How cells communicate,

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Research Highlights . . .

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'Flight simulator' for computer system administrators

Just as flight simulators provide real-world experience to pilots without jeopardizing lives, a new cyber security training capability under development at DOE's Pacific Northwest National Laboratory will give computer system administrators experience defending against cyber attacks without compromising their networks. PNNL scientists have created a prototype Systems Administrator Simulation Trainer, or SAST, to rapidly develop the cyber security experience of system administrators in any type of organization in order that they might identify, circumvent or recover from hacker activity. The program consists of a network of training tools that simulate the cyber environment and are launched through an automated system.

[Staci Maloof, 509/372-6313, staci.Maloof@pnl.gov]

New insights on complex materials

Researchers from Stanford University and the DOE's Stanford Linear Accelerator Center have recently pioneered a technique called angle-resolved photoemission spectroscropy (ARPES) to study the behavior of complex materials. In this method, a high-resolution spectrometer detects electrons emitted from the material surface by intense X-ray beams. ARPES has proved especially effective in research on high-temperature superconductors, whose behavior remains mysterious over a decade after their discovery. One recent experiment suggests that this kind of superconductivity may be due to the formation of electron pairs, as in ordinary superconductors, but that a more exotic pairing mechanism is involved.

[Michael Riordan, 650/926-2620, michael@SLAC.Stanford.EDU]

New animal imaging device

The Fast Electronics Group (FEG) at DOE's Thomas Jefferson National Accelerator Facility is collaborating with the National Institutes of Health and the Unidad de Medicina Experimental (Madrid, Spain) to create a new animal imaging device. "This project is exciting and on the leading edge of medical imaging research," says FEG leader Chris Cuevas of NIH's Advanced Technology Laboratory Animal Scanner (ATLAS). "Our collaboration with them on this project has been a perfect intermingling of talents and technology." For the ATLAS device, JLab developed signal processing amplifiers and circuit boards that will give the scanner the ability to produce a high level of sensitivity and high-resolution uniformity throughout the depth of the organ or tissue being studied.

[Debbie Magaldi, 757/269-5102, Magaldi@jlab.org]

New standard set for scientific visualizations

A 10-foot-high, 13-foot-wide screen developed at DOE's Sandia National Laboratories produces digitized images, created of 20 million pixels, approach the visual acuity of the human eye. The new screen is not only the clearest but also, says manager and program leader Philip Heermann, "to my knowledge the fastest in the world in rendering complex scientific data sets. Images are as crowded, yet detailed, as if every ear of corn on a 100-acre farm were caught in a single image by a camera at 21,000 feet. The images are expected to enable better views of complicated systems, such as crashes and fires, but the facility is also valuable for microsystems, nanotechnology, and biological explorations.

[Howard Kercheval, 505/844-7842, hckerch@sandia.gov]

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).

Enlisting the help of the natives in groundwater clean-up

Through two miles of deep, fractured Idaho rock, engineers track how native soil bacteria clean up the groundwater.

In 1998, civil engineer Kent Sorenson and his team at DOE's Idaho National Engineering and Environmental Laboratory recruited microorganisms to break down the toxic trichloroethylene (TCE) leaching into the groundwater. The experiment worked even better than planned, and since then, the laboratory has turned TCE cleanup over to the bacteria.

But the scientists are still trying to figure out exactly why it works so well: which microbes mop up the toxin, how they do it so effectively, and what helps them break down even the most concentrated TCE-sludge.

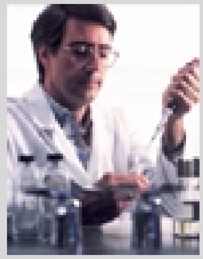
The answers are complex because the underground population dynamics are complex. Sorenson said it takes more than one type of microbe to break down TCE—one species will take TCE only so far, and then hand it off to another to finish the job. Even bacteria not directly involved in TCE degradation change the environment to make it more or less favorable for the TCE work. The separate populations wax and wane with their food sources to create shifting boom-and-bust communities.

To find out which populations are necessary for complete bioremediation, Sorenson created a laboratory environment that mimics what he sees in the field. He uses genetics to carefully trace which microbes are present during each breakdown cycle. Sorenson hopes to reveal the natural underground population changes so he can help engineers apply the bioremediation streamlined at INEEL to other similarly contaminated sites—underneath most dry cleaning businesses, and at about half of the superfund and federal remediation sites.

"Understanding the microbial ecology of a system is a really important step to being able to create the most efficient conditions for TCE dechlorination," Sorenson said. That understanding will help him encourage the right bugs to grow, at the right time, to fully decompose one of the most obstinate groundwater contaminants.

Submitted by DOE's Idaho National Engineering and Environmental Laboratory

PNNL's Wiley explores cell signaling



Steve Wiley

Steve Wiley is a cell biologist whose passion for science is driven by his fascination with the communications process. A biologist by training, Steve has always been drawn to the performing arts. He says there are many similarities between the human communications process and the cellular communications process.

"Life is communications. To manipulate living organisms you have to learn how to manipulate communications. This is true whether you are promoting a product through advertising or trying to change cellular activity by changing its environment."

Cellular biology has entered into a new paradigm which recognizes that individual cell response is not necessarily hard-wired in genes or orchestrated by central hormonal systems. Rather, cells respond independently and flexibly to a changing environment.

New to DOE's Pacific Northwest National Laboratory, Steve has found himself at the forefront of this paradigm as he leads a Laboratory initiative to understand the cell signaling process. The initiative is a key component of DOE's Genomes to Life program. "Even a simple organism is so complex that we need to encapsulate the complexity, capture it and reduce it so we can deal with it. Fortunately, cells are subject to the same physical and chemical properties that govern the rest of the universe. They followed physical laws during their evolution. That understanding helps reduce the complexity, but it's only the first step."

Wiley spent 18 years on the faculty of the University of Utah. He was lured away from academia to PNNL by the opportunity to collaborate and communicate. "The national laboratory system is the perfect place to pursue this branch of science," says Wiley. "It offers an opportunity to collaborate with researchers around the country to solve one of the most complex challenges facing science today. I couldn't walk away from that kind of opportunity."

Submitted by DOE's Pacific Northwest National Laboratory