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Research Highlights . . .

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

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Improving the search for environmental toxins

Security personnel may soon be using a hand-held device to analyze air, soil, or water samples in the field for the presence of dangerous chemical or biological toxins. Researchers with DOE's Berkeley Lab, led by Frantisek Svec and Jean Fréchet, have dramatically increased the efficiency of microfluidic chips by pairing them with a monolithic polymer-based material they invented. Microfluidic chips are typically small rectangular plates of glass, silica, or plastic that feature narrow channels which are used to isolate specific compounds from a sample. The Berkeley scientists improved microfluidic chip performances by filling an entire cross section of the channels with their monolithic porous polymers.

[Dan Krotz, 510/486-4019, DAKrotz@lbl.gov]

Virtual protein folding

Researchers at DOE's Los Alamos National Laboratory and the University of California - San Diego have created the first computer simulation of protein folding. The simulation focuses on the physics of the protein folding and looks specifically at temperature changes that occur in the process. Protein folding is a chemically and physically complex process with some protein molecules folding in millionths of seconds. The Los Alamos model simulates the folding of a relatively simple protein—consisting of about 18,000 atoms—in roughly 10 microseconds. The eventual goal of the simulation is to model the folding process of more complex protein structures.

[Kevin Roark, 505/665-0582, knroark@lanl.gov]

JGI to sequence notorious plant pathogen

Scientists at DOE's Joint Genome Institute will decode and study the genomes of two species of Phytophthora, a fungus-like microbe responsible for sudden oak death syndrome, soybean root rot, and a wide variety of other destructive plant diseases, including the Irish potato blight of the 1840s. By sequencing and comparing the DNA of the two Phytophthora genomes, the scientists hope to uncover clues to virulent diseases that are attacking 17 species of trees on the West Coast and causing serious damage to soybean crops in the Midwest and South.

[Charles A. Osolin, 925-296-5643, osolin1@llnl.gov]

New tools mimic the internal structure of rock

Stereolithography—an industrial technology that creates product prototypes from computer images using a three-dimensional laser printing process—has emerged as a scientific tool, owing to the creative vision of researchers at DOE's Idaho National Engineering and Environmental Laboratory. The team designed transparent, plastic models of natural rock, including simplified versions of their internal twists and turns, to examine the flow of water and even bacteria through the winding tunnels. They plan to create ever more realistic rock-renditions from scans of complicated fractures. The work opens a window into the "black box" of natural rock, says physicist Vance Deason, and paves the way for other scientific applications of the technology.

Water flows through simplified rock.

[Kendall Morgan, 208/526-3176, morgkk@inel.gov]

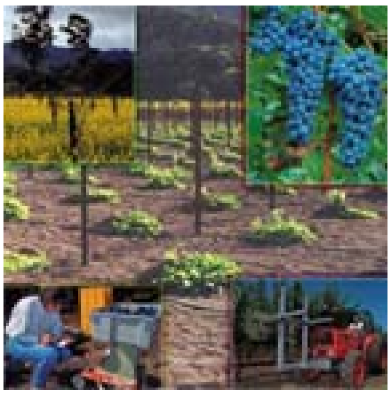
DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. ***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).

Wine industry to benefit from JGI microbe sequencing

All who enjoy the taste of wine stand to benefit from the latest round of genome sequencing at DOE's Joint Genome Institute, a collaboration of Lawrence Berkeley, Lawrence Livermore and Los Alamos National Laboratories funded by DOE's Office of Biological and Environmental Research.

JGI researchers have completed the sequencing of *Oenococcus oeni*, a lactic acid-fermenting bacteria that plays a critical role in de-acidifying wine after the alcoholic fermentation has been completed.

Most wine lovers know that yeast is used to ferment the sugar in the grape "must" (the mixture of skins, pulp, seeds and juice) into alcohol. Less familiar is the need in many wines for a secondary fermentation, the conversion of harsh-tasting malic acid into lactic acid, a much softer-tasting acid so-named for its presence in milk.



Wine is California's number one agricultural product in retail value with an estimated annual economic impact of $33 billion in wages, revenues and economic activity, according to a study commissioned by the Wine Institute and the California Association of Winegrape Growers.

In many wines, the malolactic fermentation will be carried out spontaneously by lactic acid bacteria, in particular, *Oenococcus oeni,* which is unusually tolerant of the wine's acid and ethanol concentrations. However, this species of bacterium grows slowly and if the malolactic fermentation process is not timed to start immediately after the alcohol fermentation, its performance can be sluggish.

"We want to gain a more comprehensive understanding of *Oenococcus oeni's* genetics and physiology, particularly in relation to its role in wines and other fermented foods and beverages," says David Mills, a viticulture and enology professor at the University of California at Davis. "We also want to identify and enhance the beneficial roles of these bacteria in food preservation and safety, and in the health of humans and animals."

Mills is co-leader, along with Utah State University professor Bart Weimer, of a nationwide, multi-institute scientific collaboration called the Lactic Acid Bacteria Genome Consortium. Through the consortium, Mills and Weimer developed a proposal for the *Oenococcus oeni* genome to be sequenced at JGI under DOE's Microbial Genome Program.

Submitted by DOE's Berkeley Lab

NREL's Nick Nagle: Focusing on the future

Nick Nagle

Nick Nagle, senior engineer at DOE's National Renewable Energy Laboratory, began his career in microbiology at a dairy production plant in Denver, Colo. But a love of kayaking brought him to NREL (formerly known as the Solar Energy Research Institute) in 1984.

"A bunch of the people I kayaked with worked at SERI and they urged me to come and see what it was all about," Nagle said. "Before long, I was hooked and I've been here 18 years."

Nagle's work at NREL's Biotechnology Division for Fuels and Chemicals has centered around microbiology, large scale fermentations, thermo-chemical pretreatment of biomass, pilot and engineering scale experience with anaerobic digestion processes.

"What we do here is so different and that is pretty exciting," Nagle said. "Our focus is really towards the future."

Nagle is currently working on an ongoing project involving washing of pretreated biomass for ethanol production. Researchers at NREL have discovered that by adding a Pressurized Hot Wash (PHW) step immediately after pretreatment, while the pretreated material is still at high temperature and pressure, significantly improves the overall process.

"One of the job benefits of working at NREL is that you're expected to bring your curiosity to work with you every day," Nagle said.

Nagle also is involved in an advanced corn mill project, looking for ways to extract more carbohydrates from distiller's grain for ethanol. Distiller's grain is the material left over after the fermentation of corn.

Nagle graduated from Colorado State University in 1976 with a degree in microbiology and returned to CSU to earn a master's degree in Environmental Engineering in 1990.

Submited by DOE's National Renewable Energy Laboratory