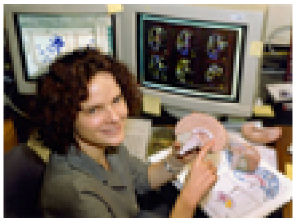

Brookhaven's Volkow has a craving for science.

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DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

Number 79 April 23, 2001

Research Highlights . . .

From greenhouse to useful gases

Scientists at DOE's National Energy Technology Laboratory are working to develop a catalytic process that converts natural gas and carbon dioxide, both greenhouse gases, into synthesis gas, a mixture of hydrogen and carbon monoxide that can be used to produce fuels or chemicals. Diesel fuel made from synthesis gas produces less pollution than conventional diesel fuel. This process can also be used for recovering energy losses in combustion/gasification systems or advanced gas turbines, leading to an increase in overall efficiency. The major challenge in this area is developing catalysts that operate at high pressure and temperature without forming excess carbon. NETL has developed and tested several catalysts with encouraging preliminary results.

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Solar estimator program aimed at cooler cars

The Center for Transportation Technologies and Systems team at DOE's National Renewable Laboratory has developed the Load Estimator (VSoLE) program to address questions about the effects of various types of window glazings on how much a vehicle cabin heats up and how much of that solar energy is absorbed by the glazings. Industry can use this tool to develop glazings that will best keep drivers and passengers comfortable while reducing energy use. The VSoLE program will be integrated with NREL's Advanced Vehicle Simulator (ADVISOR), which can be used to analyze glazing effects further.

[Sarah Holmes Barba, 303/275-3023, sarah_barba@nrel.gov]

Polymer gel holds medical promise

Researchers at DOE's Pacific Northwest National Laboratory have developed a new polymer-based material with unique gelling properties that may be useful in medical applications ranging from targeted cancer treatment to tissue engineering. Physicians will be able to inject a mixture of the polymer and a medicinal solution directly into a specific target in the body, where it would warm and instantly gel. While more research remains to be done before this becomes an accepted medical procedure, stimuli-sensitive gels show promise for the effective treatment of inoperable tumors and may be able to support repair of articular cartilage—the durable type of cartilage that provides cushion between joints.

[Geoff Harvey, 509/372-6083, geoffrey.harvey@pnl.gov]

Real-world survivors are motherly

According to popular culture, survival depends on rugged individualism, ruthless cunning and athletic prowess. In practice, however, real-world survivors more often exhibit benevolent leadership, personal sacrifice and endurance born of sheer will, says a geographer at DOE's Oak Ridge National Laboratory. Historical and recent events overwhelmingly contradict the rat-eat-rat mentality of shows like "Survivor." In contrast, Ernest Shackleton, who led his entire crew to safety after being stranded for 18 months on Antarctica's ice, was described as "motherly" in his concern for each man's safety.

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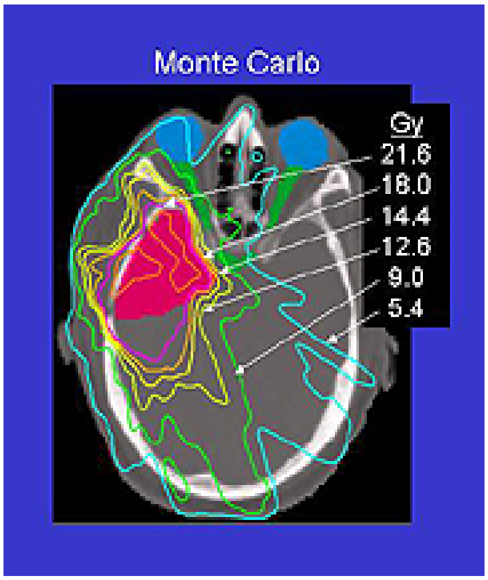
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***DOE Pulse*** (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

SLAC software finds place in cancer battle

A computer program developed at DOE's Stanford Linear Accelerator Center to simulate showers of high-energy particles is finding extensive use in cancer therapy.

Ralph Nelson of SLAC's Radiation Physics department originally wrote the EGS (for Electron-Gamma Shower) software to mimic the streams of energetic electrons and photons that flow through particle detectors and shielding. Medical physicists then adapted the program to aid in planning X-ray treatments to reduce or eliminate tumors.



Simulation of radiation therapy for a brain tumor (red area). The contour lines show X-ray dosages as calculated by the EGS program. (Source: Stanford Medical Center.

EGS can simulate the paths and energy deposits of particles in an endless variety of materials and geometries. In the late 1980s, researchers at the National Research Council of Canada extended the software to include lower-energy electrons and photons that arise in medical applications. The program has since witnessed steadily increasing applications in radiation therapy, with hundreds of users worldwide.

When a patient goes under an X-ray machine, it is crucial to concentrate as much energy as possible on the tumor and minimize what strikes nearby healthy tissues. Using EGS, therapists can design X-ray beam configurations to achieve this goal.

"The medical community's response to EGS has been overwhelming," says Nelson, who is pleased that his program has found such wide, beneficial applications. More than 60 percent of its use, he estimates, occurs in medicine. One reason for this growth, he surmises, is the exponential increase in computer power due to faster microchips. The long, detailed Monte Carlo simulations, which originally required a large mainframe computer, can now be done on a desktop computer.

Such computer power permits use of EGS in planning treatments for individual patients, which medical physicists are pursuing at nearby Stanford Medical Center. This approach helps reduce errors that can occur when a tumor is small or located in sensitive areas such as the head, neck or lungs.

Submitted by DOE's Stanford Linear Accelerator Center

Addicted to Science

Nora Volkow

Nora Volkow, associate laboratory director for Life Sciences at DOE's Brookhaven National Laboratory, has a hunger for knowledge that would rival a cocaine addict's craving for the drug. Through science, she seeks to understand the very source of understanding—the human brain.

Within the past year alone, she has published studies on how Ritalin, the drug commonly prescribed for Attention Deficit Hyperactivity Disorder (ADHD), helps children to concentrate; how aging depletes certain brain chemicals associated with sensing pleasure and reward; and how obese people's brains differ from normal-weight subjects'.

But Volkow's chief obsession is pinning down the biochemical nature of drug addiction. Through years of research using specifically tailored radiotracers and Brookhaven's positron emission tomography (PET) scanners, Volkow has mapped the neurological actions of a wide range of addictive drugs, including cocaine, methamphetamine, marijuana, alcohol, and nicotine. "All interfere with the brain's pleasure and reward circuits," Volkow says.

Specifically, these drugs affect the brain's supply of dopamine, a neurotransmitter that produces feelings of satisfaction and pleasure. Initially, addictive drugs produce increases in dopamine, which accounts for the 'high' many drug users experience. But Volkow's PET studies have shown that, over time, "drug abusers lose dopamine receptors, so they lose the ability to respond to dopamine and cease to experience the pleasure," Volkow says. The *desire* for the pleasure, however, does not go away. So abusers take more of the drug to try to achieve it.

A board-certified psychiatrist, Volkow hopes to use her research to find an effective pharmacological treatment for addiction. "Through knowledge of what drugs do to the human brain, we may be able to understand better why people become addicted, and to develop better treatments for addiction and for prevention," she says. One such treatment is currently being investigated in collaboration with Brookhaven's Chemistry Department.

Submitted by DOE's Brookhaven National Laboratory