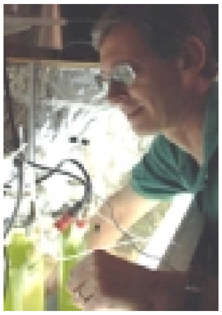

Biologist unleashes algae's potential.

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DOE Pulse

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Research Highlights . . .

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).

Berkeley Lab maps way to swift completion of fly genome

When Celera Genomics asked the Berkeley Drosophila Genome Project (BDGP) to join in completing the genome of the fruit fly in record time [*Science*, 24 March 2000], one reason was that the BDGP's major sequencing facility at Lawrence Berkeley National Laboratory had already constructed extensive maps of the location of specific DNA sequences on the fly's chromosomes. Using a library of bacterial clones, Susan Celniker, Roger Hoskins, and their colleagues assembled detailed maps of the major chromosomes and produced a "rough draft" sequence, which served as a check against Celera's whole-genome shotgun sequence and is being used to close some of its 1,600 gaps.

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Gas-O-Mat-ic

While humans breathe in oxygen and breathe out carbon dioxide, plants do just the opposite. Using plants to pull carbon dioxide out of exhaust streams of power plants and convert it to useful products such as oxygen may reduce the gas in the atmosphere. Chemical engineer Tish Stoots at the DOE's Idaho National Engineering and Environmental Laboratory, collaborating with the Center for Biofilm Engineering at Montana State University and the University of Memphis, is optimizing a mat of algae to use carbon dioxide power plant emissions as a nutrient for growth. Stoots also plans to increase the efficiency of the mat's photosynthesis, to better stuff carbon dioxide into carbohydrates.

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Quantum computing leaps

Scientists at DOE's Los Alamos National Laboratory recently made two experimental leaps forward in quantum information processing. Using nuclear magnetic resonance techniques, researchers created a seven-qubit quantum register, or computer, within a single drop of liquid. The development may someday lead to a functional quantum computer capable of solving large mathematical problems or encrypting secret codes at speeds far faster than today's supercomputers. Other researchers demonstrated the use of entangled photons—twin particles of light created by the same source but sharing identical properties—for quantum cryptography. This advancement of quantum encryption techniques offers heightened security against eavesdropping of free-space communications, such as data transmissions from earth stations to satellites.

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World's smartest transistor

A "smart" transistor takes advantage of a recent materials breakthrough, at DOE's Oak Ridge National Laboratory, in depositing a high-quality film of barium titanate on germanium. Unlike a silicon transistor, the field on the new transistor stays up or down all the time, so no external power is needed unless the field must be flipped. In addition, all the information in the "on" and "off" transistors is retained even when the power is turned off. The new transistor could pack in much more information than a silicon transistor, making possible a low-power gigabyte chip that could serve as the hard disk drive of a laptop computer and greatly extend battery life.

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Biologist unleashes the energy potential of algae

Michael Seibert found a way to "trick" algae to produce more hydrogen.

About 60 years ago, researchers discovered that not only could green algae split water, but it could release hydrogen as a byproduct. This was an important discovery, since hydrogen from water could help to meet future needs for a safe, versatile form of renewable energy.

In the decades since, scientists tried to discover how to cause the algae to produce more hydrogen.

Enter biologist Michael Seibert and his colleague, Maria Ghirardi, at DOE's National Renewable Energy Laboratory. In collaboration with Professor Tasios Melis of the University of California at Berkeley, Seibert discovered a new two-step process that shows promise for producing commercial quantities of hydrogen from algae.

"We played a trick on the organisms," Seibert said. "What is interesting is that we are able to produce large amounts of hydrogen without imposing all the expensive, mechanical or chemical processes used before."

Seibert and his team found a "switch" that turns off the part of the algae's photosynthetic apparatus, which splits water and releases oxygen. When that switch is flipped, by withholding sulfur from the culture, that part of photosynthesis stops over a daylong period.

"Now, the exact mechanism, we're still working on," Seibert said, "but it may be a process that uses storage product to produce the hydrogen. This will go on for a couple days, but before it stops we re-add the sulfur. At this point the cells recover, generate more storage product, and then we remove sulfur again. The process repeats and more hydrogen is produced."

Seibert, a biophysicist and molecular biologist by training, has worked at NREL longer than 22 years. Before that he conducted research for industry, but left to pursue a career in renewable energy so that he could help improve the energy outlook for the planet.

So, are algae the future of hydrogen production? While remaining skeptically optimistic, Seibert thinks that, "the two-stage process could well be a stepping stone to a one-stage process."

Submitted by DOE's National Renewable Energy Laboratory

Three labs form one "virtual lab" for fusion R&D

Lawrence Berkeley National Laboratory (Berkeley Lab) has joined forces with Lawrence Livermore National Laboratory (LLNL) and the Princeton Plasma Physics Laboratory (PPPL) in a memorandum of agreement (MOA) to create a "virtual lab" that will conduct research on heavy ion inertial fusion energy.

The MOA will be funded through DOE's Office of Fusion Energy Science.

Under the terms of the MOA, the three laboratories collaborating in the new Heavy Ion Fusion Virtual National Laboratory (HIF-VNL) will collaborate on "conducting heavy ion driver development and related topics in the common pursuit of Inertial Fusion Energy, and promoting more rapid progress in the development of heavy ion drivers through technical management integration of the laboratories' scientific staff, equipment, and experimental facilities."

In heavy ion fusion, high-powered beams of heavy ions ignite pea-sized capsules of deuterium and tritium fuel. The fuel burns so quickly it is confined by its own inertia long enough for the reaction to produce energy. A fusion reaction releases roughly one million times the energy released by the burning of oil without contributing to global climate change. Deuterium and tritium, isotopes of hydrogen, are readily obtained and so plentiful as to be virtually inexhaustible.

Roger Bangerter, of Berkeley Lab's Accelerator and Fusion Research Division (AFRD), a long-time leader in heavy ion fusion research, will be the director of the HIF-VNL. The deputy directors will be Grant Logan of LLNL and Ronald Davidson of PPPL.

The HIF-VNL agreement has been publicly hailed by Stephen Dean, president of the Fusion Power Associates, an independent fusion advocacy group, as proof that DOE's non-weapons labs can still collaborate on research projects with the weapons labs even though the latter is now a part of National Nuclear Security Administration.

Submitted by DOE's Lawrence Berkeley National Laboratory