Modeling Plant Metabolism To Optimize Oil Production

Computational studies aim to increase use of plant oils as renewable resource

Scientists at BNL have developed a computational model for understanding the metabolic processes in rapeseed plants — particularly those related to the production of plant-derived biodiesel. This work was supported by DOE’s Office of Science.

“The model, described in two featured articles in the August 1, 2011, issue of the Plant Journal, may help to identify ways to maximize the conversion of carbon to biomass to improve the production of plant-derived biodiesel,” Schwender said.

One way to study these metabolic pathways is to observe the uptake and allotment of a form of carbon known as carbon-13. As it is incorporated into plant oil precursors and the oils themselves. But this method has limits in the analysis of large-scale metabolic networks such as those involved in partitioning nutrients under variable physiological conditions.

“It’s like trying to assess traffic flow on the United States by measuring traffic flow only on the major highways,” Schwender said.

To address these more complex situations, the BNL team constructed a computational model of a large-scale metabolic network of developing rapeseed (Brassica napus) embryos, based on information mined from biochemical literature, databases.

North, South, East, West — Students Study What Rides the Wind Over Long Island

Five college students from around the country have traded the lazy, hazy days of summer for an opportunity to analyze the haze itself.

During their 10-week internship in programs administered by BNL’s Office of Educational Programs, these students participated in a campaign to measure the concentration, chemical composition, size, shape, and optical properties of tiny particles in the atmosphere called aerosols. This work at BNL is supported by DOE’s Atmospheric Radiation Measurement (ARM) program.

Aerosols arrive in the atmosphere from many different starting points — both natural and anthropogenic. They come from the burning of fossil fuels, from ocean mist and desert dust, from factory emissions, and from volcanic activities.

“Aerosols are neither altogether good nor bad, but they’re very important for environmental scientists to try and understand,” says Danielle Weech, University of Illinois, a Science Undergraduate Laboratory Internship (SULI) student.

Some aerosols play a major role in cloud formation and reducing solar radiation, which helps provide an overall ‘cooling’ effect for our planet. But on the other hand, some types of aerosols contribute to global warming by absorbing the sun’s heat rather than bouncing it back to space.

Currently, atmospheric scientists know a lot more about how greenhouse gases like carbon dioxide and methane affect the environment than they do about the role — that is, the many roles — aerosols play.

“Some aerosols act as direct influences on climate change by limiting or enhancing solar radiation, but others have a more indirect effect,” says Erika Schreiber, a SULI student from Cornell University. “Aerosols provide particles for water droplets to cling to in the air, which is how clouds form, and deflect sunlight. Then, if too many particles are concentrated in the same cloud, water molecules can’t form droplets big enough to rain down. This...”

See Aerosol Study on p.3

Rare Coupling of Magnetic And Electric Properties In a Single Material

Researchers at BNL have observed a new way in which magnetic and electric properties — which have a long history of ignoring and counteracting each other — can coexist in a special class of materials. These materials, known as multiferroics, could serve as the basis for the next generation of faster and energy-efficient logic, memory, and sensing technology.

The researchers, who worked with colleagues at the Leibniz Institute for Solid State and Materials Research in Germany, published their findings online in Physical Review Letters on July 25, 2011. This work was supported by the DOE Office of Science.

Ferromagnets are materials that display a permanent magnetic moment, or magnetic direction, similar to how a compass needle always points north. They exist in a variety of daily tasks, from sticking a reminder to the fridge door to storing information in computer hard drive. Ferroelectrics are materials that display a permanent electric polarization — a set direction of charge — and respond to the application of an electric field by switching this direction. These materials, known as multiferroics, can provide both a magnetic moment and an electric polarization.

“It’s like trying to assess traffic flow on the United States by measuring traffic flow only on the major highways,” Schwender said.

To address these more complex situations, the BNL team constructed a computational model of a large-scale metabolic network of developing rapeseed (Brassica napus) embryos, based on information mined from biochemical literature, databases.

See Plant Oils on p.2

New multiferroic mechanism could lead to next-generation memory and sensing devices

“Technically, the principle involves a phase change in which information is written by applying an electric field and read by detecting its magnetic state. This could make a faster and much more energy-efficient data storage device than is available today.”

See Multiferroic Device on p.2

Using the Sun’s Energy To Power the World

BSA Distinguished Lecture, 9/8

Daniel Nocera, a Massachusetts Institute of Technology (MIT) professor whose recent research focuses on solar-powered fuels, will give a BSA Distinguished Lecture titled “Harnessing Energy from the Sun for Six Billion People — One at a Time,” on Thursday, September 8, at 4 p.m. in Berkner Hall. BSA Distinguished Lectures are sponsored by BSA, the company that manages BNL, to bring topics of general interest before the Lab community and the public. The lecture is free, and no pre-registration is required. Visitors to the Lab 16 and older must bring a photo ID.

Nocera will explain that the world population is expected to double by 2050, increasing to about six billion people, mainly from developing nations. Global energy consumption is expected to rise from 14 to 30 terawatts, or trillion watts.

Nocera suggests that building small, “personalized” energy systems that rely on the sun’s energy will be an economically, efficient, and environmentally friendly way to meet these ever-increasing energy needs.

He and his research team have found a way to harness solar energy through artificial photosynthesis — mimicking the way plants turn sunlight into energy. They have developed a device called “artificial leaf” that can be used to power a home in the developing world. Made of nickel, silicon, and cobalt, the device is smaller than an oak leaf.

See BSA Lecture on p.3

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See BSA Lecture on p.3
caused by the outer cloud of electronic structure of a metal oxide may result in an electric polarization. The magnetic material, which can interact weakly with each other electric field — are rare in nature. Materials with north and south magnetic poles coexist. When they coexist, the idea of distorting the atomic arrangement, or crystal lattice, can be coupled with the notion of electric field. Simulations to predict what's going on, Continuing the traffic analysis, he said, "We can now try to simulate the effect of roadblocks or to add new roads to most effectively eliminate traffic congestion." The model also allows the researchers to assess the potential effects of genetic modifications (for example, inactivating particular genes that play a role in plant metabolism) in a simulated environment. These simulations "knock-out" experiments gave detailed insights into the potential function of alternative metabolic pathways — for example, those leading to alternative metabolic pathways that are not currently known. The model includes 572 variables. The model also uses the results of experimental studies. For instance, using the large-scale computer models, the researchers can extend and adapt it for use in multiple ways to improve our understanding of the metabolic pathways — the big-picture view of how those reactions are involved in the formation of oil precursors. This is an essential tool for understanding of metabolism or the formation of oil precursors. Of Other Languages Classes began the fall terms with full classes. The scientists are already incorporating information from the new large-scale computer models into the original model and which make oil production more realistic network, which can result in a change in the material's magnetic structure will result in a change in direction of its ferromagnetic state. By definition, that makes the material a multiferroic. Multiferroics — magnetic materials that can simultaneously rotate and south poles that can be reversed with an electric field — are rare in nature. Ferrroelectricity and magnetism tend to be mutually exclusive and interact weakly with each other when they coexist. Most models used by physicists to describe this coupling are based on the concept of a spin-1/2 atom sitting at a lattice site in a crystal. Now, scientists have found a new way that electric and magnetic properties can be coupled in a material. The group used extremely bright beams of x-rays at the Advanced Photon Source, a powerful light source, to examine the electronic structure of a metal oxide material. They found the magnetic-electric coupling in an insulator and the presence of two states of magnetism around the atom. "Previously, this mechanism has been predicted theoretically and its existence was hotly debated," Wilkins said. In this particular material, the manganese and oxygen electrons mix atomic orbitals in a process that creates atomic bonds and keeps the material together. The researchers’ measurements show that this process is dependent on the size of the very large unit cell, which in this material, causes the material to become ferroelectric, i.e., have an electric polarization. In other words, any change in the material’s magnetic structure will result in a change in direction of its ferromagnetic state. By definition, that makes the material a multiferroic. "What is especially exciting is that this result proves the existence of a new coupling mechanism and provides a tool to study it," Wilkins said. Scientists are using a new instrument at NSLS designed to answer key questions about intriguing classes of materials such as multiferroics and high-temperature superconductors, which conduct electricity without resistance. The instrument, developed by Wilkins and engineers D. Scott Coburn, Phiontis Science, and William Leonhardt and William Schoenag, both of CPMPS, will ultimately be incorporated into the National Synchrotron Light Source II (NSLS-II), a state-of-the-art machine under construction. NSLS-II will produce x-rays 10,000 times brighter than at NSLS, for studies of materials’ properties at even higher resolution. — Kendra Snyder

Plant Oils from p. 3 and prior experimental results that result from the two methodologies. The model includes 572 biochemical reactions that play a role in the seed’s central metabolism and/or seed oil production, and incorporates information on how those reactions are involved in the formation of oil precursors. This is an essential tool for understanding of plants’ metabolic pathways — the big-picture view of how those reactions are involved. The scientists are already incorporating information from the new large-scale computer models into the original model and which make oil production more realistic network, which can result in a change in direction of its ferromagnetic state. By definition, that makes the material a multiferroic. "What is especially exciting is that this result proves the existence of a new coupling mechanism and provides a tool to study it," Wilkins said. Scientists are using a new instrument at NSLS designed to answer key questions about intriguing classes of materials such as multiferroics and high-temperature superconductors, which conduct electricity without resistance. The instrument, developed by Wilkins and engineers D. Scott Coburn, Phiontis Science, and William Leonhardt and William Schoenag, both of CPMPS, will ultimately be incorporated into the National Synchrotron Light Source II (NSLS-II), a state-of-the-art machine under construction. NSLS-II will produce x-rays 10,000 times brighter than at NSLS, for studies of materials’ properties at even higher resolution. — Kendra Snyder

The Bulletin August 19, 2011

Multiferroic from p. 1

For extending extraordinary efforts in response to the needs of their departments or divisions, the following individuals were among those honored with Spotlight Awards for 2010:

Basic Energy Sciences Directorate: Rita Niccolai

Condensed Matter Physics & Materials Sciences: Jon Harsager, Maxim Khodas, Jonathan Rameau, Arlen Ramerat, William Schiavoni, Jing Tao

Environmental Restoration Division: Sonia Kirk

Fiscal Services Division: Marga Desmond, Linda Jones, Sophie Marrero, Osba Pettit

Global & Regional Operations Directorate: Louis Garlach, Robert Lake, Joanne Madia, Lisa Mirello, Michael Ziminski, Christopher Zimmer, Peter Zimmerman

Human Resources & Occupational Medicine Division: Lisa Allen, Louise Lane, Melissa Liccardo, Ben Atherton

Information Technology Division: Lisa Cano, Anita Kuzucuoglu, Camille Pelling

Instrumentation & Measurement Division: Mary Bratham, Gwen Von Anach

Laboratory Protection Division: Louis Garlach

Legal Office: Carmen Alvarado

Maintenance & Fabrication Services Division: Howard Kea, Mary Ann Schum, Linda Thompson

Modernization Project Office: William Bockman, Larrie Casarole, Thomas Smtih

National Synchrotron Light Source II Project: Mary Curi, Joseph Calabrese, Joseph Cosentino, Michael Davidson, Christine Hortz, Barbara Mosbe, Robert Petkus, Lydia Rogers, Bruno Samon, Yale Tian, Patrick Zoccoli

Nonproliferation & National Security Directorate: Charol Charol, Donna Gili, Lori Happick, Thomas Roberts, Cindy Sley, Jacob Tackett, Stephen Brady

Procurement & Property Division: Michael Barsanou-Orlando, Phil Bentham, Johny Collie, Susan Casares, Michael Carusan, Linda Commander, Cheryl Elasser, Elise Fonne, Phil Gatti, Michael Holbrook, Laura Roupe, Janet Schlock

Quality Management Office: Joyce Fortune, Michael Russo

Radiological Control: Gregory Condron, Beth Ballin, Pat Sullivan, Francis Dill

Safety & Health Services Division: Anna Barilla, Deborah Cordillo, Linda Greer

Site Services Division: Mike Bonanno, Nancy Desimone, Raymond Johnson, Joseph Rubino, Louis Gerlach, Robert Proctor, Joe Vanni, Bill Vanni...
Meet Emily Ruppel, the Science-Writing Caricaturist

During the past three months, Emily Ruppel has been writing about BNL’s ongoing science programs and many other aspects of life at BNL.

An intern in the Lab’s Media & Communications Office — through BNL’s Graduate Internship Program (GIP), which is administered by BNL’s Office of Education Programs — Rup- pel’s told the stories of students at the NASA Space Radiation Lab and written toward solutions to protect astronauts from naturally occurring space radiation. She’s also written about students training as International Atomic Energy Agency inspectors, about the recom- mended Medical Research Scientist, scientific breakthroughs made at DOE laboratories, and helping those less fortunate in the Town of Brookhaven and around the world.

And if you happen to see the cubicle where Ruppel has been changing the face of BNL’s Bulletin and website, you’ll see from a collection of drawings that she’s not your typical artist. In fact, Ruppel has been drawing caricatures for 15 years, and is an accomplished professional before pursuing a master’s program in science writ- ing at Columbia University’s Graduate School of Journalism (MIT) in 2010.

“Many people have a misconcep- tion that caricature is just about trying to bring out the worst in people by drawing them with big ears and huge noses,” Rup- pel said. “I don’t think there’s all that much about me that you can draw about every person’s face. When I’m drawing someone, my inten- tion is to make the drawing look more like they do than they do.”

Hailing from Louisville, Ken- tucky, Ruppel has been drawing for most of her life, but she didn’t start making caricatures until she worked as a cartoonist for her college newspaper at Bellarmine University. In someone’s last min- ute scramble to find a caricaturist for a graduation celebration, she got that gig and many more after that.

“When I’m writing about science or drawing a caricature, I’m trying to represent something as truthfully and engagingly as possible, but the way I reach the finished product is different,” Ruppel explained. “Once I know what the story you want me to write, I think about getting all the details right and then com- press it into the whole. When I draw a caricature of someone’s face, I start with the basic shapes and then work in the details.”

As Ruppel’s intern at BNL’s Media & Communications Office draws to a close, she is on track to complete her master’s program from MIT in October. She has ac- cepted a job as a science writer for the American Scientific Affili- ation, a nonprofit organization in Boston, Massachusetts, and will begin in September. See more of her caricatures at her website: http://www.emilyrup- pel.com/.

— Joe Geller

BERA Trips Get tickets at BERA Store, Berkner Hall, weekdays, 9 a.m.-3 p.m. See also www.bnl.gov/bera/.

Tues. 9/6 US Open, Flushing, Queens, 9/6-9/15.

Sun. 9/9 Camelot, Hamburger, PA. 820 Sports, outdoors shop- ping. Dep. 7 a.m.

Sat. 10/1 BGI E State Fair, W. Springfield, Mass. 9/28-10/10. All but Midway carnival of rides and games, $20. Early start.

Sun. 10/2 NASCAR Sprint Cup, Hampton Beach, NH. 10 laps, gate 40 tickets, $1100/ea. Dep. 5 a.m. Pool Open and Free, 8/29 – 9/2 – 2

The swimming pool (Bldg. 478) will be open for children and their parents to swim for free from 2 to 5 p.m. from August 29 until September 29. Parents must remain with their pool with the children.

DOE Updates Updated Website: energy.gov

The U.S. Department of Energy (DOE) has advanced the next step of its comprehensive website reform, making energy.gov a cut- ting-edge interactive information platform and saving taxpayers more than $10 million annually.

Service Anniversaries

The following employees cele- brated a service anniversary during March 2011:

- 40 years – John Nicollelli – C-AD
- 35 years – Cleveland Doolittle – C-AD
- 30 years – James Lemley – NNS
- 29 years – Francine Donnelly – Waste Mgmt
- 25 years – Diane Cabell – Chemistry
- 25 years – Carlos Calvillo – BEE Dr.
- 20 years – Shari Busby – Lab Prot.
- 20 years – Kathleen Walker – Lab Prot.
- 20 years – Ralph Vella – Lab Prot.
- 15 years – Joseph Brennan – C-AD
- 10 years – Matthias Harrington – Lab Prot.
- 10 years – Arthur Barmonte, Jr. – Lab Prot.
- 10 years – Richard Ruggiello – Physics
- 10 years – Michael Fuulkerson – Phono Sciences
- 10 years – Robert Bubba – Site Labs.
- 10 years – Joseph Nubile – Site Svcs
- 10 years – Ulysses Tapley – Site Svcs
- 10 years – Chris Osgood – Mod. Proj. 
- 10 years – Marc Alaire – Photon Sci.
- 10 years – Catherine Connor – Rad. Contr. 
- 10 years – Gabriella Carini – Site Svcs
- 10 years – Susan Santana – Staff Svcs

BRL Noon Recital, 8/24

Vocalist Melissa Errico

Broadway vocalist Melissa Errico, fresh off an exciting summer tour and recent Lincoln Center debut in Camelot, will sing on Wednesday, August 24, at noon in Berkner Hall. Sponsored by BSA, the concert is free and open to the public. Visitors to the Lab 16 and older must bring a photo ID. Tony nominee Errico will be accompanied by her father, pia- noist Larry Errico, as well as a program that includes classical musical theater songs by Rodgers and Hammerstein, Bernstein, Sondheim, and Stephen Sondheim, as well as classics by Michael Leibman from her upcoming recording, Legend Affair (produced by Phil Ramone, release date October 18, 2011 on Ghostlight Records). Other songs will recall her star- ring roles in such Broadway musicals as Les Miserables and My Fair Lady.

— Jane Korosap

[Image of a collection of caricatures by Emily Ruppel, including depictions of prominent figures such as Tony Bennett, Barbra Streisand, and Donald Trump.]
92 MERCEDES 300SL CONVERTABLE – mec wrk, runs well. $3,000 neg. 612-4568.

99 VOLVO S80 TURBO 4 DOOR – 117 mi. a/t srvce recs. Silver w/tan leathr. Just passed a/c, full pwr, c/c, tilt, htd seats, ABS, fr, sde

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Get Fit, Join BERA Classes

All the Lab community is encouraged to join in these classes. Ad-

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- 08/10 CHEVY MALIBU - 2005, blk, loaded, runs well, $3,600.
- 08/10 FORD F-150 - 2009, blk, loaded, runs well, $9,900.
- 08/10 CAVALIER - 2002, blk, loaded, runs well, $2,500.
- 08/10 JEEP WRANGLER - 2003, blk, loaded, runs well, $7,500.
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- 08/10 VOLKSWAGEN JETTA - 2007, blk, loaded, runs well, $5,000.
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- 08/10 JEEP CHEROKEE - 2004, blk, loaded, runs well, $4,500.
- 08/10 BUICK REATTAIN - 2005, blk, loaded, runs well, $5,500.
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