Community Outreach and Education Programs

On January 29th, the University of Rochester's Life Sciences Learning Center went to the Rochester Museum and Science center to present a Science Saturday session in infectious diseases. Visitors to the RMSC performed mock ELISA assays, looked at microscopic parasites and learned the value of hand-washing through different activities. RMSC Science Saturdays bring science to the general public in the form of hands-on experiments and demonstrations presented by community science organizations each Saturday from October to May. The LSLC now joins other Science Saturday participants, including scientists from Eastman Kodak and researchers from RIT's Carlson Imaging Center, in providing opportunities for the community to experience science. On April 16th, the LSLC presented another Science Saturday session on DNA.

Welcome to Our Newest Faculty Member

Dr. Camille Anne Martina, PhD

Dr. Camille Anne Martina joined the Department of Environmental Medicine as a Research Assistant Professor in the Center for Science Education and Outreach in February 2005. Camille has her PhD in Education from the University of Rochester in which she studied the role and access of institutional agents using French sociologist Pierre Bourdieu's social reproduction theory. Dr. Martina's PhD study was inspired by her seventeen years of observations as an urban educator for the Rochester City School District. Furthermore, Dr. Martina is not unfamiliar with the Department of Environmental Medicine; she worked as a research assistant on our "My Environment, My Health, My Choices" project as a curriculum consultant and program evaluator and currently continues her role in this program. One of Dr. Martina's interests is to create more educational (K-postgraduate) and community outreach programs that "translate" the scientific research advanced by the work of our Center scientists in the construct of environmental health.

Grant Awarded

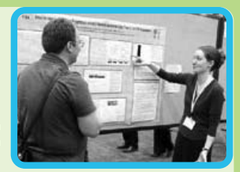
William S. Beckett, M.D., M.P.H. has received a grant from the Centers for Disease Control/Agency for Toxic Substances and Disease Registry. He will be working with the director of the National Institute of Miners' Health in India on a study of the relative lung toxicity of tremolite versus chrysotile asbestos fibers. Data collection will begin in May. Shirley Eberly from the Department of Biostatistics will assist with the data analysis on this study.

Toxicology Training Program News

The Society of Toxicology s 2005 Rochester Alumni Reception took place on March 8th in New Orleans.

Award Presented:

Geniece Lehmann: 1st Place Student Award; Immunotoxicology Specialty Section
Donna Lee: 2nd Place Student Award; Neurotoxicology Specialty Section
Christine Palermo: 2nd Place Student Award; Mechanisms Specialty Section



Congratulations to the following Toxicology graduate student who were recently awarded their PhD s:

¥˚**Russell Garrett,** Advisor: Thomas Gasiewicz, Ph.D. Thesis title: "A Role of the Aryl Hydrocarbon Receptor in Hematopoietic Precursors: Consequences to the Knockout Phenotype and 2, 3, 7, 8 Tetrachlorodibenzo-p-Dioxin Exposure."

¥˚**Carissa Filbrandt,** Advisor: Thomas Gasiewicz, Ph.D. Thesis title "The Blood Brain Barrier as a Target of 2,3,7,8 tetrachlorodibenzo-p-dioxin Toxicity mediated by the Aryl Hydrocarbon Receptor."

¥˚**David Lehmann,** Advisor: Harold Smith, Ph.D. Thesis title: "Role of Phosphorylation of Apobec-1 Complementation Factor, ACF, in Ethanol-Stimulation of ApoB mRNA Editing."

¥˚**Mary Williamson,** Advisor: Lisa Opanashuk, Ph.D. Thesis title: "Aryl Hydrocarbon Receptor Expression in Cerebellar Granule Neurons: Implications for Development and Neurotoxicity"

¥˚**Jason Michael Roper,** Advisor: Michael O'Reilly, Ph.D. Thesis title: "The Response of Alveolar Type II Epithelial Cells to Oxidative Stress from Hyperoxia"

Two of our former graduate studens were awarded Paper of the Year, Immunotoxicology Specialty Section, Society of Toxicology, 2005

Laiosa, M.D., Wyman, A., Murante, F.G., Fiore, N.C., Staples, J.E., Gasiewicz, T.A., Silverstone, A.E. (2003). Cell proliferation arrest within intrathymic lymphocyte progenitor cells causes thymic atrophy mediated by the aryl hydrocarbon receptor. Journal of Immunology.J. Immunol. 171: 4582-4591.2003.

Researchers Probe Link Between Nanotechnology and Health

by Leslie Orr

Nanotechnology, a hot scientific field devoted to engineering things that are unimaginably small, may pose a health hazard and should be investigated further, warns Gü9fnter Oberdö9arster, Ph.D a worldwide expert in the field, who received a $5.5 million grant in 2004 to conduct such research.

Dr. Oberdö9arster, Professor of Toxicology in Environmental Medicine and Director of the University of Rochester's EPA Particulate Matter Center, has already completed one study showing that inhaled nano-sized particles accumulate in the nasal cavities, lungs and brains of rats. Scientists speculate this buildup could lead to harmful inflammation and the risk of brain damage or central nervous system disorders. Oberdö9arster's study appears in the May 2004 journal Inhalation Toxicology, and is receiving widespread attention in the scientific community.

Backed by $600 million in recent federal funding and the support of President Bush, nanotechnology is a rising industry in the United States. Other countries such as Japan and Taiwan are also racing to produce nanomaterials, which can be applied to electronics, optics, medical devices and other industries.

The nanotechnology evolved when scientists found ways to manipulate carbon, zinc and gold molecules into microscopic clusters that could be useful in building almost anything ultra-small. Medical applications under development include using nanoparticles as drug-delivery systems, or as a super-advanced type of radiation therapy that could eradicate tumors with heat-seeking missile precision.

However, some scientists are concerned that the industry is moving too quickly. Oberdö9arster and colleagues are developing a model that will predict the toxicity of certain nanoparticles. Oberdö9arster is leading the five-year study, employing a multidisciplinary team from ten departments at three universities (University of Rochester, University of Minnesota, Washington University at St. Louis.)This collaborative team plans to test the hypothesis that the chemical characteristics of nanoparticles determine how they will ultimately interact with human or animal cells. A negative cellular response may indicate impaired function of the central nervous system in the nose of rats traveled into the olfactory bulb.

At this point the team is not entirely opposed to nanotechnology, Oberdö9arster explains. In fact, researchers hope to work with the industry, as well as with the American and Canadian governments, to seek solutions if problems arise. Another goal is to develop an ed
that future enginee
understand the he
nanotechnology.

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studied how the b
ambient ultrafine pa
automotive and power plant emissions and dust from the World Trade Center disaster. What's different about nanotechnology is that these particles are man-made into a well-defined size, down to a billionth of a meter, and appear to seep all the way into the mitochondria, or energy source, of living cells.

"We must consider many different issues before we come to a judgment on risk," he says. "Foremost is an assessment of potential human and environmental exposure by different routes: inhalation, ingestion, dermal. Then, what is their fate in the organism? And what are the risks of cumulative effects, given that these particles are being mass produced? At this point we're trying to balance the tremendous opportunity that nanotechnology presents with any potential harm."

Despite the concerns raised by his research, Oberdö9arster is not categorically opposed to nanotechnology. "I'm not advocating that we stop using nanotechnology, but I do believe we should

Your Health & the Environment
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Your Health & the Environment
NEWS FROM THE UNIVERSITY OF ROCHESTER
ENVIRONMENTAL HEALTH SCIENCES CENTER • FALL ISSUE 2004

Q: What contributes to roughly 100,000 deaths per year?

A: Particulate Matter

What is Particulate Matter?

Particulate matter (PM) is what you observe when you see the 'dirty-looking' exhaust coming from a diesel truck. It's also what you can't see coming from that exhaust pipe. Particulates are also formed naturally from volcanic eruptions (Mount St. Helen), wind-blown soil, and forest fires.

Particulate matter is contributing factor to ambient (outdoor/surrounding) air pollution. It is a general term for a mixture of microscopic solid particles and liquid droplets that are found in the atmosphere, like a fine dust or mist (an aerosol). PM can be composed of a variety of materials; including sulfate, nitrates, metals, or soil particles. The smallest particulates are invisible to the naked eye while larger ones can easily be seen.

PM is classified by characteristics such as the mode of generation, size, composition, or source. By understanding these characteristics, people are able to identify where and how the particulates were created. Research has found that one of the most important characteristics of PM is its chemical composition. These characteristics are important to understand in order to create regulations that protect human health and the environment in the most efficient manner. Current research is helping to accomplish this.

Effects of Particulate Matter

Human Health Effects and other Consequences

Current research is clarifying that not only is the respiratory system negatively affected, but the cardiovascular system and central nervous system are impacted by PM as well.

- development of acute respiratory symptoms (aggravated coughing)
- development of long term ailments (bronchitis, decreased lung function)
- development of lung cancer
- negative impacts to the cardiovascular system
- negative impacts to the central nervous system
- increased risk of mortality (death)
- increased morbidity (hospital/emergency room visits)
- increased insurance for all due to hospital visits of those that become sick
- school and work absences
- children unable play outside on certain days

Susceptible Populations

Particulate matter is harmful for everyone. However, there are susceptible populations who present an even higher risk of mortality and morbidity when exposed to PM.

- elderly
- young
- pre-existing cardiovascular diseases (heart disease, prior issues such as a heart attack)
- pre-existing respiratory diseases (chronic obstructive pulmonary disease-COPD, chronic bronchitis, asthma) diabetics

A recent report by the American Lung Association, "Diesel and Health in America: The Lingering Threat," states that New York has the nation's highest rates of disease and death that are due to exposure to diesel fuel exhaust. This exhaust is an aerosol which is composed of particulate matter coated with other toxins.

Continued on panel 4.

Online Resources:

- http://ehp.niehs.nih.gov
- http://es.epa.gov/ncer/science/pm/centers.html
- http://pubs.acs.org/journals/estha/index.html
- http://www.epa.gov/airnow/particle/airborne.html
- http://www.savewollicreek.8m.com/particmatter.htm
- http://air.tamuk.edu/noaca_2000/particulate.html
- http://www.ioe.ucla.edu/publications/report01/ParticulateAirPollution.htm
- http://www.rachel.org/bulletin/bulletin.cfm?Issue_ID=2371
- http://www.ibiblio.org/ncair/index php?page=particulate
- http://www.airmonitoring.utah.gov Pm10.htm
- http://www.nano.gov/index.html
- http://www2.envmed.rochester.edu/envmed/PMC/indexPMC.html
- http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/outlinks.centers/centerGroup/1

Particulate Matter Centers

The University of Rochester Particular Matter Center is one of five particulate matter research centers developed from a grant from the U.S. Environmental Protection Agency (EPA) as a part of its Science to Achieve Results (STAR) program. The Center has completed its 5th year and is currently in the renewal process.

What Are the Particulate Matter Centers?
In order to integrate scientific assessment and policy decision making, the Environmental Protection Agency (EPA)'s Clean Air Act requires a review of the National Ambient Air Quality Standards' criteria pollutants every five years. These indicators of air quality are PM10 (particulate matter with diameter <10 m), Nitrogen Dioxide (NO2), Sulfur Dioxide (SO2), ozone (O3), Carbon Monoxide (CO_2), and lead (Pb).

During the 1990's, researchers made significant progress on understanding the health impacts of particulate matter, especially those of very small particles. With this knowledge, in 1997 the EPA proposed new National Ambient Air Quality Standards to include standards for fine particulates, known as PM2.5. These fine particulates, as well as ultrafines (<100 nm), are often found in vehicle exhaust. Due to fine particulates' characteristics, the EPA decided that they should be addressed differently than the larger particulates (PM10).

Concurrently, the EPA began a multimillion dollar research program in order to better understand the physical/chemical characteristics of particulates, as well as the sources of airborne particulates, how much particulate matter people are exposed to, and how these particulates cause disease. This led to the creation of the Committee on Research Priorities for Airborne Particulate Matter in 1998. This committee generated a report suggesting that coordinated and multidisciplinary research was needed in order to address the ten top priorities they established. This report, as well as other research in the field, led the EPA to establish a program of integrated university-based research. In 1999, five centers were awarded grants as a part of the EPA's Science to Achieve Results (STAR) program in order to address policy-related scientific uncertainties about particulates. They were charged with addressing the ten priorities in a multi-disciplinary, integrated, and open manner. Currently, these centers have finished up their first five years under the grants and are currently awaiting renewal.

What were the Committee s research priorities for the five Centers?
1. Relationships between indoor and outdoor air quality
2. Characteristics and exposure of particulates
3. Development of new technologies and analytical tools
4. Applying new analytical and modeling tools
5. Toxicology and epidemiology studies
6. Dosimetry
7. Exposure length and co-pollutants
8. Susceptible subpopulations
9. Toxicological mechanisms leading to death or illness
10. Statistical Methods

The Centers *The following are some of the Centers focuses and findings.*

I. Harvard University Particulate Matter Center
- focus: differences between indoor and outdoor sources by taking into account that what people inhale is different than the data monitoring sites collect
- finding: connection between ambient air pollution and arrhythmias (abnormal heart rhythms)

II. North West Center for Particulate Air Pollution and Health (University of Washington, Seattle)
- focus: characterizing the NW aerosol composition and characteristics, determining the potency of particulates due to their composition.
- finding: correlation between long-term exposure to PM2.5 and the development of cardiovascular disease.

III. New York University School of Medicine Particulate Matter Center
- focus: identification of PM characteristics that cause a negative impact on human health.
- finding: exposure to low concentrations of PM and ozone creates a more significant negative health effect than just unaccompanied low concentrations of PM

IV. Southern California Particle Center and Supersite
- focus: emission sources and adverse health effects
- finding: an association between low birth weight and traffic density

V. University of Rochester Particulate Matter Center
Studies at the University of Rochester were focused on examining the correlation between ultrafine particles in an urban environment and the resulting health effects, especially in susceptible populations. The University of Rochester led the consortium of researchers which also included the Clarkson University, University of San Diego, and the National Center for Environmental Research in Munich, Germany.
Some of their research findings include:
- on a mass basis, ultrafines cause greater adverse effects than fine and coarse particulates.
- when ultrafines are inhaled, they are deposited in human tissue to a higher degree than fine and coarse particulates in the respiratory tract; this deposition of ultrafine particulates is noted as being higher in asthmatics

The University of Rochester Particulate Matter Center is composed of five Research Cores. Below is a summary of the research that was conducted in each of the Research Cores:

1. Characterization of the Chemical Composition of Atmospheric Ultrafine Particles
Studies were conducted in order to gain detailed knowledge on the physical and chemical characteristics of ultrafine particles. Methods were first developed in order to study ultrafine particles because previous technology was based on larger particulates. An Ultrafine Concentrated Ambient Particle System, built at Harvard and tested in collaboration with the Center there, is one of these new methods. This system allowed for particle characterization of ultrafines and controlled exposure of animal and human subjects to ambient ultrafine particulates which enabled researchers to correlate physical and chemical characteristics with adverse health effects.

2. Inflammatory responses and cardiovascular risk factors in elderly subjects with cardiopulmonary disease in association with fine and ultrafine particles
This Core studied the effects of fine and ultrafine particle exposure on people who have a preexisting cardiopulmonary disease. Two groups of people with stable coronary artery disease and chronic obstructive pulmonary disease were studied.

This Core group found that exposure to ultrafine and fine particles can increase the risk for cardiac morbidity and in people who have preexisting heart disease.

3. Clinical studies of ultrafine particle exposure in susceptible human subjects
In a controlled environment with healthy and potentially susceptible subjects, researchers studied where in the body ultrafine particles were deposited and looked at the possibility that exposure to ultrafine particles caused respiratory and cardiovascular health effects. Volunteers were recruited and they rode on bikes while being exposed to ultrafine carbon. One of the conclusions from this study is that "ultrafine particle deposition is increased in mind asthmatic subjects compared with healthy subjects."

4. Animal Models: Dosimetry, and Pulmonary and Cardiovascular Events
This core focused on particle size, lung deposition and disposition, host susceptibility (the elderly and those with cardiovascular disorders), and the impact of gaseous co-pollutants using laboratory-generated and highway aerosols.
A mobile emissions lab (MEL) was used to expose rodents to exhaust from MEL itself and from surrounding vehicles as they were actually being driven on the New State throughway between Rochester and Buffalo. Some rodents were pre-exposed to endotoxin or influenza virus to induce lung inflammation in order to study susceptible hosts. Both the cardiac and vascular systems were affected. This research showed that ultrafine carbon particles and manganese oxide can be translocated from the upper respiratory system to the central nervous system.

5. Ultrafine Particle Cell Interactions: Molecular Changes Leading to Altered Gene Expression
In vitro studies were conducted in order to better define mechanisms of response. This Core focused on the Center's overall emphasis on ultrafine particles and their unique physical

Q: What contributes to roughly 100,000 deaths per year?

A: Particulate Matter

Continued from panel 1.

articulate Matter and the Environment
PM is also destructive to the environment. It changes the nutrient and chemical compositions of soil and water, thus harming ecosystems. Fine and ultrafine particles can travel from a coal-fueled power plant in Ohio and land in the Adirondacks. Sulfates comprise a major part of the PM chemical composition which contributes to acidifying the lakes and killing off fish. Physical structures such as monuments, bridges and buildings can become corroded. It is known that the smaller and ultra-fine particulates are contributing factors to decreased visibility (haze) in many cities and towns.

Policy and Particulate Matter History:
People once thought that PM was just a nuisance, not a health risk. However, research has found that it is a threat to human heath and the environment. Current research and analysis is being conducted in order to protect human health (primary standards) and the environment (secondary standards) in the most effective manner.

After initial air sampling research in 1987, the government established air quality standards for coarse particulate matter of less than 10 microns in diameter (PM10). This was during a time when there was in increasing interest about the connection between PM and human health. However, in 1997 the EPA found that while both fine (less than 2.5 microns in diameter, PM2.5) and coarse particulates have negative effects on human health, PM2.5 was more active in its negative effects .As a result, the PM10 regulations were changed in order to address PM2.5, and new national ambient air quality standards were established.

The U.S. Court of Appeals remanded these standards back to the EPA in response to a lawsuit brought by the American Trucking Associates against the EPA in 1999. In 2002, the court found that by having both PM10 and PM2.5 standards, PM2.5 was getting double-regulated and PM10 was getting under-regulated. Therefore, the court directed the EPA to develop a new PM10 standard. The court ruled against the industry groups that claimed that the regulations were based on bad science.

Recently, new National Ambient Air Quality Standards (NAAQS) have been passed in order to address this issue, in part, to the studies conducted at particulate matter research facilities. This research that supports the new standards, which would delineate and designate coarse particulates as those falling between PM10 and PM2.5. Therefore, particulates smaller than PM2.5 would no longer fall under the umbrella of PM10.

"Particulate Matter Centers" will provide details on the research that has been conducted in order to constructively characterize particulates and address policy-related scientific uncertainties.

Basic Characterizations of Particulate Matter
Particle Size: This is based on the diameter of the particle and is measured in microns (um). Total Suspended Particles (TSP) have diameters less than 50 um. Particles of concern to human health are usually 10 um in diameter or less (PM10) because they efficiently deposit in the respiratory tract.
Since the size of the particle greatly influences the health risk, particles less than 2.5 um (PM2.5) and 0.1 um are categorized separately for more useful test results. PM2.5 denotes that the particle is less than 2.5 microns so it doesn't include the larger particles that PM10 includes.
New technologies are being created in order to have the ability to research ultrafine (<0.1 um) particles with more accuracy. These ultrafine particulates are also known nanoparticles and have the largest surface area, in relation to the actual mass and volume, compared to PM10 and PM2.5.
Generation:
- Primary particulates are released directly from their sources into the atmosphere (direct emissions). These include soot, road dirt, and condensation of vapors during combustion, and forest fires.
- Secondary particulates are mainly formed from the photochemical reaction of gases that have been released in the atmosphere. For example, the gases which are directly released from vehicles are sulphur dioxide, nitrogen oxide, and hydrocarbons (primary particulates). After being released, chemical reactions will transform the gases into nitrates, sulfates, and organic carbon compounds which are now comprised of solid particles and liquid drops. Temperature and humidity can effect these chemical reactions.

Mode: Particles can also be characterized by their mode: nuclei, Aitken, accumulation, and coarse particle modes. The nuclei and Aitken modes are mainly comprised of ultrafine particulates. The source is often motor vehicles (or other combustion sources) and can be either the primary or secondary particulates.

The majority of the particles in the accumulation mode are fine particulates. The source includes combustion and nuclei particles that have attached to the fine particulates. Coarse mode particles are the largest of the three and are usually generated by mechanical means and wind erosion.

Source: The source of particulates is important to understand in order to ensure useful regulations, technologies, and protection of human health. In the northwest, a majority of the particulates are from vehicles or vegetative burning sources. The PM in the eastern United States is mainly inorganic aerosols. Regional and seasonal differences (the north has less road dust in the winter due to the weather) influence the origin and significance of the source. Understanding the source is important because it helps to classify the chemistry of the particle.

Effect in the Body: The size of PM determines if and where it is deposited in the respiratory system. Respirable particles are those less than 10 m in diameter; size determines where deposition occurs along the respiratory tract. The smallest particles are deposited in all regions of the respiratory tract. Ultrafine particles can translocate from the nose to the olfactory bulb (the part of the brain which is the center of smell detection) and affects organs like the brain or liver. On a mass basis, ultrafines are potentially the most toxic. Larger

Nanotechnology

What is Nanotechnology?
The National Nanotechnology Initiative (NNI) is a multi-agency federal research and development program which was created in order to coordinate the work being done and future plans regarding nanotechnology. They describe nanotechnology as *research and technology development at the atomic, molecular or macromolecular levels (1-100 nanometers); creating and using structures, devices and systems that have novel properties and functions because of their small and/or intermediate size; and the ability to control or manipulate on the atomic scale.* This nanoscale is based on the nanometer which is 1 billionth of a meter. This is about how far your fingernails grow in a day.

Dr. Ralph Merkle, a distinguished professor of computing at Georgia Tech who has done extensive work in this field, describes nanotechnology in a more concrete fashion. "Today's manufacturing methods are very crude at the molecular level. It's like trying to make things out of LEGO blocks with boxing gloves on your hands. Yes, you can push the LEGO blocks into great heaps and pile them up, but you can't really snap them together the way you'd like. In the future, nanotechnology will let us take off the boxing gloves."

Nanotechnology has the potential to create more precision and efficiency in the field that it is applied to. The large surface area and extremely small scale of nanoparticles allow for numerous applications. There has been research in this field for twenty years, but the actual applied use is limited in these early stages. One current use are quantum dots. These are semi-conducting nanocyrstals that allow for optical medical diagnostic detection that can identify and locate cells by lighting them up with a spectrum of colors that can be up to a thousand times brighter than conventional dyes. However, these current and future possibilities also bring up concerns.

The University of Rochester and Nanotechnology
The University of Rochester received a grant from the Department of Defense Multi-Disciplinary University Research Initiative (MURI) in 2004. This is one of the programs that is associated with the NNI. The Rochester MURI group is currently using in vitro and in vivo experiments in rodents and creating models in order to study the physical and chemical characteristics as well as the adverse biological effects that are caused by nanoparticles. The research at the University of Rochester suggests that ultrafine particulates can affect the health and functions of the lungs, heart, and brain. The researchers believe that the nanoparticles' physical and chemical characteristics will determine how they interact with cells.

Current Uses of Nanotechnology:
- mechanical polishing
- automotive catalyst supports
- optical fibers
- clothing (stain resistant, wrinkle-free)
- water filters
- protective coating for eyeglasses
- sunscreens

Future Uses of Nanotechnology:
- smaller computers with more capabilities
- sensors for airborne chemicals
- artificial red blood cells

Concern of Nanotechnology:

Health and Safety of humans and the environment:
With a greater ability to penetrate tissues and cell membranes, nanoparticles pose a threat to the people working with them as well as the general public.

Standard Regulations:
Regulations need to be created so that everyone from researchers to factory workers use the same units of measurement, emission standards…

Seemingly Endless Uses:
The potential uses of nanotechnology are massive and end results could cause major damage to humans and the environment.

Research is being conducted by groups such as those in the National Nanotechnology Initiative to address some of these concerns. One example of this research is occurring at the University of Rochester's Department of Environmental Medicine.