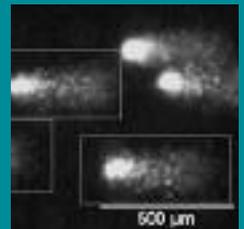


CROET

Putting science to work for working Oregonians



CROET
2003
ANNUAL
REPORT

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.



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Message from the Director

Dear Fellow Oregonians,

The year 2003 was another year of growth for CROET. External federal grant funding was up, new faculty joined the Center, our faculty and staff continued to receive recognition across the state and nation, important new results emerged from our research, and our outreach and education continued to expand and reach ever larger numbers of Oregonians.

External federal grant funding increased from 2002. While grant funding is likely to ebb and flow, CROET has enjoyed continuous growth in its grant funding for several years. Each dollar from the Oregon Workers Benefit Fund now leverages \$3 from the federal government, mostly from the National Institutes of Health.

Three new faculty joined the Center in 2003. Dr. Stephen Lloyd and his wife Dr. Amanda McCullough arrived at CROET from the University of Texas Medical Branch at Galveston. Oregon Opportunity funds were added to CROET funds to create a startup package sufficient to renovate space and re-establish their laboratories in CROET. Both specialize in DNA repair and cancer. Dr. Pam Lein also joined us from Johns Hopkins University. She is a neuroscientist and toxicologist working on health issues such as developmental disorders and asthma.

Outreach and education continue to expand and reach even larger numbers of Oregonians. In 2003, our educational offering on safety culture featured speakers from Intel, SAI, the University of North Carolina, and the Labor Education and Research Center (LERC). Our highly praised website now serves the Oregon workforce better with over 1,000 links. Finally, in collaboration with Bear Creek Corporation in Medford, CROET's computer-based program, cTRAIN, was used successfully to train its entire orchard workforce on ladder safety. The Bear Creek training demonstrated that computer-based training could be used with a typical agricultural workforce.

In all, CROET had another year of solid growth and new findings. I encourage you to review CROET's annual report for 2003.

Respectfully submitted,



Peter S. Spencer, PhD, FRCPath
CROET Director and Senior Scientist

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. Finally, through its outreach efforts, CROET serves as an information conduit to Oregon workers, employers, labor, and the general public.

Applied research is focused on 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 prevention-related research is focused on agriculture, service industries, and construction. This research has short-term payoffs. Examples: (1) surveillance is identifying unrecognized trends in Workers' Compensation claims, suggesting new prevention priorities; (2) computer-based training has been developed for respirator safety, pesticide exposures, and ergonomics in drywall finishing, and training effectiveness is under study; (3) agriculture workers are provided safety training and are monitored for exposure to pesticides and adverse nervous system health effects.

Basic research is focused on nerve and muscle damage and repair, occupational/environmental exposures and their consequences, and DNA damage and cancer. This research requires a long-term commitment and synergy among investigators, and has a long-term payoff. It is applicable to many diseases and disorders, including those associated with the workplace and those that arise from other causes (e.g., genetic, environmental). While this is important for Oregonians, it obviously has a wider impact. Thus, most of the funding for CROET's research in these areas is supported by grants from the National Institutes of Health and from other federal sources. Examples of what CROET scientists are studying: (1) how nerves grow, how they connect (form synapses) with other nerve cells and with muscles, and how to enhance their regenerative potential—all of which are critical to post-injury recovery; (2) how environmental exposures trigger DNA damage and cancer, and how mutations in specific genes disrupt cell function.

Core research facilities In order to support the work of faculty scientists and ensure that CROET takes advantage of contemporary technologies, CROET maintains several shared-use facilities: (1) Toxicogenomics (application of the human genome project to occupational and environmental health); (2) National Center for Nanobiotechnology (exploring the biomedical application of electronics industry techniques for mass fabrication of very small structures—for neural prostheses or tissue engineering); (3) Chemical Analysis, Morphology, Tissue Culture, Live Cell Imaging, Statistics, and Graphics.

Education We are teaching the next generation of research scientists in neuroscience, integrated biomedical sciences, cell biology, and toxicology. CROET is updating industry, labor, and government health and safety specialists on topics (e.g., developing effective training, health and safety issues) for office workers.

Outreach CROET is an information conduit—using our expertise to help provide information to workers and employers that they might have difficulty obtaining or interpreting on their own. Our educational outreach efforts are helping people understand the difference between “junk” science and real science. The Toxicology Information Center provides a help line, and CROETweb.com provides a resource directory for safety and health, focused on Oregon occupations and industry.

Community service CROET scientists serve on Oregon government boards and work with minority groups including: (1) Oregon's Interagency Hazard Communication Council (IHCC) and the State Emergency Response Commission (SERC); (2) Oregon's Pesticide Analytical and Research Committee; (3) Workers' Compensation Fee Advisory Committee; (4) Oregon Department of Environmental Quality's Air Toxics Advisory Committee and Water Quality Standards Review Toxics Technical Committee; (5) Shoshone-Bannock and Yakima Indian Nations; (6) Citizen Advisory Group (CAG) for the Portland Harbor Superfund Site; (7) Oregon Childhood Development Coalition (migrant Head Start); (8) Labor Education and Research Center; (9) Creating Roads for Empowerment and Advancement Through Education (CREATE); and (10) Oregon Migrant Education Program (MEP).

Synergy Together, CROET's resources can tackle any of the broad range of issues facing working Oregonians and the institutions supporting them. CROET has responded, and continues to address the needs of the Oregon Legislature, government, industry, labor—all working people of Oregon.

Committees and Scientific Leadership

2003 OHSU President's Advisory Committee CROET

Donald Baird, PhD, Oregon State University
Hon. Alan Bates, DO, Oregon State Representative
Jim Craven, American Electronics Association
John Kirkpatrick, Painters District Council
Hon. Mary Gallegos, Oregon State Representative
Hon. David Nelson, Oregon State Senator
Meg Reinhold, Oregon Department of Consumer & Business Services
Marilyn Schuster, Oregon OSHA
Hon. Frank Shields, Oregon State Senator
Bob Shiprack, Oregon Building Trades
Lisa Trussell, Associated Oregon Industries
Sheldon Wagner, MD, Oregon State University

Recognition of CROET Faculty and Staff Appointments; Regional, National, and International

American College of Occupational & Environmental Medicine, Board of Directors — Gary Rischitelli
Fudan University, Advisory Professor, Shanghai, P.R. China — Peter Spencer
NIH Synapses, Cytoskeleton, and Trafficking Study Section — Gary Banker
NIEHS Conference Grant Applications (R13) — Pam Lein, Chair
NIEHS National Advisory Environmental Health Science Council — Peter Spencer
Center for Nanobiotechnology Steering Committee — Gary Banker
Committee on Toxicology, U.S. National Research Council — Peter Spencer
Oregon's Interagency Hazard Communication Council (IHCC) — Joan Rothlein
Medical Advisory Committee (consulting member), Oregon Workers' Compensation Division — Gary Rischitelli
NIOSH Working Group on Bloodborne Pathogens in First Responders — Gary Rischitelli
National Academy of Sciences, Subcommittee on Toxicologic Assessment of Low-Level Exposures to Chemical Warfare Agents — Peter Spencer
National Academy of Sciences, Institute of Medicine, Advisory Panel for the Study of Long-Term Health Effects of Participation in Project SHAD (Shipboard Hazard And Defense) — Peter Spencer
Oregon DEQ Advisory Committee: Oregon Water Quality Criteria Policy for Aquatic Life Protection and Human Health — Joan Rothlein
Oregon Department of Human Services and Agriculture: Pesticide Analytical and Response Center — Joan Rothlein
University of Washington Center for Ecogenetics & Environmental Health Science Advisory Board — Kent Anger

Invited Presentations at Major Scientific Meetings

9th International Neurotoxicology Association — Pam Lein
23rd International Summer School for Brain Research, Netherlands Institute for Brain Research — Gary Banker
American College of Occupational & Environmental Medicine State of the Art Conference — Gary Rischitelli, Chair
American Society for Biochemistry & Molecular Biology Symposium on Organelle Visualization — Gary Banker
Neuron — 15th Anniversary Symposium — Gary Banker
NIH Festschrift to Honor Phillip Nelson — Gary Banker
Sibte Hasan Zaidi Oration, Industrial Toxicology Research Center, India — Peter Spencer
Sitlington Lecturer in Toxicology, Oklahoma State University College of Veterinary Medicine — Peter Spencer

Membership on Editorial Board of Major Journals

Journal of Neurocytology — Gary Banker
Mutation Research — Mitch Turker
Science of Aging Knowledge & Environment — Mitch Turker
Journal of Biological Chemistry — Stephen Lloyd
Chemical Research in Toxicology — Stephen Lloyd
Environmental Health Perspectives: Toxicogenomics — Peter Spencer

CROET's

Areas of Emphasis

Education and Outreach Programs

CROET's Education and Outreach Programs have four goals:

- Provide to the public scientifically accurate information on Oregon's occupational issues—continuously on the Internet and daily with scientific interpretation for complex issues through the Toxicology Information Center (TIC)
- Offer educational programs on Oregon's occupational needs to medical providers and health and safety specialists
- 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 health and safety questions

Research

Factors that affect workplace performance

- Cellular mechanisms that control sleep-wake cycles
- Job performance in shift workers
- Computer-based training methods to enhance worker safety training

Damage and repair (e.g., post-injury) of the nervous system and muscles

- Nerve cell protein distribution, change, and transport
- Nanotechnology to enhance nerve growth
- Factors that govern the accuracy of nerve synapse formation
- Pharmacological interventions to speed nerve regeneration
- Genetic models of neural degeneration

Occupational/environmental exposures and their consequences

- Effects of pesticide exposures assessed using exposure biomarkers and neurobehavioral testing
- Mechanisms underlying toxic neuropathy
- Gene-environment interactions in neurodegenerative disease
- Airborne pollutants and their health effects

DNA damage, genetic alterations, and disease

- Role of DNA repair in protecting the nervous system from genotoxins
- Gene silencing and cancer
- Mutations induced by ionizing irradiation, oxidative stress, and other genotoxins
- Ion channel mutations that underlie diseases

Selected 2003 Accomplishments and Awards

- CROET faculty and staff recognition continues to grow regionally, nationally, and internationally
- In-depth investigation of Oregon fatalities produces hazard alerts and an interactive website
- CROET's cTRAIN computer-based training shown to be effective in typical agricultural workforce
- CROET website expands to provide enhanced access to CROET activities and the widely used resource directory with 46 topic areas and over 1,000 resource links
- CROET leads application of cutting-edge technology to risk assessment as a member of first national toxicogenomics consortium
- Adverse effect of organophosphate pesticide found at concentrations that do not alter standard damage measures
- Evidence of oxidative stress in farmworkers and pesticide applicators are under study at CROET and on Oregon farms
- CROET discovers a new type of cell that modulates control of sleep and wakefulness
- External application can reduce skin cancers produced by exposure to ultraviolet light that causes sunburn
- Genetic studies of laminins shown to affect nerve growth and ability to walk suggest potential for post-injury improvement
- Federal and other grant revenue continues to climb in 2003

2003 CROET Highlights

Workplace fatality surveillance in Oregon produces hazard alerts, interactive website

CROET and the Oregon Departments of Human Services and Consumer & Business Services received a cooperative agreement from the National Institute of Occupational Safety and Health (NIOSH) to identify, investigate, and develop prevention strategies for traumatic occupational fatalities in Oregon. Oregon joins 13 other U.S. states in the NIOSH-sponsored Fatality Assessment & Control Evaluation (FACE) program. In the first year of the program (2003), Dr. Gary Rischitelli (Principal Investigator) and Dr. Joan Rothlein have conducted in-depth investigations of over 30 occupational fatalities in Oregon and developed industry-specific recommendations for prevention. For example, one hazard alert focused on electrocutions in Oregon companies using the same equipment (truck-mounted guard rail installer). These hazard alerts and other reports are available at <http://www.ohsu.edu/croet/face>. This interactive website provides current information on demographic factors in Oregon fatalities.

Computer-based training effective in people with limited formal education

CROET's cTRAIN computer-based training, developed by Dr. Kent Anger, continued to grow in 2003. Content programs on safety in food service and drywall finishing have increased worker knowledge and safe work practices. In addition, the content programs have been well received by workers in those industries. The food services research has been accepted for publication in the *Journal of Safety Research*. Begun in November, a collaboration between CROET and Medford's Bear Creek Corporation demonstrated that cTRAIN computer-based training can be used to provide critical safety training (ladder safety) to the entire agricultural workforce of orchard workers, including some who had no formal education. Work began on a new grant to use cTRAIN in Oregon vineyards. (<http://www.ohsu.edu/croet/faculty/anger/>)

CROET website adds second home page to improve access

CROET's website was divided into two separate, but complementary, websites in July. One site (<http://www.ohsu.edu/croet/>) contains information about CROET faculty and staff projects, while the other is devoted exclusively to CROET's popular and well-regarded occupational safety and health resource directory (<http://www.croetweb.com>). This change provides easier access to both the resource directory and to CROET research capabilities, outreach, and education. CROET's occupational safety and health resource directory, organized into 46 topic areas, contains links to over 1,000 resources and serves as a major source of safety and health information for working Oregonians and their families. All resources are now stored in a database resulting in new functionality. For example, the website can be sorted for Oregon-specific or Spanish-language materials, and a new search tool allows for specialized searches. Another added functionality of the website is the ability to accept online registrations for CROET's annual health and safety symposia. This resulted in increased efficiency and decreased expenditures for paper and mailing. All of CROET's newsletters dating back to 1999 have been made available online, also reducing mailing costs.

Toxicogenomics, a cutting-edge technology, begins at CROET

Toxicogenomics is a new technology that promises to revolutionize understanding of chemical risk, disease mechanisms, and even treatment options. The heart of the technology is the microarray, a glass plate containing up to 20,000 "spots" of genetic material obtained from an animal such as the mouse. These spots can be used to interrogate molecules derived from animals that have been exposed to test chemicals. The resulting pattern of microarray response indicates which cellular networks are affected. In 2003, Dr. Peter Spencer and colleagues completed development and initiated research operations of this new laboratory. OHSU and CROET thus became part of NIH National Institutes of Environmental Health Sciences (NIEHS) Toxicogenomics Research Consortium; this consortium includes the Massachusetts Institute of Technology, Fred Hutchinson Cancer Research Center, University of Washington, Duke University, and University of North Carolina. CROET is using the microarray technology to assess the neurotoxicity of organic solvents, including those used as cleaners and degreasers. (<http://www.ohsu.edu/croet/research/centers/toxicogenomics/>)

New mechanism of organophosphate pesticide damage reveals very low-concentration effects

Nervous system damage follows high-concentration exposures to organophosphate (OP) pesticides such as chlorpyrifos. A metabolite of the pesticide reduces the activity of the enzyme acetylcholinesterase (AChE) which normally acts as a brake on repeated, uncontrolled firing of nerve cells. AChE reduction is therefore widely used as a biomarker or internal measure of exposure to OP pesticides. However, recent animal studies suggest that pesticide concentrations that do not inhibit the AChE may still cause damage to the nervous system in very young or still-developing animals. Learning, memory, and motor behavior are implicated. Assessing risk to children has been complicated by the fact that the mechanisms by which organophosphate pesticides disrupt the developing nervous system are not understood. CROET's Dr. Pamela Lein recently found that chlorpyrifos blocks the effect of AChE in growing nerve cell (axon) processes, and at levels below those required to reduce AChE activity. Since disruption of axon growth has been associated with functional deficits, these findings reveal a mechanism that explains how exposure to very low levels of OP pesticides could cause behavioral problems in children. Since many of the same mechanisms that regulate axon growth in the developing nervous system also influence axon regrowth following injury, Dr. Lein's work raises the possibility that exposure to low levels of pesticides may also interfere with nerve regeneration in adults following work-related injuries. Further, these data raise questions of the sensitivity of AChE activity for monitoring damage following exposure to OP pesticides. (<http://www.ohsu.edu/croet/faculty/lein/>)

One more piece of the sleep-wake jigsaw puzzle

A significant number of Oregonians work nontraditional hours. They are staying awake and working while a part of the brain called the suprachiasmatic nucleus (SCN) is telling them it is time to sleep. Nerve cells in the SCN contain a "molecular clock" that keeps 24-hour time. Through the work of Dr. Charles Allen, CROET is studying how these nerve cells translate the molecular clock information into an output signal that regulates activities such as sleep and wakefulness. Before now, it was believed that "rhythmic" neurons — that cycle on and off during the day and night — controlled our circadian rhythm and thus caused us to sleep and wake. However, in 2003, Dr. Allen discovered a group of SCN neurons that are important for driving behavioral and hormonal rhythms, but that are not rhythmic — they do not cycle on and off over time. These findings suggest that the molecular clock that controls sleep and wakefulness is an interaction between rhythmic and non-rhythmic neurons. These observations add another piece of information to complete the puzzle of how the brain generates timing information. A better understanding of the brain timing mechanism will help develop more effective strategies for workers to handle the health and performance challenges arising from rotating or night work schedules. (<http://www.ohsu.edu/croet/faculty/allenc/>)

Nerve repair: Protein promotes nerve development

Nerves regenerate imperfectly following injury in adults. Nerve formation requires growth of the nerve fiber process (axon), multiplication of attendant Schwann cells to match the length and number of axons, and the formation by Schwann cells of an axon ensheathment that is called myelin. These steps occur on a precise schedule during development and are recapitulated during nerve regeneration after injury. The molecular mechanisms that control the developmental schedule are still largely unknown. Genetic defects in children with a congenital neuropathy have provided a clue. There is a protein missing in these children, called *laminin*, which normally covers the surface of Schwann cells in the nerve. Working with laboratory mice, Dr. Bruce Patton's research group found that Schwann cells actually make multiple versions or types of laminin. Mice engineered to lack two versions of the laminin protein were completely unable to produce myelin and unable to walk. They tested the feasibility of genetic therapy for these myelin defects by re-engineering the mice to make large amounts of a third version of laminin, which is normally present at very low levels in nerves. The additional protein stimulated myelin formation and enabled the mice to walk. (To see a movie of these mice, visit <http://www.ohsu.edu/croet/research/highlights/nerverepair.html>.) By increasing the output of this protein in children with neuropathy, or in injured patients, nerve development and regeneration might be improved. Perhaps more importantly, future studies aimed at discovering how the laminins promote myelin formation by Schwann cells may allow the development of drugs that act like laminins, to promote myelination without genetic engineering. (<http://www.ohsu.edu/croet/faculty/patton/>)

Reducing ultraviolet light exposure to prevent skin cancers

Exposure to solar radiation is the single most significant risk factor associated with the development of skin cancer. More than half of all new cancers are skin cancers, with the total number of new cases exceeding 1 million annually. Occupational exposure to deleterious amounts of natural ultraviolet (UV) sunlight (for example, enough to cause a sunburn) occurs in the farming, maritime, and construction industries, and all of these workers are classified as high-risk groups for skin cancer. This type of skin cancer is named “non-melanoma,” and it is the most common type of skin cancer. Fortunately, it is usually not malignant or life-threatening. In an effort to prevent or at least delay the onset of non-melanoma skin cancers, research in the laboratories of Dr. Amanda McCullough and Dr. Stephen Lloyd has focused on novel ways to enhance the capacity of skin cells to repair DNA damage caused by sunlight overexposure. If skin can rapidly repair damage from sun overexposure, most skin cancer will not develop. Their research has shown, in a test system consisting of human cells, that the application of a specific type of enzyme repairs the damage caused by UV light by as much as 10 times faster than the skin’s natural repair enzymes. They have been issued a patent for enzymes that have the potential to reduce or prevent non-melanoma skin cancers and suppression of the body’s immune system, another danger that follows UV overexposure. This technology will allow the development of new DNA repair enzymes that can be introduced into human epidermal (skin) cells through a skin lotion, to rapidly initiate the repair of damage to DNA caused by exposure to UV light. This new DNA repair system is expected to reduce the frequency and rate of onset of non-melanoma skin cancer and prevent or greatly alleviate UV-induced suppression of the immune system. (<http://www.ohsu.edu/croet/faculty/mccullough/>)

Motor proteins and muscle strength

In order to grow and maintain nerve processes, special molecules called motor proteins transport molecules from the nerve cell bodies, where they are made, out into the axon and dendritic processes, where they do their work. The neuronal transport system is particularly important for motor nerve cells that control muscles, because their axons reach all the way from the the spinal cord out into the arms and legs, where they supply muscles. Loss of motor nerve cells results in profound muscle weakness, as seen in poliomyelitis and Lou Gehrig's disease. Two CROET groups are studying the role of motor proteins in nerve cells. The Banker lab is developing imaging methods to visualize the movement of motor proteins and nutrients in living cells. They have found that some motor proteins are “smart”— they take their cargoes only to a specific location in the cell — unlike their “dumb” colleagues that can’t distinguish between axons and dendrites. Smart motors may be important for ensuring that key cellular molecules always go to the right destination. (<http://www.ohsu.edu/croet/faculty/banker/>). A second team, led by Dr. Mohammad Sabri, has been investigating how certain solvents used in industry may lead to adverse effects on the nervous system. They discovered that solvent-derived chemicals react with motor and other proteins, causing them to accumulate in swellings that disrupt function and cause muscle weakness. (<http://www.ohsu.edu/croet/faculty/sabri/> and <http://www.ohsu.edu/croet/faculty/spencer/>)

New health effects of pesticides — oxidative stress studied

Most studies involving pesticide exposures compare reported exposure to health effects, such as evidence of damage to the brain and nervous system. However, the amount and frequency of “exposure” is based on statements by the exposed individuals. Dr. Glen Kisby is studying the biological mechanisms of pesticide exposure to health effects. With former CROET faculty member Dr. Linda McCauley, Dr. Kisby is studying potent organophosphate pesticides (OPs) such as those used in Oregon. OP pesticides have been found to produce oxidative stress. Oxidative stress occurs when oxygen free radicals (oxygen molecules) combine with other molecules in a way that damages those molecules or prevents them from performing their normal function. Dr. Kisby and Dr. McCauley compared pesticide applicators with farmworkers who do not apply pesticides and with people who do not work on farms (controls). The levels of oxidative stress as measured in urine (DNA damage), blood (oxidized lipids), and white blood cells (activity of a DNA repair protein) were much higher in farmworkers and pesticide applicators than in controls. Additional research is underway to confirm and expand these findings in the laboratory and in the field in Oregon. (<http://www.ohsu.edu/croet/faculty/kisby/>)

Financial Summary

CROET Expenditures: Fiscal Year 2002/2003

| Workers' Compensation Expenditures | | Federal and Other Grant Expenditures | |
|----------------------------------------------------------|--------------------|------------------------------------------------------------------------------------|--------------------|
| Salaries | | Salaries | |
| Salaries—research (12% of all salaries) | \$601,516 | Salaries—research (60% of all salaries) | \$3,012,974 |
| Salaries—outreach (6% of all salaries) | 299,656 | Salaries—outreach (2% of all salaries) | 108,360 |
| Salaries—education (2% of all salaries) | 96,007 | Salaries—education (2% of all salaries) | 77,151 |
| Salaries—administration (5% of all salaries) | 266,997 | Salaries—administration (6% of all salaries) | 304,019 |
| Salaries—core services ¹ (1% of all salaries) | 42,410 | Salaries—core services (4% of all salaries) | 210,836 |
| Supporting Services (includes cores) | | Supplies and equipment | |
| Supplies and equipment | 374,010 | (Laboratory supplies, animal costs, human subjects, equipment, and other expenses) | 2,418,167 |
| Miscellaneous support ² | 93,502 | | |
| Outreach and Education | | Other Expenses | |
| Services, supplies, and equipment | 224,788 | Building operations and maintenance | 665,726 |
| Other Expenses | | | |
| Bond principal and interest | 324,024 | | |
| OHSU administrative charges | 122,508 | | |
| Total | \$2,445,418 | Total | \$6,797,233 |

Programs: Fiscal Year 2002/2003

| | Amount paid by W/C | Amount paid by grants | Total Cost |
|----------------------------------------------------------------------------------------|--------------------|-----------------------|--------------------|
| Outreach and Education | | | |
| Information dissemination (e.g., TIC, ³ website, newsletter, and brochures) | \$510,888 | \$108,360 | \$619,248 |
| Education and training programs (professional and para-professional) | 149,058 | 406,608 | 555,666 |
| Chemical risk information service ⁴ | -39,495 | 0 | -39,495 |
| Basic and Applied Research | | | |
| Factors that affect workplace performance | 137,263 | 1,074,848 | 1,212,111 |
| Damage and repair of the nervous system and muscle | 410,626 | 858,027 | 1,268,653 |
| Occupational/environmental exposures and their consequences | 198,588 | 1,234,114 | 1,432,702 |
| DNA damage, genetic alterations and disease | 48,604 | 1,036,722 | 1,085,326 |
| Other ongoing projects ⁵ | 0 | 2,796 | 2,796 |
| Core services support ¹ | 84,530 | 225,152 | 309,682 |
| Non-program-specific expenses ⁶ | 945,356 | 1,850,606 | 2,795,962 |
| Total Expenses | \$2,445,418 | \$6,797,233 | \$9,242,651 |

¹ core services—centralized graphics, statistics, imaging, tissue culture, and morphology (pathology)

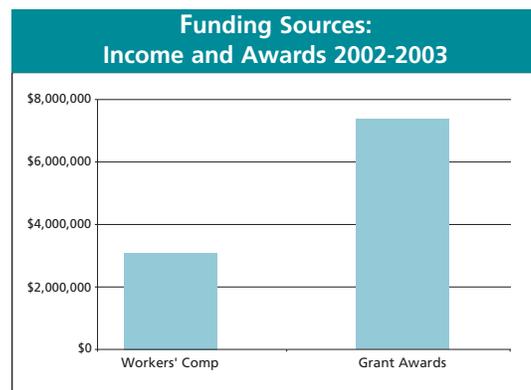
² e.g., office supplies, equipment maintenance and repair, phone rental and line charges

³ Toxicology Information Center

⁴ income-generating program; income exceeded expenses

⁵ overlaps with applied research

⁶ includes supporting services, administrative salaries, bond principal and interest, OHSU administrative charges, building operation and maintenance



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 more than 100 scientists and research staff exploring a range of questions relating to the prevention of injury and disease — and the 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 website makes health and safety information continuously available.

How to Contact Us

Mail Address

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For additional copies of this report, call CROET at the numbers listed above, or visit www.ohsu.edu/croet and click on "Contact CROET."

Directors and Scientific Staff, 2003

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Associate Director for Finance and Planning

J. Robert Williams, MBA

Assistant Director for Operations

Gregory Higgins, PhD

Assistant Director for Business Affairs

Janice Stewart, BS

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Doris Kretzschmar, PhD
William Lambert, PhD
Pamela Lein, PhD
R. Stephen Lloyd, PhD
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Amanda McCullough, PhD
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Hoa Lam-Lesselroth, MS
Elaine Mahoney, MS

Front Cover

Top Photo

Orchard worker climbing a ladder to prune a pear tree in Medford, Oregon, following computer-based training on ladder safety. See "Computer-based training effective in people with limited formal education" highlight on page 7.

Middle Photo

Health and safety specialists from labor, industry, government and academia attending the CROET seminar on safety culture. CROET's health and safety education goals are listed on page 6.

Bottom Photo

"Comet" assay reveals DNA damage in a biological sample from a farmworker exposed to organophosphate pesticides. Damaged DNA is seen in the "tail" of dots trailing to the right of the bright circular area. (The appearance of a comet with a tail is the basis for the name of this analysis.) These changes are indicative of oxidative stress, although the cause of the damage has not been established. See "new health effects of pesticides — oxidative stress studied" highlight on page 9.

Back Cover

CROET engages in research to identify and prevent illnesses and injuries in the workforce. Although we blaze a new trail, we are not the first to walk in these woods. For centuries, workers and physicians have sought to clarify the relationships between various exposures and disease. Listed on the back cover are descriptions of occupational disorders named by those afflicted or by their caregivers.

Irina Minko, PhD
Mykhaylo Moldavan, PhD
Juan Muniz, MS
Anthony Oliva, PhD
Diane Rohlman, PhD
Joan Rothlein, PhD
Bernard Sampo, PhD
Jennifer Scherer, MPH
Holly Sherburne, MS
Satoko Shimamura, MS
Rachna Sinnott, PhD
Larry Smith, MS
Diana Sticker, MPH
Daniel Storzbach, PhD
Jakob Tschape, PhD
Kamila Vagnerova, PhD
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