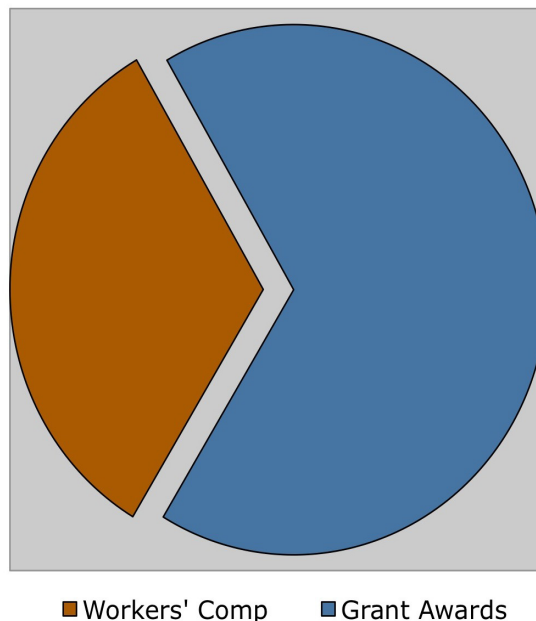


# CROET Highlights

## CROET brings federal dollars into the Oregon economy

CROET receives base operations funding from the Oregon Workers' Compensation System that, year after year, CROET scientists have successfully leveraged to obtain further federal and other research dollars. For every dollar invested by the State's Workers' Benefit Fund in 2010/2011, CROET's world-class scientists brought an average \$2.03 of federal and private grant funding into the Oregon economy (see chart below). Federal dollars for research in Oregon have a significant positive impact on the state's economy. Expenditures for goods and services, as well as the salaries of scientific and support personnel, produce a multiplier effect on the purchase of goods and services and creation of businesses that support the needs of Oregon's research institutions. Moreover, research coming out of CROET has a greater than average impact on the state's economy from the new technologies and jobs that spin off from productive research. In a study conducted by Oregon State University, multiplier effects on the economy from the infusion of federal grant funds were estimated to range from 2 up to 10 dollars per federal dollar received.

**Funding Sources: Income and Awards 2010/2011**



## Workplace studies and applications research

CROET conducts workplace surveys so that prevention and research needs can be identified, and applications research to bring the benefits of science to the workplace floor. It also reaches out to provide education and information to the Oregon workforce and beyond.

## Oregon Fatality Assessment and Control Evaluation (OR-FACE) Program

Dr. Ryan Olson is the director of the Oregon Fatality Assessment and Control Evaluation (OR-FACE) program (funding from NIOSH), and began a "tool box talk" initiative focused on fatal falls in residential construction. The aim is to create and evaluate one-page guides, based on Oregon fatality cases, which can be used by front line supervisors to promote safe behaviors and conditions at worksites. The OR-FACE program is designed to prevent occupational fatalities through surveillance, targeted investigation, assessment, and outreach that are associated with traumatic work-related deaths in Oregon. OR-FACE is one of only nine state-based FACE programs supported by a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH).

## Safety Researchers Address Hazards for Oregon Crab Fishermen



Ryan Olson, PhD

The (OR-FACE) program at CROET, in partnership with the Field Research Group at the University of Washington, obtained a grant from the Pacific Northwest Agricultural Safety and Health Center (PNASH) to conduct a safety survey and field test a selection of personal flotation devices with Oregon crab fishermen. The U.S. Coast Guard, the Oregon Dungeness Crab Commission, and researchers at the National Institute for Occupational Safety and Health Alaska field station were also included in the project team.

The Oregon Dungeness crab fishery represents one of the most dangerous work environments in the US, with most fatalities (79%) resulting from capsized vessels while crossing river bars or working near shore. During the period 2003-2009, 14 deaths were recorded. None of the 14 drowning victims were wearing a personal flotation device at the time of the incident. A study, the Oregon Crab Fishing Safety Assessment, was conducted to (1) administer a survey to commercial Dungeness crab fishermen and solicit their experiences and perspectives on critical safety issues specific to the Oregon crab fishery, and (2) field test the usability and acceptability of current, commercially available Personal Flotation Devices (PFD). The results of the study identified three important areas where additional efforts can be made to prevent drowning related fatalities in the Dungeness crab fishery: (1) encourage PFD use among fishermen; (2) increase the frequency of safety training and onboard safety drills; and (3) improve captains' understanding of vessel stability. Additionally, this project also established new connections within the Pacific Northwest fishing industry, and built upon existing academic and government partnerships, for continued research and safety interventions by project team partners.

## SHIFT Program for Truck Drivers Funded

With new funding from the National Heart, Lung and Blood Institute (NHLBI), the Olson lab kicked off a randomized controlled trial of a weight loss and health promotion program for truck drivers called Safety and Health Involvement for Truckers (SHIFT). This year the SHIFT program was also featured as the cover story in Healthy Trucking Magazine (October 2011). In addition to the SHIFT study, Dr. Olson's group is leading a research project within the new Oregon Healthy Workforce Center (funding from NIOSH), which is aimed at creating neighborhood-based health and safety teams for home care workers. If successful, these teams will provide workers with a sustained source of education and social support for occupational health.

## Pesticide Exposure

### Assessment of Health Effects of Children Living in an Agricultural Community



Diane Rohlman,  
PhD

Organophosphorus pesticides (OPs) are used extensively in agriculture throughout the world, including in Oregon. There is increasing concern regarding the use of pesticides in agricultural communities and potential impacts on public health. OPs are among those of greatest concern, due to their persistence once in the home and their established neurotoxic effects. There is compelling evidence that repeated (chronic) low-level occupational and environmental pesticide exposures are associated with neurobehavioral performance deficits in adults. Children of farmworkers are presumed to be exposed to pesticides throughout development, and this exposure may produce subtle health effects that would not be detected by clinical examinations nor recognized by parents. A study conducted by Dr. Diane Rohlman and funded by the National Institute of Occupational Safety and Health (NIOSH) through the Pacific Northwest Agricultural Safety & Health Center, examined health effects in children living in an agricultural community. This project

established relationships within an agricultural community, built a cohort of 300 agricultural families and controls living in the same community, and assessed the exposure of children and the impact on their development. Measures of dust in the homes where members of this cohort lived revealed a range, from relatively high to very low levels, of several pesticides that would put crawling children at risk of exposure and similarly increase risk for the adults. Training on ways to reduce pesticide exposure at home and work were developed in Spanish and English and presented to several hundred members of the community who attended the county fair.



W. Kent Anger,  
PhD

CROET was awarded a grant as a NIOSH Center of Excellence in total worker health, a new term that supports the development of workplace interventions that target, in a single program, improving safety, occupational health and personal wellness. To compete for the grant, CROET partnered with OHSU's Division of Health Promotion, Portland State University's Occupational Health Psychology program (OHP), the Kaiser Permanente Center for Health Research (Portland) and the University of Oregon's Labor Education and Research Center (LERC). CROET's Kent Anger is the Principal Investigator (PI) of the grant and Director of the Center, Leslie Hammer of Portland State University is the Associate Director, and OHSU's Diane Elliot is the Chair of the Internal Steering Committee.

The Oregon Healthy WorkForce Center's theme is "Intervention Effectiveness". There are four funded research projects, largely focused on team-based and technology-based interventions to promote and protect health, all crafted with attention to translating research to practice. From a theoretical perspective, we focus particularly on improved social support designed to reduce job stress--that will in turn produce improved lifestyle choices, safer work practices, and better psychological and physical health. Each project PI has developed methods, technology and interventions to improve the workplace, and, through this new Center these investigators are applying these programs in research or translational projects. The methods and measures used by each researcher overlap to allow cross-comparisons between projects.

The 4 projects funded by NIOSH as part of this Center, are:

- Creating health and safety "Communities of Practice" for Home Care workers (Ryan Olson, PI) - uses a peer-led curriculum to organize home care workers into neighborhood-based WorkLife teams that provide education and social support for improving lifestyle (e.g., diet, exercise) and safety behaviors
- Team-based WorkLife and safety intervention for construction workers (Leslie Hammer, PI) - trains supervisors using a team-based approach to support balance in employee's work-family demands, thus reducing stress and improving safety in City of Portland construction workers.
- Health promotion and health protection in young workers (Diane Rohlman, PI) - uses internet-delivered training to foster healthy lifestyle choices and safe work practices in young summer workers in a Parks and Recreation department, enhancing dissemination with social media.
- Health promotion intervention to reduce health risks among Correctional officers [Kerry Kuehl, PI] - uses a team-based peer-led approach in corrections workers, plus one-on-one health coaching with motivational interviewing, to improve lifestyle (e.g., diet) choices in workers at higher risk of health problems.

An added value of the Healthy Workforce Center is the creation of a database of related intervention strategies and common measures housed in a data repository for sharing within and outside the Oregon Center. This will allow the Center to examine how the various interventions achieve their effects on health promotion and health protection. The Center's Design and Analysis Core, led by Nancy Perrin of Kaiser's Center for Health Research, will ensure that all projects are conducted as they were designed, as randomized controlled trials, considered the strongest scientific approach to study interventions designed to improve health or safety. The most innovative educational aspect of the Center is the Summer Institute aimed at educating scientists and practitioners in occupational health psychology, led by Leslie Hammer and supported by Center Manager Kendra Evans, Steve Hecker (LERC) and CROET's Dede Montgomery, who lead the educational and outreach components of the new ORhwc.

Critical to the success of our application was CROET's history of state funding that supports CROET's faculty and allows them to conduct the preliminary research they developed to support their proposals, which impressed the review committee, and the pledge of CROET funds to supplement the work of the proposed Center and hire an additional faculty member to conduct total worker health research. Funded in September, 2011, this is the fourth Total Worker Health Center in the US, and the only one west of Iowa. With it we take on an important responsibility to the nation that seeks to improve the health, safety and personal wellness of its workforce, a step that will most certainly improve the satisfaction and productivity of the individual workers and the US workforce as a whole. That Oregon will participate in the research and be the first to enjoy the benefits of the Center's work is certainly satisfying to the members of the Oregon Healthy WorkForce Center.



## CROET Scientists Study Training Effectiveness in 27 Oregon Counties



Training effectiveness — the extent to which knowledge and behaviors can be changed in a positive direction through training — is critically important to those interested in preventing injury and lost productivity in the workplace. For the past several years, CROET's Drs. Kent Anger and Diane Rohlman have been conducting training effectiveness research in a variety of occupational sectors, most notably in Oregon's agricultural community. Recently, they have turned their attention to the issue of domestic violence in the workplace. The project is being conducted jointly by Johns Hopkins University, Oregon Health & Science University and the Kaiser Center for Health Research (Portland, OR), and is funded by the National Institute for Occupational Safety and Health (NIOSH). Domestic violence (DV) - mental or physical abuse at the hands of a current or

former intimate partner - is a serious public health problem affecting an estimated one-third of Oregon women between the ages of 20 and 55. And women are not the only victims of DV—it has been estimated that 40% of DV is perpetrated by women against men. DV also affects the workplace. It results in serious negative health, safety and employment dilemmas for victims. Moreover, DV is costly to the workplace because of absenteeism and lost productivity of both victims and perpetrators of violence.

To help victims address DV, several states have passed DV leave laws. Oregon became one of those states on May 25, 2007, passing a law that allows survivors of DV, sexual assault and stalking to take unpaid leave from their jobs to get services or treatment. To provide training to support this law, the CROET research team visited up to 4 counties per week to provide computer-based training on the Domestic Violence and the Workplace intervention funded by the NIOSH grant. The training was based on research and interviews conducted in Oregon of 300 victims of DV and 200 perpetrators, by Dr. Nancy Glass of Johns Hopkins University. The training is focused on making the workplace safe for victims of DV and for other employees who might be endangered by the perpetrators coming to the workplace. The training tracked knowledge improvement, leave usage, and safety climate as measured by survey questions and walkthroughs of the county buildings to identify evidence of support for victims of DV. Over a 3-month period, more than 950 supervisors and managers in Oregon's county governments completed training and showed substantial gains in knowledge about the Federal Family Medical Leave Act (FMLA) and DV in the workplace. In most cases, participants improved to 95-100% correct scores at the end of the training. The training was delivered in 27 of 36 Oregon county governments; 9 declined to participate due mostly to recent staff losses in Human Relations, which would have collected the leave data. Training in Clackamas county is pictured above.

In addition to computer-based training, the CROET research team invited victims of domestic violence to have private interviews to describe their abuse experience and to describe how they used the law, for example, for leave. Supervisors and managers were each interviewed to describe their experiences with victims and/or perpetrators of violence and to describe how the law has positively or negatively impacted the workplace. These assessments are revealing how serious a problem DV is in the Oregon workplace. And perhaps most importantly, participants will have been given tools to effectively address DV spillover into the workplace.

### Highlights - Oregon Crime Victims' Leave Law (May 2007)

The Oregon crime victims' leave law protects employees who are also victims of certain crimes (domestic violence, sexual assault, stalking). This law applies to employers with six or more employees:

- The crime victims' law requires employers to grant an eligible employee a "reasonable" leave of absence if the employee or the employee's minor child or dependent needs time off to deal with issues of domestic violence, sexual assault, or stalking. These arrangements might include seeking medical treatment, obtaining counseling, relocating, getting legal advice or contacting law enforcement personnel.
- Like the Oregon Family Leave Act (OFLA) and the Federal Family and Medical Leave Act (FMLA), crime victims' leave is unpaid. However, as with OFLA and FMLA, the employer must allow or require an eligible employee to utilize vacation time or other paid leave for this purpose.
- As with all other kinds of protected leave, an employer cannot retaliate against an employee for using the leave.

## Outreach and Education

CROET has proactively engaged to provide timely occupational health and safety information to employees, employers, health and safety professionals, doctors and nurses.

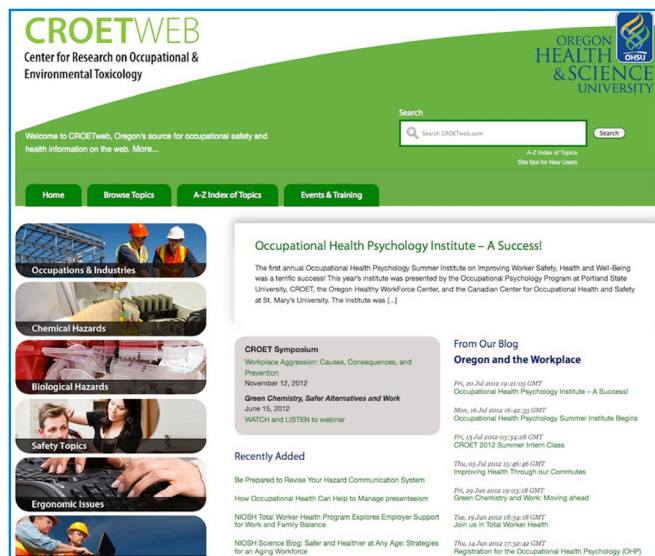
### CROETweb.com



Dede  
Montgomery, MS,  
CIH

CROETweb.com is an occupational safety and health resource directory that contains links to over 1200 occupational safety and health resources focused on day-to-day workplace issues. CROETweb serves thousands of users who regularly bookmark this resource, those who subscribe to the monthly electronic newsletter, and those seeking information by search engine (e.g. Google) for occupational health and safety topics on the web. It is widely recognized and respected by industrial health and other safety professionals as well as the general public, based on feedback from user groups. CROETweb was redesigned at the end of 2011. CROETweb had 98,000 total page hits and an average of 7,000-9,000 monthly page hits.

- The most popular topic pages during 2011 included Safety Inspections for Manufacturing and General Industry, Hospitality – Hotel, Restaurant and Kitchen, and Materials for Safety Talks.
- New topics in 2012 included Total Worker Health and Wellness and numerous subtopics.
- The Emerging Issues page, created in 2010 and summarizing work and documents related to the topic of hair smoothing products containing formaldehyde continued to be a popular internet resource, receiving approximately 10,800 page views during 2011.
- CROET's social media program expanded in mid-2011 to add a Twitter account and a blog, Oregon and the Workplace, to the existing Facebook presence. The Oregon and the Workplace blog provides information about ongoing CROET activities in brief paragraphs or bullets with a picture depicting the event. It received 4,200 page views from August – Dec. 2011.



## Health and Safety Training Symposia

CROET provides two health and safety symposia per year, one sponsored jointly with Portland State University. Topics are determined based on solicited and unsolicited feedback from the Oregon occupational health and safety professional community. The target audience includes health, safety and environmental professionals, although the targeted group varies based on the symposium topic. The purpose of the symposia is to provide timely, up-to-date presentations, forums and discussions on workplace safety and health issues. CROET presented the following symposia series in 2011:

### **Innovations in Safety Climate**

Presented by CROET and Portland State University  
Friday, October 28, 2011  
University Place, PSU, Portland, Oregon

### **Innovative Communications & Messaging**

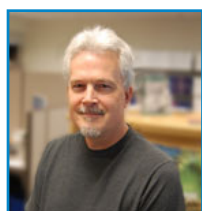
Presented by CROET  
Friday, June 3, 2011  
NECA/IBEW Training Center, Portland, Oregon

## Regional Health and Safety Conferences

OR-OSHA sponsors the majority of health and safety conferences that CROET attends; these conferences are an important means by which CROET reaches out to working Oregonians. Workers and businesses learn about CROET and what it has to offer, and CROET personnel learn about the needs and concerns of workers and the industries that employ them. CROET scientists are often asked to give health and safety presentations in addition to providing conference exhibits. Overall, conferences represent a tremendous networking opportunity for CROET outreach personnel. The following page lists safety and health conferences attended by CROET in 2010-2011:

- Northwest Ag Show
- Northwest Environmental Health Conference
- Oregon Governor's Occupational Safety & Health Conference (GOSH)
- Blue Mountain Occupational Safety & Health Conference
- Central Oregon Occupational Safety & Health Conference
- Oregon Small Business Fair
- Southern Oregon Occupational Safety & Health Conference
- 2011 Northwest Occupational Health Conference
- Western Pulp and Paper Workers Safety & Health Conference
- Oregon Workers' Compensation Educational Conference

## Toxicology Information Center (TIC)



Fred Berman,  
DVM, PhD

CROET's Toxicology Information Center (TIC) is directed by Dr. Fred Berman. The TIC provides a vital outreach function to citizens and professionals by responding to their inquiries about the potential hazards from exposure to chemicals and other agents. The goal is to provide up-to-date, unbiased information in a form that is understandable and useful. In 2011, Dr. Berman handled hundreds of consultation requests from occupational safety and health professionals, business owners, government agencies, physicians and nurses, the media, and the general working public. Inquiries covered a variety of issues. Chemical agents of concern included solvents, heavy metals, insecticides, fungicides, and herbicides. Physicians often called seeking information on a variety of potentially occupation-related health complaints. Each request took from less than an hour up to several days to respond to fully. The TIC is open from 7:30 a.m. to 4:00 p.m., Monday through Thursday. Walk-in visitors have access to a variety of resources, including computers, databases, government reports, textbooks, and journals that are devoted to toxicology-related issues and occupational health.

In addition to the TIC, Dr. Berman serves as consultant to the Oregon Department of Agriculture's Pesticide Analytical and Response Center (PARC), which is legislatively mandated to address pesticide-related incidents in Oregon that have suspected health or environmental effects (<http://www.oregon.gov/ODA/PEST/parc.shtml>). Dr. Berman is also a co-investigator with the National Pesticide Information Center (NPIC), a U.S. Environmental Protection Agency-sponsored project operated cooperatively with Oregon State University. NPIC provides objective, science-based information about pesticides and pesticide-related topics to enable people to make informed decisions about pesticides and their use (<http://npic.orst.edu/>).

## CROET's Chemical Risk Information Service



Gregory Higgins,  
PhD

OSHA regulations require employers to maintain Material Safety Data Sheets (MSDS) for the hazardous chemicals used in their workplace. This often proves to be a difficult record-keeping task, and it can be burdensome to ensure that employees have quick access to health and safety information in the workplace when they need it. Since 1998, CROET's Chemical Risk Information Service, directed by Dr. Gregory Higgins, has helped a growing number of local and international industries manage and distribute chemical safety information through its internet-based MSDS management system. CROET's working relationship with the Oregon Poison Center also ensures that employees covered by the program have ready access to medical information in the event of exposure. During 2011, the Chemical Risk Information Service added 2 new construction clients, and now provides MSDS management services to 43 municipal, construction, and service companies, most of which are Oregon-based. We also began an update of our advanced program with Portland METRO in 2011, and we are in the process of working with METRO to update their complete inventory and MSDS records. We developed two new programs to serve clients in different service areas during 2011. We developed a risk evaluation and management program for the OHSU Department of Comparative Medicine to help them manage risks to their employees who handle animals treated with potentially toxic chemicals and drugs. We also began work with the Western University College of Osteopathic Medicine Pacific Northwest to help them develop safety plans and procedures for their laboratory operations in Lebanon, Oregon. CROET continues to provide expert management services at a reasonable cost, which is attractive to both small and large organizations.



## OHSU Let's Get Healthy! Program



Jackilen  
Shannon, MPH,  
RD, PhD

Dr. Shannon, through her work as Director of the Let's Get Healthy! Program and cancer prevention research, continues to impact the lives of thousands of Oregonians. Over the past year, "Let's Get Healthy!" visited middle schools in the West-Linn Wilsonville and Bend-LaPine school districts, community members in areas ranging from Portland to Hermiston to Madras, and held their first event just for healthcare workers at the St. Charles Health System in Bend, OR. The reach of this program continues beyond the borders of Oregon, to Washington State, Kansas, Pittsburgh, Pennsylvania and again, in April 2012, to the USA Science and Engineering Festival in Washington, DC. By April 2012, over 10,000 individuals had engaged with the Let's Get Healthy! Program, learning about their diet, body composition, sleep patterns and cardiovascular risk. New this year are modules on breast cancer prevention, memory and attention, and an exciting "Mario" style video game to teach middle school children and others about skin cancer prevention. In addition, the "Let's Get Healthy" program became the OHSU recipient of the NIH Science Education Partnership Award. As part of this five year award the web-based component of "Let's Get Healthy!" will be expanded and modified to allow students, teachers and community members to utilize data from any or all "Let's Get Healthy!" events. Check the CROET website or [www.letsgethealthy.org](http://www.letsgethealthy.org) for upcoming events and opportunities to volunteer.

In addition to work in the community, Dr. Shannon continues to pursue her work in nutrition and cancer prevention. This past year she completed a clinical trial of fish oil, green tea and early prostate cancer risk and will be wrapping up a trial of broccoli sprout supplementation in women with early stage breast cancer in the coming year. Analyses are ongoing for both of these projects.

## Mechanisms of Disease and Dysfunction

Chronic disease takes a significant toll on our workforce just as it does in the broader community. CROET research seeks to discover causes of chronic diseases that are produced or exacerbated by workplace factors and identifies processes or procedures that can prevent or ameliorate those diseases and improve workplace safety.

## Recovery of the nervous system following injury



Bruce Patton,  
PhD

Damage to nerves and muscles is the primary cause of workplace disability in the United States. In a typical year, five million workers (4%) are injured on the job. Four million (80%) of these involve debilitating pain and/or dysfunction from neuromuscular injuries, including trauma, tears, strains, and musculoskeletal disorders (<http://www.bls.gov>). Nearly half require a lengthy recuperative period, substantially diminishing productivity and increasing medical costs to employers and employees. Dr. Bruce Patton's laboratory is investigating molecular pathways that promote muscle stability and innervation. The overall goal is to identify molecular targets for reducing susceptibility to nerve and muscle injury and improve recovery for people who are injured.

Nerves regenerate slowly and imperfectly in humans. Peripheral nerves are typically injured in workplace settings through trauma, toxic exposures, and chronic disuse and compression syndromes, such as carpal tunnel. Peripheral nerves contain specific arrangements of large myelinated axons and small unmyelinated sensory axons. The unmyelinated axons ("C fibers") are particularly slow to regenerate after injury, and are responsible for long-lasting pain sensation and hyperalgesia (increased sensitivity to pain). Each unmyelinated nerve fiber includes a set of thin sensory axons embedded within the folds of a special form of glial cell, the nonmyelinating Schwann cell. Schwann cells are thought to play a critical role in promoting nerve regeneration following injury. However, little is known about the biology of nonmyelinating Schwann cells, how they become allied with unmyelinated axons, or how they may support nerve regeneration following injury. The Patton lab recently discovered two cell surface proteins that together activate nonmyelinating Schwann cells to properly ensheath the unmyelinated C- fibers. Using genetic mutations in mice, they found that a cell surface matrix protein called laminin-411, and a membrane receptor called CD44, were independently required for nonmyelinating Schwann



cells to form the branching network of processes that normally isolate each C-fiber in separate membrane pockets. Additional work in cell culture suggest that these proteins regulate the sensitivity of nonmyelinating Schwann cells to a key axon-derived growth factor called neuregulin. Further work aimed at identifying the mechanisms by which these signaling pathways interact to promote the proper interaction between Schwann cells and regenerating axons will provide novel therapeutic approaches towards improving long-term functional recovery from workplace injuries.

## Circadian Cycles Research



Charles Allen,  
PhD

In humans, many physiological processes cycle with a period of twenty-four hours. These circadian rhythms are driven by an internal biological clock, which cause us to be active during the day and sleep at night. Short-term disruption of the circadian rhythms can lead to higher rates of on-the-job accidents, impairments in cognitive function, including poor decision-making, disruptions in hormone activity, and gastrointestinal distress. Long-term disruption of the circadian system contributes to the development of breast and colorectal cancer, cardiovascular disease, mood disorders and a number of metabolic derangements including diabetes. A small brain region structure called the suprachiasmatic nucleus (SCN) contains a molecular time-keeping mechanism that drives biological circadian rhythms. This biological clock sends signals throughout the body that coordinate circadian rhythms in many different tissues and organs.

The long-term goal of work in the lab of Dr. Charles Allen is to identify the cellular mechanisms underlying the generation and control of circadian rhythms. Successful completion of his work will provide a better understanding of the mechanisms underlying regulation of circadian processes such as sleep. This knowledge can lead to better and more rational treatment of circadian based sleep and mood disorders and safer shift work schedules. Generation of circadian timing signals in the suprachiasmatic nucleus (SCN) depend on transcriptional repression by the Period (PER) 1 and 2 proteins within single cells and on vasoactive intestinal polypeptide (VIP) signaling between cells. In collaboration with a research team at Washington University in St. Louis led by Dr. Eric Herzog, Dr. Allen's team tested signaling pathways required for VIP-mediated entrainment of SCN rhythms. VIP reset PER2 rhythms in a time- and concentration-dependent manner that differed from light. Unlike VIP-mediated signaling in other cell types, simultaneous antagonism of adenylate cyclase (AC) and phospholipase C (PLC) was required to block the VIP-induced phase shifts of SCN rhythms. Using single cell imaging methods it was found that VIP rapidly increased intracellular cyclic AMP in most SCN neurons. It was concluded that VIP controls the individual circadian clocks in SCN neurons through rapid and parallel changes in AC and PLC activities.

## Loss of Circadian Clock Accelerates Aging



Doris  
Kretzschmar, PhD

Circadian clocks are found in almost any species and affect many cellular and behavioral rhythms. Disruptions in circadian rhythms have been described in neurodegenerative diseases but also in normal aging, however it is unclear whether this is a mere consequence of aging and disease or whether it is actively aggravating these processes or even causing them. To address this question, CROET's Doris Kretzschmar and colleagues led by Dr. Giebultowicz at Oregon State University have combined *Drosophila* mutants that interfere with the circadian clock with mutants showing age-related neurodegeneration and studied the effects on longevity, mobility, and degeneration. They have shown that disrupting the clock dramatically shortened the lifespan, accelerated the age-dependent decline in mobility, and enhanced neuronal degeneration. This suggests that disruptions in the circadian clock might actively lead or at least promote these deleterious health outcomes. This indicates that interfering with our endogenous

rhythms by shift work and trans-meridian travelling such as long distance air flights might have very negative effects on our health as we age. This work was accepted for publication at the end of 2011 (Krishnan, N., Rakshit, K., Chow, E.S., Wentzell, J.S., Kretzschmar, D., Giebultowicz, J.M., 2012. Loss of circadian clock accelerates aging in neurodegeneration-prone mutants, *Neurobiol Dis.*).

## Organic Solvents and Cyanide Metabolites Aid our Understanding of Neurological Disorders



Daniel D. Tshala-Katumbay, MD, PhD

Workers exposed to certain organic solvents (such as n-hexane and 1,2-diethylbenzene) or metabolites of cyanogenic compounds can develop nerve and spinal cord damage that lead to a crippling disease known as peripheral neuropathy. While n-hexane neuropathy is all too common today in certain low- and middle-income countries, improved workplace practices have greatly reduced the disease from U.S. industry. The markers and burden of disease associated with workplace exposure to cyanogenic compounds are, however, yet to be elucidated. Now, the neurotoxic metabolites of n-hexane, 1,2-diethylbenzene, or cyanide, are used as valuable laboratory tools with which to probe the vulnerabilities of the nervous system. The detoxification products (metabolic byproducts) of such solvents, or those of cyanide, induce abnormal modifications of proteins in the nervous system. Dr. Tshala-Katumbay's research group has used state-of-the-art proteomic tools to identify these aberrant protein modifications and have developed small molecules to be tested for their potential to protect neurons from these adverse effects. Potentially neuroprotective molecules were selected and linked through chemical conjugation to a synthetic analog of the non-virulent C fragment of tetanus toxin (Tet1). Tet1 is known to be transported specifically to neurons in the central nervous system; therefore, any molecule linked to Tet1 will theoretically be targeted to these neurons as well. Potentially neuroprotective molecules linked to Tet1 were screened for delivery to neuron targets and were found to be successfully and specifically delivered to nerve cells in experimental models (patenting in progress). Ongoing studies will determine whether the neuroprotective effects of these molecules are seen in experimental models relevant to the neurotoxicity mechanisms associated with exposure to industrial solvents or cyanogenic compounds.

## DNA Damage, Genetic Alterations and Disease

Human health and risk for disease ultimately depend on the integrity of our DNA, the genetic material that provides the body's blueprint for manufacturing proteins that carry out the function of cells and organs. Aberrant forms of DNA can produce inherited diseases, and changes in DNA during life are believed to trigger cancer and many other chronic diseases. Such changes can result from exposure to certain chemicals found in the workplace and others in the diet and medications, and to sunlight in outdoor workers. Two broad types of DNA changes are recognized: DNA damage and DNA silencing.

## CROET Senior Scientist Works at Department of State



Mitchell Turker, PhD, JD

Dr. Mitchell Turker represented CROET and OHSU at the Department of State from August 2010 to August 2011 as a Jefferson Science Fellow funded by Congress. This program funds a dozen senior scientists each year from around the country to help advise State Department offices on a variety of issues that involve science. Dr. Turker worked in the Office of the Geographer and Global Issues within the Bureau of Intelligence and Research during his fellowship year. His projects included participating in an interagency team preparing the United States position for the World Health Organization's Pandemic Influenza Preparedness Framework negotiations, studying potential chemical attacks on girls' schools.

## Clues to Fighting Cancers

A long held assumption in cancer research is that mutations cause cancer, and therefore environmental exposures that increase mutations will also increase the risk to develop a cancer. Dr. Turker's research with ionizing radiation has shown that this relationship can be more complicated. His laboratory has been investigating mutation formation in two organs that have different susceptibilities to radiation-induced cancers. Although the lung is more sensitive to cancer after radiation exposure than the kidney, Dr. Turker has found that the kidney is more sensitive to radiation-induced mutations. Future research to determine why kidney cells can accumulate mutations without developing cancer could provide clues to help fight cancers caused by workplace and other environmental exposures.

## Drug Discovery Program Screens 400,000 Molecules



R. Stephen Lloyd,  
PhD

Cancer is the second leading cause of death in the United States, with over 1,500,000 new cases reported in 2010, a figure that does not include the 1,300,000 new cases of non-melanoma skin cancers diagnosed each year. Lifetime probabilities of having cancer are nearly 50% for men and 35% for women, and this results in greater than 600,000 deaths in the United States each year, nearly 25 percent of all deaths. The nationwide costs for treating and managing these diseases are estimated to be in excess of \$264 billion per year. In 2010, more than 21,000 Oregonians were diagnosed with a new cancer and more than 7,500 died as a direct result of these diseases. Many of these cancers are at least partially the result of environmental toxicant exposures, (including those found or experienced in the workplace such as polycyclic aromatic hydrocarbons, butadiene, and formaldehyde) making their prevention and effective treatments a high priority for research in the Lloyd laboratory. A major focus in the laboratory has been to identify more effective cancer treatments that use chemotherapeutic agents.

When an individual is diagnosed with a cancer related to exposure, it is the end result of a complex series of events that are related to occupational and environmental exposures to toxic agents combined with the genetic makeup of that individual to either succumb to or fight off the cancer. Once such a diagnosis has been made, treatments often include a combination of surgery, radiation therapy and chemotherapy, all of which are designed to kill (or remove) the cancer cell, but spare as much of the normal healthy tissue as possible. The fundamental concept underlying radiation and chemotherapy is to so severely damage the DNA of the cancer cell that it can no longer replicate (reproduce and grow) and incur so much damage that it dies. However, often cancer cells have adapted special mechanisms that thwart these approaches and one of those mechanisms is to produce large amounts of a substance (enzyme) that ignores the DNA damage and allows the cancer cells to keep growing. This enzyme is called a DNA polymerase. In order to improve cancer therapies, the Lloyd laboratory has initiated a drug discovery program that will identify new drugs to shut off the activity of the DNA polymerases and allow the chemotherapeutic agent to kill the cancer cells. This year they have screened over 400,000 candidate drug molecules for potential therapeutic efficacy, with more than 500 candidate drugs already identified. The immediate goal is to determine which of a small subset of these (~500 drugs) can be further refined and eventually used in human cancer trials.

## Reducing Formaldehyde Damage to DNA



Amanda  
McCullough, PhD

Formaldehyde is a reactive chemical that is commonly used in the production of industrial, laboratory, household, and cosmetic products. Inhalation of formaldehyde-containing products is associated with elevated cancer, asthma and nasopharyngeal irritation. Based on the association between formaldehyde exposure and increased incidence of cancers, formaldehyde has been classified as a known human carcinogen. Although it is well established that formaldehyde induces damage to the DNA within cells, little is known about the cellular and genetic changes that can lead to formaldehyde-induced cell death and genetic damage. The McCullough laboratory investigates how cells respond to the deleterious effects of formaldehyde exposure. Recent studies have revealed that there is a specific subset of genes that are critical for repairing formaldehyde-induced DNA damage following an acute high-dose exposure. These studies also demonstrated that cells immediately stop growing prior to cell division. This growth arrest presumably allows cells to repair the DNA damage; however, even in normal repair-proficient cells, formaldehyde exposure can result in cells that contain an abnormal number of chromosomes, a condition frequently found in cancerous cells. Additionally, an elevated number of DNA double-strand breaks, chromosomal breaks, and abnormal chromosome structures were observed in DNA repair-deficient cells following formaldehyde treatment. Collectively, these findings illuminate the role of a specific DNA repair pathway in reducing the sensitivity to formaldehyde-induced DNA damage as shown by the increased genomic (chromosomal) instability and reduced cell viability. These studies have demonstrated a possible mechanism for the causal relationship between formaldehyde exposure and human disease.



## CROET Expenditures Fiscal Year 2010/2011

Workers' Compensation Expenditures		Federal and Other Grant Expenditures	
<b>Salaries</b>		<b>Salaries</b>	
Salaries - research (15% of all salaries)	583,487	Salaries - research (67% of all salaries)	2,598,955
Salaries - outreach (2% of all salaries)	110,318	Salaries - outreach (<1% of all salaries)	9,134
Salaries - education (2% of all salaries)	69,356	Salaries - education (<1% of all salaries)	5,374
Salaries - administration (9% of all salaries)	326,189	Salaries - administration (4% of all salaries)	143,491
Salaries - core services <sup>1</sup> (<1% of all salaries)	17,624	Salaries - core services (<0% of all salaries)	0
<b>Supporting Services (includes cores)</b>		<b>Supporting Services (includes cores)</b>	
Supplies and equipment	291,886	Supplies and equipment	1,309,868
Miscellaneous support <sup>2</sup>	72,971	Miscellaneous support <sup>2</sup>	327,467
<b>Outreach and Education</b>		<b>Outreach and Education</b>	
Services, supplies and equipment	392,690	Services, supplies and equipment	0
<b>Other Expenses</b>		<b>Other Expenses</b>	
Bond principal & interest	353,481	Building operations & maintenance	0
OHSU administrative charges	0	OHSU administrative charges	299,834
<b>Total</b>	<b>\$2,218,002</b>	<b>Total</b>	<b>\$4,694,123</b>

## Programs Fiscal Year 2010/2011

	Amount paid by W/C	Amount paid by grants	Total Cost
<b>Outreach and Education</b>			
Information dissemination (e.g., TIC <sup>3</sup> , website, newsletters, brochures)	398,412	9,134	407,546
Education & training programs (professional & para-professional)	112,666	5,374	118,040
Chemical risk information service <sup>5</sup>	61,286	0	61,286
<b>Basic and Applied Research</b>			
Factors that affect workplace performance	224,859	1,001,008	1,225,867
Damage and repair of the nervous system and muscle	108,428	347,503	455,931
Occupational/environmental exposures and their consequences	71,522	943,050	1,014,572
DNA damage, genetic alterations & disease	175,813	1,933,686	2,109,499
Core services support <sup>1</sup>	39,650	8,562	48,212
Non-program-specific expenses <sup>4</sup>	1,025,366	445,806	1,471,172
<b>Total Expenses</b>	<b>\$2,218,002</b>	<b>\$4,694,123</b>	<b>\$6,912,125</b>

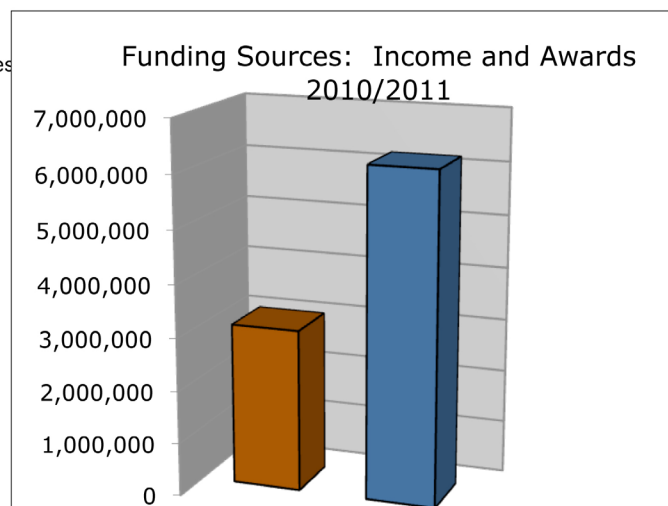
<sup>1</sup> core services - centralized graphics, statistics, and imaging

<sup>2</sup> e.g., office supplies, equipment maintenance and repair, phone rental and line charges

<sup>3</sup> Toxicology Information Center

<sup>4</sup> includes supporting services, administrative salaries, bond principal and interest, OHSU administrative charges, building operation & maint.

<sup>5</sup> Chemical risk information service is self-supporting. This amount reflects current year expenses and income only, however, prior year carry forward was used to cover all costs.





# CROET

The Center for Research on Occupational and Environmental Toxicology (CROET) conducts research, trains health professionals, provides consultation, and offers the public information on hazardous chemicals and their health effects. CROET includes scientists and research staff exploring a range of questions relating to prevention of injury and disease, and promotion of health, in the workforce of Oregon and beyond. CROET's Toxicology Information Center (TIC) is staffed to answer Oregonians' questions about chemical and other occupational exposures, and the Center's web site, CROETweb, makes health and safety information continuously available.

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For additional copies of this report, call CROET at the numbers listed above or visit [www.ohsu.edu/croet](http://www.ohsu.edu/croet) and click on "About"

## Directors and Scientific Staff, 2010/2011

### Interim Director and Senior Scientist

R. Stephen Lloyd, PhD

### Associate Director and Senior Scientist

W. Kent Anger, PhD

### Assistant Directors

Gregory Higgins, PhD  
Janice Stewart, BS

### Faculty

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W. Kent Anger, PhD  
Gregory Higgins, PhD  
Doris Kretzschmar, PhD  
R. Stephen Lloyd, PhD  
Amanda McCullough, PhD  
Irina Minko, PhD  
Harvey Mohrenweiser, PhD  
Ryan Olson, PhD  
Bruce Patton, PhD  
D. Gary Rischitelli, MD, JD, MPH, FACOEM  
Diane Rohlman, PhD  
Jackilen Shannon, MPH, RD, PhD  
Peter Spencer, PhD, FRCPath  
Philippe Thuillier, PhD  
Daniel D. Tshala-Katumbay, MD, PhD  
Mitchell Turker, PhD, JD

### Investigators

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Mohammad Sabri, PhD (Emeritus)

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Terry Hammond, MPH  
Aaron Jacobs, PhD  
Roman Kassa, PhD  
Anuradha Kumari, PhD  
Naima Laharjnar, Dip. Psychology  
Mike Lasarev, MS  
Lisa Mariott, PhD  
Mykhaylo Moldavan, PhD  
Dede Montgomery, MS, CIH

## FRONT COVER

### Left Photo

CROET's Erika Zoller and Justin Karr, summer intern from Western Oregon University, present their research during CROET's annual Summer Intern Poster Session.

### Middle Photo

CROET faculty, staff and graduate students pose with their newly appointed Director, Steven A. Shea, PhD. Dr. Shea takes the helm at CROET starting in 2012.

### Right Photo

Scene from one of the many fine symposia hosted by CROET.

## BACK COVER

The iconic marble head, located near the entry to CROET at OHSU.

Amy Palma, RD  
Harini Sampath, PhD  
Vladimir Vartanian, PhD  
Bradley Wipfli, PhD  
Erika Zoller, MS





# OREGON HEALTH & SCIENCE UNIVERSITY

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CENTER FOR RESEARCH ON OCCUPATIONAL  
AND ENVIRONMENTAL TOXICOLOGY

