

MAINE

INBRE

IDEA NETWORK OF BIOMEDICAL RESEARCH EXCELLENCE

Picture This: The Bates College Imaging & Computing Center

Bates College opened the doors to an exciting new campus facility this semester, and with it opened up new possibilities for faculty and student research. The Bates College Imaging and Computing Center provides centralized access to shared optical and computer equipment for the capture, interpretation, and analysis of information in visual formats – scientific equipment previously unavailable or housed in various departments across campus.

INBRE support helped the college obtain additional funds from three private foundations to establish the center in the renovated first floor of Coram Library, one of Bates' architectural gems. Built in 1902, Coram is at the heart of campus, in a perfect location to bring all of the sciences together and maximize opportunities for the facility's use and for collaboration across departments.

The result is a state-of-the-art center providing 3,700 square feet of new space for research, including an imaging lab, a small prep lab and a digital photography lab. An adjoining gallery and computer lab provide exhibition space and computer workstations. The college used a portion of its INBRE funding to purchase new equipment including four optical microscopes, large-format printers, a flatbed scanner, and twenty wide-screen computers. The center's sophisticated tools enhance student and faculty researchers' ability to capture, interpret, and present visually all manner of information.

The Imaging and Computing Center's capabilities have research applications across disciplines, from the



NEIL MARYA, BATES '07, PROFESSOR NANCY KLECKNER AND FELICE FRANKEL EXPLORE SOME OF THE NEW EQUIPMENT'S CAPABILITIES. PHOTO: PHYLLIS GRABER JENSEN, BATES COLLEGE

visualization of nanostructures and the presentation of large amounts of genomic data, to the plotting of natural science and social science data. Since its opening two months ago, eight classes involving 175 students have been using the center's high-tech equipment for research during their courses' labs.

"This is the one site on campus where many students can congregate and work with computers especially suited for viewing and working with images," says Nancy Koven, assistant professor of psychology. *Continued on page eight*

Upcoming Events

Maine Biological & Medical Sciences Symposium:
April 27th and 28th, 2007

Maine INBRE Annual Meeting:
August 14, 2007, MDI Biological Laboratory

Northeast Regional IDeA Meeting:
August 15 - 17, 2007, The University of Vermont

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DR. PATRICIA HAND, ADMINISTRATIVE DIRECTOR OF MDIBL AND DIRECTOR OF THE MAINE INBRE PROGRAM.

Spring is coming in like a lion this year – in terms of the weather and in the amount of activity going on around the Maine INBRE network. Right now the Mount Desert Island Biological Laboratory's campus is alive with students, as we host laboratory short courses for undergraduates from the College of the Atlantic, Bowdoin College and The University of Maine. Student programs are going strong, and many students will present their research at next month's Maine Biological and Medical Sciences

Symposium.

Each year at this time, the process of completing our annual INBRE progress report to the National Center for Research Resources allows us to reflect on the achievements of the past year. During the '06 – '07 grant year, fifty-six students participated in short course research training sessions at MDIBL, and another seventy undergraduates were involved in faculty-mentored research during either the summer or academic year. We also saw an impressive increase in the number of publications and presentations from our INBRE – more than double the previous year, in fact, indicating that the research begun three years ago is now coming to fruition. Many of our Junior Faculty are submitting grant applications, and we're seeing the success of the investment in their research.

You'll read in this issue about the marriage of research and teaching, as exemplified by the work of Dr. Hadley Horch of Bowdoin College. As do many of our INBRE Professor/Researchers, Dr. Horch creates a flow of energy and knowledge that connects her laboratory and classroom.

Also in this issue, we celebrate the recent opening of the Bates College Imaging and Computing Center, which provides exciting new avenues for research, and gives undergraduates and faculty access to the latest in imaging technology. The center, which is open to INBRE participants from across Maine, is one example of the significant impact

of the IDeA program on our state.

One of the strengths of our network's focus on Comparative Functional Genomics comes from the tools we've been able to develop through our Bioinformatics Core and Science Research Core. We highlight in this issue some of the progress that our DNA Sequencing and Analysis Facility has made in developing expressed sequence tags (ESTs). These data will enable us to examine evolutionarily conserved genetic patterns that contribute to our understanding of human health.

We are continuing to build our EST library for skate, shark, sea urchin, lobster and other species as well. The wealth of genetic data and analysis tools provided by the Bioinformatics Core enhances our ability to harness the power of computational biology. Anne Czechanski, '06 graduate of College of the Atlantic and research technician at MDIBL, works in both worlds, helping to develop and characterize cell lines at the bench while pursuing research that uses bioinformatics to analyze developmental differences across species.

We're anticipating another rich year, and looking forward to welcoming many of you back to MDIBL for this spring's symposium and a summer full of research and programs.

Best regards,
Patricia Hand
Principal Investigator

Awards and Honors

DAVID BARNES, INBRE Program Coordinator and MDI Biological Laboratory Research Scientist, has been asked by the Scientific Review Branch at the National Human Genome Research Institute to serve on a R01/R21 Review Panel on "Technology Development for the Comprehensive Determination of Functional Elements in Eukaryotic Genomes".

BENJAMIN LAKE, Bowdoin College '07, received the Best Poster award from the Society for Integrative

and Comparative Biology, Division of Invertebrate Zoology at its 2007 meeting. His winning poster – entitled "Influence of orientation and flow speed on feeding behavior and metabolism of the barnacle *Semibalanus balanoides*" – presented the results of his INBRE academic year fellowship research.

CAROLYN MATTINGLY, MDI Biological Laboratory, INBRE Junior Faculty Researcher and Bioinformatics Core Co-director, served on the National Institutes of Health Biodata Management and Analysis (BDMA) Study Section in

January 2007 as a Temporary Member.

DAVID TOWLE, MDI Biological Laboratory Research Scientist and INBRE Science Research Core Director, is being honored for his contributions as a researcher, teacher and mentor. Lake Forest College in Illinois – where Dr. Towle taught for 13 years – has created *The David W. Towle Research Award* in his name. The award will be given annually to the best research student at Lake Forest College.

Developing Genomic Tools for Lobster Research



INBRE SCIENCE RESEARCH CORE DIRECTOR, DR. DAVID TOWLE,
WITH A FINE SPECIMEN OF *HOMARUS AMERICANUS*

The lobster industry is a critical part of the Maine economy. Over 7,000 lobstermen and women set 3 million traps and harvest at least 60 million pounds of lobster (*Homarus americanus*) each year with a dockside value of over \$250 million. Although the Maine fishery is doing well right now, the lobster fisheries in Rhode Island and Connecticut have recently collapsed, and diseased lobsters are being found farther and farther north every year. Now the same genomic tools that are advancing biomedical research are also being applied to studying lobsters and understanding their reaction to the many kinds of stress, including disease, they face today.

In 2002, scientists had identified only 100 genes in lobsters. Therefore, in 2003 the Marine DNA Sequencing and Analysis Facility at the Mount Desert Island Biological Laboratory (MDIBL) decided to start generating expressed sequence tags (ESTs) for lobsters. Over the past four years, Christine Smith, Sequencing Supervisor at MDIBL, has catalogued 9,000 ESTs from a multiple-tissue cDNA library, and another 4,000 ESTs from lobster neural tissue have been added by another laboratory to the collection. All of these DNA sequences are available to other scientists through the Genbank database, and MDIBL supplies clone samples from the multiple-tissue library upon request. The Marine Biological Laboratory at Woods Hole recently was able to develop new genomic markers for lobsters by analyzing the ESTs produced at MDIBL.

David Towle, Ph.D., director of the Marine DNA Sequencing and Analysis Center and leader of the lobster genomics projects at MDIBL, recently gave a talk for the Mount Desert Island community on “New Genomic Tools for

Lobster Research.” He described in non-technical terms the resources available through the Maine INBRE, including ESTs, microarrays, real-time quantitative PCR, and genomic DNA analysis. His talk attracted several working lobstermen and women as well as other members of the community. He recalled working with a 2004 INBRE class of College of the Atlantic students which succeeded, by the end of its two-week session, in sequencing the lobster’s gene for heat shock protein 90 – an important part of a cell’s response to stress. The amino acid sequence of the lobster protein bears 80% identity to the corresponding human protein; understanding how this lobster protein participates in the stress response may give insight into similar mechanisms in humans.

Other genomic tools being used in lobster research include microarrays, which can show which genes are being affected by a given stressor. A first-generation DNA microarray, with 2,313 oligonucleotide spots representing as many genes, has been produced by INBRE-supported work at MDIBL. In collaboration with scientists at the Virginia Institute of Marine Science, microarrays have identified two previously unknown antibacterial proteins that respond to experimental injections of a pathogenic microbe. A third antimicrobial protein, crustin, has been characterized by seasonal investigator Dr. Andrew Christie and his students, starting with a partial sequence in MDIBL’s expressed sequence tag database. These antibacterial proteins identified in lobsters may prove to be useful in combating human infectious diseases as well as providing tools to control the growing incidence of disease in the lobsters themselves.

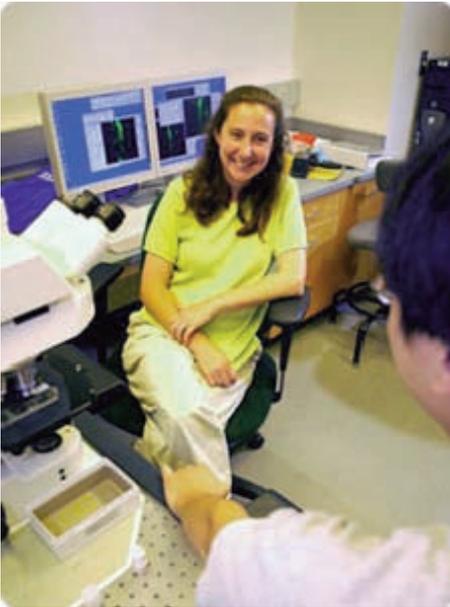
The antibacterial proteins identified in lobsters may prove to be useful in combating human infectious diseases.

In addition, the lobster microarrays will be used for monitoring lobsters’ growth and development – including molting cycles – and their response to environmental factors. A collaborative project between MDIBL, the Lobster Science Centre at the University of Prince Edward Island, and the Atlantic Microarray Facility in Moncton, New Brunswick plans to produce a second-generation microarray incorporating even more genes.

Genomics can also help monitor the success of lobster hatchery projects. The Penobscot East Resource Center, led by MacArthur Fellow Ted Ames, plans to release tens of thousands of lobster hatchlings in areas where lobster populations were once abundant but are currently in decline. When released, the hatchlings are too small to carry any kind of tag or transmitter, so in the summer of 2007, “simple sequence repeats,” a kind of genetic marker, will be used to identify lobsters recovered from the release sites and assess the program’s success. Four different markers assure a greater than 99% accuracy in distinguishing hatchery-reared specimens from completely wild ones.

The genomic DNA tests on recovered lobsters will be carried out at MDIBL. While scientists will be helping to monitor the health of lobsters in Maine, they will also be developing more genomic data important to biomedical research as a whole.

INBRE Research Profile: Hadley Horch, Bowdoin College



Given proper care, most wounds – from significant skin injuries to broken bones – will heal. Cut a nerve, however, and its complicated network of message-bearing conductors may never repair itself. Neuronal systems in vertebrates, especially in the brain and spinal cord, lack the regenerative powers of other organs, and don't predictably "recover" from an injury, resulting in a significant loss of function.

Bowdoin College Biology Professor Hadley Horch is investigating the unusually robust neuronal regeneration of an invertebrate – the cricket, *Gryllus bimaculatus* – in search of clues as to which genes control this regrowth, and whether those genes are evolutionarily conserved in other species.

Most of the time nerves degenerate or even die when they're cut. The cricket's auditory interneurons, however, sprout new dendrites upon the loss of auditory input from one ear. These new nerve fibers grow across the mid-line, a boundary they normally respect, invading the territory of their mirror-image neurons and forming connections with the intact auditory nerve on the opposite side. While it is unclear whether this unusual compensatory regeneration results in better hearing through the remaining ear, studies of one-eared females have demonstrated that positive phonotaxis (or the ability to walk towards a sound) was preserved, and that the subjects

could still find a chirping mate, a characteristic important to survival.

What interests Horch is finding which genes are involved in the regrowth process, and how they compare to the genes important to neuronal development in young crickets. Genes involved in development are different from adult genes, and many special cues and proteins that are important in the developmental stage "turn off" at an organism's maturity. Are these developmental genes turning "on" again to regenerate nerve tissue after an injury?

Horch and her lab are examining changes in gene expression by comparing the tissue from an uninjured cricket to that of an injured one. They are studying changes in the levels of messenger RNA – RNA that carries genetic information

"Working with students encourages me to think more broadly, while at the same time my research informs my teaching."

from the cell nucleus to the cell area where protein synthesis takes place. They can then develop hypotheses as to developmental cues and look more closely at genes whose expression levels change dramatically after injury, to discover if these genes are, at least in part, responsible for the new growth after injury. Preliminary results from Dr. Horch's study indicate that the levels of semaphorin – which plays a role in development in other species – change in crickets upon loss of an ear.

This month sixteen Bowdoin College students came to the Mount Desert Island Biological Laboratory to learn molecular neuroscience research techniques, using Dr. Horch's research and the cricket model as the basis for their experiments. Students learned how to perform interneuron backfills, filling a carefully dissected cell tissue sample with fluorescent dye so that they could visualize the neuronal patterns under a confocal microscope. Students have also been experimenting with RNA isolation, DNA amplification and other molecular

techniques which should allow them to assess relative expression levels of their candidate genes.

For Horch, teaching, learning and research go hand-in-hand. While acknowledging that it is sometimes difficult to balance teaching and research, she says that "working with students encourages me to think more broadly, while at the same time my research informs my teaching." Many students have worked with her on research, and several were co-authors on a paper to be published in an upcoming issue of the *Journal of Comparative Neurology*. Horch will have at least two students working with her this summer to further explore changes in gene expression after injury – one through the INBRE program, and one through a grant Horch recently received from SOMAS (Support for Students and Mentors).

In her own career, mentorship has played a significant role. Horch maintains a collaborative relationship with Dr. Ronald Hoy of Cornell University, with whom she did her post-doctoral work. Their lab groups meet regularly at the Society of Neuroscience annual meeting, and she has even taken her students to Ithaca, New York for a group meeting.

Horch appreciates the INBRE program's network, noting that she "would feel a lot more isolated without it." She finds it especially helpful that the Junior Faculty Researchers touch base with one another and share what they are working on. Horch benefits as well from close ties with her INBRE mentor, Dr. Patsy Dickinson, Chair of Bowdoin College's Neuroscience program.

For her part Dickinson appreciates the effect federal research funds can have on the college's teaching mission: "Dr. Horch's research has not only involved a number of undergraduates in the research itself, where they have flourished and learned a great deal, but it has also been integrated into some of her classes so that students conducted projects related to the research in class, thereby increasing the number of students who were affected by the INBRE grant."

INBRE Alumna, Anne Czechanski, COA '06



When Anne Czechanski enrolled at the College of the Atlantic in 2002, she knew that COA offered a strong education in the sciences – what she didn't know was that the college was also part of Maine INBRE and enjoyed both a close proximity to and a close working relationship with two research laboratories. During her undergraduate career, Czechanski took advantage of this network, participating in research fellowships both at The Jackson Laboratory (TJL) and the Mount Desert Island Biological Laboratory (MDIBL).

While Czechanski had nurtured a long-standing interest in science, she hadn't previously focused on a particular field. "Participation in the INBRE program gave me the opportunity to discover whether biomedical research was what I wanted to do," she says, and she found that this type of research allows her "a sense of giving something back to people."

Now, almost a year since her graduation, she is continuing her involvement with researchers at both institutions. Czechanski currently works full-time in the laboratory of Dr. David Barnes at MDIBL, working with cell cultures to develop and characterize skate and shark cell lines. In her free time, she continues to work with her TJL mentor, Dr. James

Denegre, as well. These two endeavors take different approaches to research – one keeping her in touch with traditional lab-based tools and techniques, and the other using the power of computational biology to study genomics.

During her college career, Czechanski was inspired by Denegre to get excited about doing science "anywhere." Over the past year the two

"Participation in the INBRE program gave me the opportunity to discover whether biomedical research was what I wanted to do"

developed a model experiment which could be performed by students without access to a laboratory – one that doesn't involve any chemicals, pipettes, or specimens. The project is designed to demonstrate that "in the absence of a laboratory, fundamental issues in biology are still accessible to students by asking simple, creative questions."

Through analyzing and comparing *Drosophila* genes involved in early development to *Mus* genes, they were able to identify genetic similarities and

areas in which there was an absence of homologous genes, indicating some fundamentally different developmental processes between fruitflies and mice. This past December they presented an abstract on their project – "in *drosophila*: Using *Drosophila melanogaster* as a tool to better understand mouse oogenesis and early development" – in the "Education" division of the American Society for Cell Biology Meeting in San Diego, California.

Czechanski enjoyed interacting with other biologists at the meeting, which "presented the opportunity for a lot of learning from people of disparate backgrounds," she says, as there were 5,000 people attending from various parts of the world. Being in the education division also meant that she met scientists from different fields, including a science professor interested in introducing genomics to his classroom, and some graduate students who wanted guidance on using the available databases.

The amount of available genomic data is really "pretty amazing," Czechanski says, noting that we can now compare the genes of a Maine lobster to a Chinese shrimp, and that the ability to use other's data can help fill in gaps in your own research. She appreciates the power of computational approaches, while still treasuring hands-on lab time and the confidence one feels in data you've generated yourself.

Czechanski plans to continue in biomedical research and is thinking about getting a Ph.D. in epidemiology or public health to pursue her interest in how diseases spread through populations. For now she'll let her curiosity lead her to science wherever she may find it.

Do you have INBRE news?

Please let us know about upcoming events, items of interest and your program accomplishments.

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Upcoming Events

34TH ANNUAL MAINE BIOLOGICAL AND MEDICAL SCIENCES SYMPOSIUM APRIL 27 - 28TH, 2007, MDI BIOLOGICAL LABORATORY

The Maine Biological and Medical Sciences Symposium is a state-wide gathering of researchers and students — an opportunity to share research results, exchange ideas, promote collaboration, and network with Maine scientists in a variety of disciplines. All Maine researchers, science faculty, graduate, undergraduate and high school students are cordially invited to attend.

Students are particularly encouraged to take advantage of this opportunity to present their work — The Maine INBRE will cover registration fees, travel, and on-campus housing for undergraduate and graduate students who wish to attend MBMSS. Please inquire with Jeff Baroody (jbaroody@mdibl.org) at MDIBL.

Platform and poster sessions will include:

- Genomics and Computational Biology - including bioinformatics
- Integrative and Organismal Biology - including neuroscience, physiology, development, toxicology
- Comparative and Population Genetics

THE DEADLINE FOR ABSTRACTS HAS BEEN EXTENDED TO MARCH 23RD.

Friday night's keynote speaker will be Dr. David Botstein, Director of the Lewis-Sigler Institute for Integrative Genomics at Princeton University.

Saturday afternoon there will be a special session on Maine Research and Research Training Initiatives, with representatives from the Maine Institute for Human Genetics and Health, the Foundation for Blood Research, The University of Maine Graduate School of Biomedical Sciences and the Integrative Graduate Education and Research Traineeship Program.

More information and online registration is available at:

<http://www.mdibl.org/courses/mbmss07.shtml>

MAINE INBRE ANNUAL MEETING AUGUST 14, 2007, MDI BIOLOGICAL LABORATORY

Save the date for our yearly gathering of Maine's IDeA network. Our External Advisory Committee members are looking forward to seeing you all again and hearing about your programs' progress over the past year.

NORTHEAST REGIONAL IDEA STATES MEETING AUGUST 15 - 17, 2007, THE UNIVERSITY OF VERMONT

The Vermont Genetics Network at the University of Vermont Medical School will host the Northeast Regional IDeA States meeting August 15th – 17th, 2007. "Foster Collaboration and Share Resources" is the theme for this two day event for INBRE and COBRE researchers from Delaware, Maine, New Hampshire, Rhode Island and Vermont.

The meeting will begin Wednesday evening with a keynote speech on stem cell research by Dr. James Battey, Director of the National Institute on Deafness and Other Communication Disorders, National Institutes of Health.

Platform and poster session topics for the two-day conference include: Stem Cells, Development and Regeneration, Neuroscience, Protein Structure/Function, Inflammation and Immunology, Computational Biology and Cancer Biology. The conference will also feature workshops for Core Directors and interaction with NCRR/NIH staff.

The conference provides an excellent opportunity for researchers to share the results of their work and to learn from their colleagues about other IDeA states' scientific initiatives. For more information and registration, please visit the conference website at: <https://www.uvm.edu/~vgn/ideameeting/>

IDeA Network of Biomedical Research Excellence

Research Institutions:

Mount Desert Island Biological
Laboratory
The Jackson Laboratory

Baccalaureate Institutions:

Bates College
Bowdoin College
Colby College
College of the Atlantic
The University of Maine

Outreach Baccalaureate Institutions:

University of Maine at Farmington
University of Maine at Machias

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Maine INBRE Program Coordinator:

David Barnes, Ph.D.

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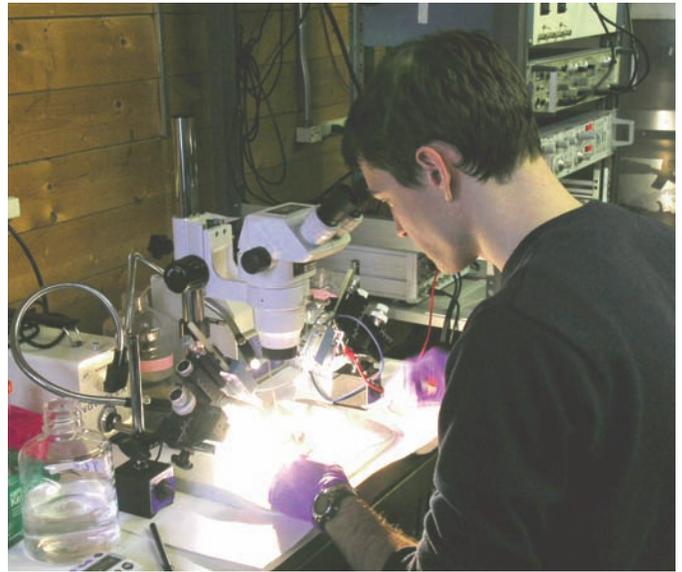
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National Institutes of Health

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Laboratory Field Experiences for Undergraduates

Maine INBRE sponsors field experiences for undergraduates every winter and spring. These intensive research training sessions give students the opportunity to gain valuable experience in the laboratory, with access to state-of-the-art facilities and equipment that may not be widely available at their home institutions.

Participants benefit greatly from working with practicing scientists on real experiments, and from the opportunity to learn new techniques and approaches. The professional interaction between established scientists and undergraduates helps students develop not just their skills, but also their career plans and goals.



University of Maine students came to the MDI Biological Laboratory in March to study *Functional Genomics of Membrane Transport*, with instructors from MDIBL, Dartmouth College Medical School, The University of Maine and The University of Pittsburgh Medical School.



Bowdoin College students came to the MDI Biological Laboratory for one week in January and one week in March to study *Molecular Neurobiology* with INBRE Research Scientist Dr. Hadley Horch. The Horch Lab uses the cricket model system to examine the molecular neurobiological basis of a number of areas including regeneration, behavior, and development (*see story on page 4*).

Students used confocal microscopy to visualize the auditory interneurons in crickets using fluorescent backfills, as well as getting experience with Real Time PCR equipment.

Students from the University of Maine-Farmington and the University of Maine-Machias spent their spring vacation in the laboratory at MDIBL. There they trained with Dr. Charles Wray on *Molecular Biology Research Techniques*, including PCR amplification of DNA.

Despite working in the Smith Lab overlooking the construction site for MDIBL's new laboratory building, students had a very productive week.

The results of their experiments demonstrated that paternity in *Squalus acanthias* is determined by a unique male, rather than multiple partners. Several groups of these students will present their research findings in April at the Maine Biological & Medical Sciences Symposium at MDIBL.



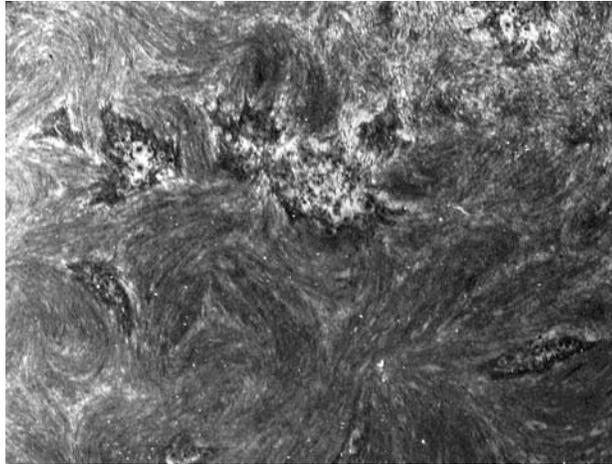
Bates College Imaging and Computing Center *(cont. from front)*

Koven and some of her students are using the facility to study magnetic resonance images of the human brain as they investigate correlations between physical brain structures and neurological disorders.

Translating and conveying information visually has become as important in science as it is in art, a theme Felice Frankel highlighted in her lecture to commemorate the new center's opening. A leading expert in the use of imagery to express scientific data and concepts, Frankel heads the Envisioning Science program at Harvard's Initiative in Innovative Computing, and holds a concurrent appointment as a research fellow at the Massachusetts Institute of Technology.

Two students and eight faculty participated in a Saturday morning workshop Frankel led at the center the first weekend in March. Each

BELOW: HEL (HUMAN EMBRYONIC LUNG) CELLS INFECTED WITH CMV (CYTOMEGALOVIRUS). THE SOLID COLOR AREAS ARE THE INTACT CELLS, AND THE OPEN FOAMIER AREAS ARE THE VIRAL PLAQUES, WHERE THE VIRUS HAS LYSSED THE CELLS. PLAQUE ASSAYS ARE USED TO STUDY AND MEASURE FACTORS AFFECTING VIRAL ACTIVITY. PHOTO: DR. LEE ABRAHAMSEN AND MATT DUVAL



INBRE FACULTY AND STUDENTS ARE WELCOME TO VISIT AND USE THIS NEW FACILITY. CONTACT MATT DUVAL, CENTER MANAGER, FOR MORE INFORMATION: MDUVAL@BATES.EDU

participant brought visual data samples with them, and, like a peer-review panel, critiqued each other's work and how effectively it communicated the scientific information presented. Addressing technological and aesthetic problems together, the group helped each other resolve visual issues, such as how to get a good picture of virally-infected cells (which they did using the flatbed scanner).

Dr. Pamela Baker, Bates' Director of Faculty Research and Scholarship, sees the center fostering more of these types of dialogues and collaborations between researchers.

"Bringing people together across disciplines develops all of our imaginations," she says. "The Imaging and Computing Center is taking us places we never even dreamed of."

Who we are

The Maine IDEa Network of Biomedical Research Excellence (INBRE) is an NCRR/NIH-supported network of nine Maine institutions including Mount Desert Island Biological Laboratory (lead institution), Bates College, Bowdoin College, Colby College, College of the Atlantic, The Jackson Laboratory and The University of Maine. Maine INBRE outreach institutions include The University of Maine at Farmington and The University of Maine at Machias.

The overall goal of the Maine INBRE is to strengthen Maine's capacity to conduct NIH competitive biomedical research. Maine's INBRE provides research support and core facilities to junior faculty, creates research and training opportunities for undergraduates, serves as a pipeline for undergraduate students to pursue health research careers and enhances the scientific and technical knowledge of Maine's workforce.



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