The destruction of the World Trade Center on September 11, 2001 was an unparalleled event. Not only were a large number of lives lost, but potentially thousand of workers were exposed to hazardous material resulting form the burning rubble and clouds of dust and smoke. The disaster changed the focus of many lives, including that of Center member Dr. Alison Geyh. Her research interests have long focused on airborne contaminants — quantifying these contaminants, identifying their sources, investigating their chemical composition, and following the routes of human exposure. So when clean up of the disaster site began, Geyh was ideally positioned to study the exposure of clean up workers to airborne contaminants and the potential health problems that could result from those exposures.

“The environmental health scientist must be prepared to respond quickly to address emerging public health threats and to produce solutions to those challenges,” explains Geyh. “Events or outbreaks may dictate where the scientist’s talents can best be utilized to meet the public health challenges of the day.”

Three weeks following the disaster, Geyh arrived at the site to study the exposure of individuals working at Ground Zero to a range of airborne contaminants. Using monitoring devices, Geyh’s research team examined the personal exposure of approximately 50 truck drivers hauling debris away from the disaster.

Area monitoring was conducted at 4 locations around the disaster site for particulate matter, asbestos, and volatile organic compounds (VOC).

In addition to exposure assessment, Dr. Alison Geyh (left) was interested in evaluating the respiratory health of workers at the disaster site. Historical and current respiratory symptoms were assessed using an interviewer-administered questionnaire.

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Disruption of a single gene, Nrf2, plays a critical role in determining the susceptibility to asthma according to a study by a research team led by Shyam Biswal, PhD at the Johns Hopkins Bloomberg School of Public Health. Researchers found the absence of Nrf2 exacerbated allergen-mediated asthma in mice models. The study’s findings, published in the July 4, 2005 edition of the *Journal of Experimental Medicine*, may hold therapeutic potential for the treatment of human asthma.

Asthma is a complex inflammatory disease of the airway characterized by airway inflammation and hyperreactivity, affecting 20 million Americans. Alarmingly, the incidence of asthma has doubled in the past two decades in the United States. Controlling inflammation is a central focus of asthma therapy. Inflammation occurs when certain cells migrate into the airways. These “inflammatory” cells release reactive oxygen species (ROS), causing the airway lining to swell and restrict. ROS is thought to cause lung tissue damage as well. ROS levels are normally offset by antioxidants in non-asthmatics. Recently, researchers have been hunting for novel genes that regulate inflammation with the hope of developing them as targets for the next generation of asthma drugs.

Suspecting that a defect in antioxidant response exacerbates asthma severity, the team of researchers began looking into the genetic factors that might contribute to this deficiency. In 2002, Biswal’s lab discovered Nrf2 acts as a master regulator of the majority of antioxidant pathways and detoxifying enzymes for environmental pollutants. This led researchers to consider the role of Nrf2 in lung inflammatory diseases caused by exposure to allergens. They found that the absence of Nrf2 gene increased migration of inflammatory cells into the airways and caused an enhanced asthmatic response in mice. “Nrf2 is critical for proper response to allergens in lungs and maintenance of a balance between ROS production. Antioxidant capability regulated by Nrf2 may be a major determinant of susceptibility to allergen-mediated asthma,” says Biswal. “Nrf2 regulated pathways seem to intervene inflammation at several points.”

The findings provide a better understanding of the human body’s defense mechanisms to stress, which may hold clues to better control the inflammation process and improve control over asthma and its symptoms. Study coauthor Tirumalai Rangasamy, PhD said that the next step for researchers will be to look for molecular mechanism of regulation of asthmatic inflammation by Nrf2 and determine if there are alterations in the response of Nrf2 gene in asthma-prone humans. Future studies will determine the therapeutic potential of targeting Nrf2 for treatment of asthma.
Changes in ground level ozone were significantly associated with an increase in deaths in many U.S. cities, according to a study supported in part by grants from the National Institutes for Environmental Health Sciences and the NIEHS Center for Urban Environmental Health. The study compared the rate of death on days where the prior weeks ozone was higher to otherwise similar days where the ozone was lower within each urban community. The team of researchers from the Johns Hopkins Bloomberg School of Public Health and the Yale University School of Forestry and Environmental Studies found that the risk of death was similar for adults of all ages and slightly higher for people with respiratory or cardiovascular problems. The increase in deaths occurred at ozone levels below the Environmental Protection Agency clean air standards. The study, which is the first to examine daily ozone and mortality on a national scale, was published in the Journal of the American Medical Association.

Ground level ozone is a pollutant in the Earth’s lower atmosphere that is formed when emissions from cars, power plants and other sources react chemically to sunlight. Stratospheric ozone, which is higher in the atmosphere, is the “ozone layer” that protects the Earth from ultraviolet radiation.

“The ozone study was part of the ongoing National Morbidity Mortality and Air Pollution Study at the Bloomberg School of Public Health, which routinely assesses health effects of air pollution on a national scale,” explained Center researcher Dr. Francesca Dominici. “To determine the association between ozone and mortality, we looked at the total number of non-injury-related deaths and cardiovascular and respiratory mortality in the 95 largest U.S. communities from 1987 to 2000.” Air pollution data was supplied by the EPA. Mortality data was supplied by the National Center of Health Statistics. Researchers accounted for variables such as weather, particulate matter pollution and seasonality, which could impact mortality rates.

Researchers found that an increase of 10 parts per billion (ppb) in weekly ozone levels was associated with a 0.52 percent daily increase in deaths the following week. The rate of daily cardiovascular and respiratory deaths increased 0.64 percent with each 10 ppb increase of weekly ozone. The average daily ozone level for the cities surveyed was 26 ppb. The EPA’s regulatory standard for 8-hour max ground level ozone is 80 ppb. The researchers calculated that a 10 ppb reduction in daily ozone, which is roughly 35 percent of the average daily ozone level, could save nearly 4,000 lives throughout the 95 urban communities included in the study.

“Our study shows that ground-level ozone is a national problem, which is not limited to a small number of cities or one region. Everyone needs to be aware of the potential health risks of ozone pollution,” concluded Dominici, senior author of the study.

WHAT IS OZONE?
Ozone is the prime ingredient of smog in our cities and other areas of the country. Ozone can irritate lung airways and cause inflammation much like a sunburn. When inhaled, even at very low levels, ozone can cause acute respiratory problems, aggravate asthma, and impair the body’s immune system defenses, making people more susceptible to respiratory illnesses, including bronchitis and pneumonia.
Connecting to the Curriculum

Winter Colloquium Helps Teachers Implement Environmental Health Lessons

Due to a winter snow storm, this year’s Winter Colloquium was rescheduled for April 15 and 16. This event brought together interdisciplinary teacher teams from area middle schools to develop and implement environmental health lessons and activities. The intensive two-day workshop included lectures, tutorials, seminars, and hands-on exercises.

During the annual event, teachers received input and support from Hopkins scientists and education technology trainers. Speakers included Dr. Rolf Halden (left) talking about the public health concerns regarding sewage spills and Dr. Ellen Silbergeld speaking on urban fishing and public health.

Participants became acquainted with a variety of environmental health science topics and instructional/resource materials, including teacher’s guides, hands-on activities, and Internet-delivered curriculum. Many of these materials are made available for use by Maryland teachers through NIEHS-funding.
What I Did During My Summer Vacation

Center Offers Maryland Teachers Training in Environmental Health Sciences

Through its educational outreach efforts, the NIEHS Center in Urban Environmental Health partners with Maryland Public Television to train teachers and encourage more students to enter educational programs in environmental health sciences. As part of this mission, the two organizations sponsor an annual four-day Summer Institute at the Johns Hopkins Bloomberg School of Public Health. This year’s Summer Institute ran from July 18 through 21, and drew more than 100 Maryland teachers.

Over the past nine years, the Summer Institute has trained hundreds of Maryland teachers to explore the relationships between the environment and human health. These teachers have in turn impacted thousands of students throughout our communities. The event includes electronic training at the School’s computer labs, to increase teacher awareness of online environmental health science resources.

This 4-day professional development opportunity is designed for Grade 6-12 teachers in all curriculum areas interested in integrating the most recent information and research about human environmental health issues and cutting edge education technology tools into their curricula. The workshop contains a balance of lectures, hands-on lessons, lab tours and computer-based activities. Tables were set up each day with free resources for teacher participants.

Lab tours of the Sydney Kimmel Comprehensive Cancer Center highlighted research scientists studying a variety of cancers. Participants visited several labs for a one-hour, learning session with top cancer researchers. State-of-the-art equipment and laboratory processes were explained. The goal of the tours was to raise awareness of the various scientific approaches to cancer research.
A Journey into Nature
Walk Deepens Students' Awareness of the Environment

More than 100 students from Baltimore City's Rognel Heights Middle School joined NIEHS Center Deputy Director and Outreach Director Dr. Michael Trush for a walk in the woods this spring. The group hiked through the woodlands and along the banks of Gwynns Falls, identifying plants and insects along the way. “The trail travels through an environmentally valuable urban greenway park, which contains an incredible diversity of plant and animal species,” explains Trush. “The distinct environment is a wonderful educational tool for students to explore the natural world.”

Leaves of three, let it be! During the walk, students received hands on experience from Trush at identifying plants. “We used all of our senses to experience nature in a new way,” said one enthusiastic student.

During the walk, many students were interested in what an environmental health scientist does. Earlier this year, Trush participated in a career seminar, presenting the same students with information on career opportunities in environmental health sciences.

“The students are always surprised by the animals and plants they can discover in an urban park when they know where to look,” added Trush. Here a group of students proudly shows Trush a small garter snake found alongside a stream.
Life expectancy and overall health have improved in recent years for a large number of Americans, due to an increased focus on preventive medicine and dynamic new advances in medical technology. However, not all Americans are benefiting equally. There are continuing disparities in the burden of illness and death experienced by underserved urban communities as compared to the U.S. population as a whole.

As a longtime resident of East Baltimore, Pat Tracey is all too familiar with the health disparities found in many urban communities. So when Tracey joined the Center staff last year, she brought with her a firsthand knowledge of the underserved community’s health needs and a willingness to do something about it. Today, Tracey remains a familiar face in her old neighborhood, working with the Partnership for a Healthier East Baltimore to help carry out a needs assessment to evaluate the health status of the area. “Determining the unmet healthcare needs is the first step in delivering needed curative and preventive services,” explains Tracey. “This research can be translated into effective policies.”

The Partnership recognized that although a significant amount of community-based and institution-based research had been carried out in the East Baltimore community, little of the research had led to improvements in health status. The group began by reviewing the research literature to identify the strengths and gaps in this work. The next step in the process was organizing a retreat to discuss the plans for conducting the assessment. In June, Tracey joined community advocates for a one-day meeting to discuss goals, methods, and outcomes of the project. “The Partnership has committed to developing study protocol so that field work can begin in early 2006,” says Tracey. “The retreat resulted in identifying several specific reasons that a needs assessment should be performed and explicit end results.”

Although the assessment will focus on East Baltimore, Tracey believes the model could be used citywide. “Our work will provide opportunities to prevent, screen, diagnose, and treat health conditions that have a disproportionate and adverse impact on underserved populations,” concludes Tracey.
Five Pilot Projects Receive 2005-06 NIEHS Funding

Each year, the NIEHS Center in Urban Environmental Health provides seed funding of new ideas that hold promise in the generation of preliminary data in support of subsequent grant applications. The program benefits include facilitating research into areas and methods important to environmental health and stimulating collaboration between investigators. Over the last six years, the Center has funded pilot project grants in such areas as the molecular toxicology of agents found in the urban environment; susceptibility determinants such as obesity and receptors; toxicogenomic research; and community-based research and education. The 2005-2006 grant recipients are:

Testing a Simple Prevention Procedure Against Exposure to Pathogens via Contact with Surface Waters in Urban Environments of Baltimore

Thaddeus Graczyk, PhD

Recreational contact with surface water via urban fishing within the Baltimore metropolitan area causes exposure to serious waterborne pathogens. Using molecular techniques, researchers found positive matches between human pathogens recovered from fish and from the hands of respective anglers, which substantiated the possibility of parasite transmission via hand contamination. Graczyk believes that a simple prevention procedure can alleviate this threat. The overarching goal of the proposed project is to assess and characterize the intensity of exposure to waterborne pathogens via hand contamination of people who use surface waters of the Baltimore area for recreational fishing. Additionally, researchers will assess the efficacy of a prevention procedure, such as use of a commercially-available hand disinfectant, i.e., antimicrobial moist wipes, mechanical removal and/or inactivation of these pathogens.

Community-Capacity Building and Environmental Justice in the Sandtown-Winchester Neighborhood

Janice Bowie, PhD

The Sandtown-Winchester neighborhood in West Baltimore disproportionately faces a variety of socioeconomic and environmental exposures (e.g. deteriorating housing stock, a large traffic volume, and a high smoking prevalence), which may result in a higher risk of certain diseases. Through the use of community-based participatory research (CBPR) to assess the community’s needs and exposures, Center researchers hope to assist Sandtown-Winchester residents to cope with environmental justice issues. To carry out this research, young people ages 17-25 will be trained in environmental and community assessment, and lend their voices in the development and dissemination of outreach materials. This project illustrates a true CBPR approach in addressing environmental justice issues and can be used as a model for future work.

Dendritic Cell Activation by Ambient Particulate Matter

Marc Williams, PhD

Dysregulated expression of the Th2 type cytokines interleukins (IL)-4, IL-5 and IL-13 is critical in the immunological pathology of allergic asthma. However, despite numerous investigations the precise role of environmental exposures in the enhanced Th2 cytokine expression in asthma has not been delineated. Dendritic cells (DC) are highly specialized professional antigen presenting cells that continuously sample their local environment. Immature DC’s reside in surface epithelia and after appropriate activation migrate to regional lymph nodes to initiate T cell activation. DC’s secret soluble factors and express cell surface receptors promote Th2 differentiation during contact with T continued on next page
lymphocytes. Thus DC’s are in a critical state of readiness to translate environmental exposures and direct the polarization of a Th2-type immune response in vivo. Researchers hypothesize that exposures to environmental pollutants induce the maturation of a Th2 promoting DC. Preliminary data shows that Baltimore ambient particulate matter (APM) profoundly influences myeloid DC generation in vitro. It is unknown to what extent environmental exposures could modulate the immunological activation and function of DC. This study will investigate multiple aspects of DC function in response to APM exposure in vitro. These studies should provide a paradigm for the investigation of how any airborne environmental compound could influence innate immunity in vivo.

**Adverse Health Outcomes in Terminally Senescent Mice Exposed to Baltimore Urban Air Pollution**  
Clarke Tankersley, PhD

This research will test the hypothesis that susceptibility to premature mortality is provoked by Baltimore urban air pollution (BUAP). Investigators will test the chronic health effects of exposures to overall and altered composites of BUAP. Altered composites of BUAP will include the particulate matter fraction, the gaseous fraction and completely filtered Baltimore urban air. Researchers will test the adverse health effects in a model of physiological aging, where terminal senescence is defined by parameters of homeostatic decay. Researchers will explore the initial phase of a multidisciplinary project, which would incorporate new exposure assessment techniques, novel biostatistical approaches, and significant advances in evaluating relevant health outcomes. We will focus this first phase by studying two groups of AKR mice exposed continuously to either filtered air or BUAP for a period of 5 weeks. Using a radiotelemeter implant in each animal and a dedicated computer, researchers will longitudinally measure an inventory of physiological endpoints, including daily body weight, the circadian pattern in activity, body temperature, and heart rate, along with changes in the PM and gaseous fractions of BAUP to correlate environmental variability with adverse health outcomes.

**Hazardous Air Pollutants and Autism Risk**  
Craig Newschaffer, PhD

Recent escalating rates of autism diagnosis and autism spectrum disorders have fueled concern that environmental exposures may be involved in the etiology of these developmental disorders. This research proposes a case-control study examining the possible association between autism and hazardous air pollutants (HAPs). The study will be accomplished by linking existing data bases on surveillance-ascertained autism cases from Maryland, Delaware, and metropolitan Atlanta; birth certificate files, from which controls will be randomly selected; and data bases containing estimated annual levels of HAPs for census tracts across the contiguous United States. Logistic regression models will be used to compare risk for autism between those with high and low exposure to groups of chemicals with similar structural or functional properties. This work has the potential to guide future research on environmental risk factors for autism.

**Spatial Regression Methodology for Data Located at Different Levels of Geographic Precision: Application to Environmental Exposure Assessment**  
Frank Curriero, Ph.D.

Evaluating spatial relationships and geographic determinants of exposure and health is an active and growing area of environmental and public health research. The purpose of this research is to develop statistical regression methodology that can accommodate spatial information from both precise point level location (geocoded addresses) and censored zip code level location (nongeocoded addresses). Researchers will also address the bias incurred by ignoring nongeocoded data in analysis. The methodology developed under this pilot proposal will provide the requested preliminary results for an NIH RO1 revised application involving environmental exposure assessment as a major substantive area of application.
site. In addition, area monitoring was conducted at 4 locations around the disaster site. Exposure assessment focused on particulate matter, asbestos, and volatile organic compounds (VOC). As the disaster cleanup was coming to a close, Geyh returned to the site in April 2002 to conduct follow up area monitoring and personal exposure assessment on the 15 remaining truck drivers working on site. Each driver was provided an asbestos monitor and an additional monitor for either particulate matter or VOCs.

In addition to exposure assessment, Geyh was interested in evaluating the respiratory health of workers at the disaster site. Historical and current respiratory symptoms were assessed using an interviewer-administered questionnaire adapted from standardized questions developed by the American Thoracic Society for use in epidemiological research to quantify respiratory symptoms. A spirometer was used to measure workers’ air flow and air volume, indicators of lung health.

Geyh was not just interested in the physical exposures of workers but the psychological effects as well. To assist in this research, Geyh was joined by Dr. Grant Tao, an occupational epidemiologist from the Johns Hopkins School of Medicine, and Raz Gross, a Columbia University psychiatrist. A questionnaire was developed to assess respiratory health, mental health, and quality of life and sent to all workers identified by their unions as having been involved in the clean up operation. A comparison group of “non-exposed” workers from some of the same organizations were also asked to fill out a questionnaire. The version of the questionnaire for the “non-exposed” workers did not contain World Trade Center related exposure questions but was otherwise identical to the questionnaire sent to Ground Zero workers. “The responses to this questionnaire will establish a baseline of health for each worker as well as provide a better understanding of the prevalence rates of health symptoms that resulted from the clean-up of the disaster,” says Geyh.

The epidemiological study helps to establish in a quantitative way the health impact of clean up workers. Geyh has already published four papers on this research; two more are in preparation. She hopes her research will provide a better understanding of health symptoms that potentially resulted from the clean-up effort and improve our preparedness for responding to future crises. “This NIEHS-funded research helps us identify tools to minimize the health risk to clean up workers should such a disaster happen again,” concludes Geyh. “Work shifts, risk communication, site management, and personal protection equipment are all tools that could minimize individual exposures of clean up workers.”

Center-Supported Research Among Most Cited

Congratulations to Assistant Professor Dr. Shyam Biswal for making a significant impact among his colleagues. Biswal is a member of the Center’s Molecular Toxicology Research Core. Since 2000, Biswal’s article entitled Identification of NRF2-Regulated Genes Induced by the Chemopreventive Agent Sulforaphane by Oligonucleotide Microarray has been cited 58 times. According to Essential Science Indicators, this places it in the top 1% within its field.
Is offering Pilot Project Grants of up to $20,000 for April 1, 2006 through March 31, 2007 to stimulate new lines of research on such topics as:

- The adverse health impact of hazardous environmental exposures on populations
- How the interaction of socioeconomic status and environmental exposure contributes to health disparities
- Early biological effects of environmental agents in urban populations
- Community outreach and environmental health education
- The molecular epidemiology, exposure assessment, and mechanisms of action of agents found in the urban environment

Deadline for submission is January 16, 2006