

MAINE

INBRE

IDEA NETWORK OF BIOMEDICAL RESEARCH EXCELLENCE

Maine Senator Olympia Snowe Visits MDIBL

Senator Olympia Snowe visited the Mount Desert Island Biological Laboratory on February 21, 2006 while a week-long INBRE course on molecular biology research techniques for undergraduates from The University of Maine campuses at Farmington and Machias was underway. She met with MDIBL staff and scientists, toured the renovated year-round facilities, and asked the students, who were studying experimental procedures in the analysis of gene sequences and gene expression, lots of questions. The students were applying their newly-acquired skills to assist with Dr. David Towle's research into an invasive species of crab and its effect on Maine's lobstering industry.

According to UMF student Laura Lalemand, "Senator Snowe seemed really excited and impressed that students were devoting their winter breaks to spending long days in a lab doing molecular biology to benefit the state of Maine." The course was sponsored by Maine's INBRE, funded by grants from the National Center for Research Resources at the National Institutes of Health.



SENATOR SNOWE IN THE LAB WITH DAVID TOWLE OF MDIBL AND UNIVERSITY OF MAINE STUDENTS.

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AT LEFT: BRAULIO PEGUERO BOWDOIN '05 WITH HIS MENTOR, BOWDOIN NEUROSCIENCE CHAIR PATSY DICKINSON, AT THE 2005 ANNUAL CONFERENCE OF THE NEUROSCIENCE FOUNDATION IN WASHINGTON, D.C. BRAULIO WAS ONE OF ONLY A HANDFUL OF UNDERGRADUATES WHO PRESENTED THEIR RESEARCH AT THIS CONFERENCE OF 35,000 NEUROSCIENTISTS. FULL STORY PAGE 3.



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

Over the past year the Maine INBRE made significant progress towards our goal of addressing the statewide need to enhance the biomedical research capacity and competitiveness of faculty and students in Maine. Many of the participating institutions were able to purchase new equipment to improve their laboratory infrastructure for faculty research and student research training. In addition, our network gained increased access to electronic journals and databases through our Bioinformatics Core.

Comparative functional genomics is increasingly reliant on bioinformatics tools to analyze, compare and understand sequence data – our INBRE provided several training opportunities for students and researchers to familiarize themselves with the capabilities of computational biology programs and resources.

We are very pleased with the increased educational opportunities we were able to offer for undergraduates this year through our Outreach Core. Forty-six students from across the state participated in six short courses held over the course of the year. Seventeen fellowships were awarded to students from INBRE institutions and outreach institutions, which paired them with a network mentor for ten weeks of work on an independent, hypothesis-driven project. Last month we held our annual INBRE student symposium at MDIBL where they could share the results of their research with each other.

The New York Times noted this summer the importance of such science education opportunities for young people. In an opinion piece published July 3 they wrote: “*The emerging consensus among educators is that students need early, engaging experiences in the lab – and much more mentoring than most of them receive now – to maintain their interest and inspire them to take up careers in the sciences.*” Many students across Maine’s IDEa Network have benefited from just these types of experiences this year.

You’ll read in this issue about some of our students’ outstanding work. Braulio Peguero, Bowdoin ’05, just finished a one-year post-graduate research fellowship. Nishad Jayasundara, COA ’05, is starting graduate school at Stanford University after a year working in the laboratory of Dr. David Towle at MDIBL. As I write to you summer programs are coming to fruition and enthusiastic students are heading back to school invigorated by a summer of lab research.

Our investigators have been hard at work as well. Eight INBRE working teams presented abstracts at the National IDEa Symposium of Biomedical Research Excellence in Washington, D.C. in July. The national forum was an exciting opportunity to meet with researchers and scientific leaders from other states where biomedical research has been historically under-funded – we share similar challenges and opportunities.

Our annual meeting this past month focused on learning more about the research progress of Maine INBRE Projects and Pilot Projects. You’ll read on the following pages about some of the publications, honors and awards our research teams earned this year, as well as student fellowships and courses. The INBRE goal of promoting collaborative research across disciplines is exemplified in the work of Clare Congdon and Joel Graber, featured in this issue.

I’m proud of the accomplishments of our IDEa network in Maine, and anticipate another fruitful year ahead.

Patricia Hand, Principle Investigator

INBRE Honors and Awards

Bates College Professor **RYAN BAVIS** received the Giles F. Filley Memorial Award from the American Physiological Society. Since 1994 the Society has distributed the honor recognizing excellence in respiratory physiology and medicine. The award is given annually to an investigator who holds an academic rank no higher than assistant professor and

demonstrates outstanding promise in the field based on his research program.

CAROLYN MATTINGLY and **J. DENRY SATO**, both of MDIBL, were named Associate Graduate Faculty in the Department of Biochemistry, Microbiology and Molecular Biology at The University of Maine.

ANTONIO PLANCHART, College of the Atlantic and MDIBL, was named Adjunct Faculty Member of The University of Maine at Orono Graduate School of Biomedical Sciences.

J. DENRY SATO, MDIBL, was named Editor-in-Chief of *In Vitro Cellular and Developmental Biology*, the journal of the Society for In Vitro Biology.

Joel Graber Awarded NIH R01 Support

Joel Graber, Associate Staff Scientist at The Jackson Laboratory states it simply: “This was what was supposed to happen under INBRE.” When Graber obtained National Institute of Health R01 funding this past year for a project based on his INBRE-funded research, one of the major goals of the INBRE program – to support scientists while they develop their careers and become competitive for independent funding – was met.

Graber credits INBRE with helping him get through the NIH proposal process successfully. Application revisions are not uncommon in the competitive NIH funding process, and Graber’s award came after his third try. One comment on his first application cited his “modest publication record,” so Graber concentrated on submitting studies to peer-reviewed journals. “The INBRE grant award reduced the pressure on me to find immediate funding and gave me time to concentrate on publishing,” he says.

Graber says one of the most exciting aspects of his INBRE-supported work at The Jackson Laboratory is the collaboration between wet bench and computer scientists. Graber’s earlier work focused narrowly on fundamental RNA and less on entire organisms. Now he can test computational hypotheses with bench biologists and have their experimental results provide feedback for improving computational models.

Graber has a long list of collaborators, including Maine INBRE participants Keith Hutchison and Jesse Salisbury, both at The University of Maine, and Barbara Knowles and her group at The Jackson Laboratory.

“The INBRE grant award reduced the pressure on me to find immediate funding and gave me time to concentrate on publishing.”

“Joel’s enthusiasm for his work is infectious,” Knowles says, “and he is a very rigorous scientist. His success is a tribute to INBRE support. He was mentored by senior scientists at his home institution and at MDIBL to complete studies and write focused grant proposals. In turn he will be a great resource for the state. He is training three graduate students, two postdoctoral fellows and summer college students, and he will be a great mentor for future young computational scientists.”

Indeed, Graber considers teaching and mentoring a big part of his job. “Research isn’t for everyone, and classroom course work doesn’t tell you if you’re good in the lab or not, or whether you like it or not. I was given opportunities, so I feel the obligation

to give back.” He impresses upon students an axiom someone passed along to him: Fail, fail, fail, succeed, write a paper. Fail, fail, fail, succeed, write a paper, write a grant. Start over. “Failure,” he says “is not the end of everything.”

This past year Graber’s team completed a broad survey of 3’-processing downstream elements from ten organisms, including human, mouse, rat, dog, chicken, zebrafish, fugu, fruit fly, mosquito, and nematode. They identified statistically significant patterns including both elements common to all metazoans and elements specific to sub-groups, and, through a corresponding analysis of the RNA binding proteins that recognize these elements, were able to put forward a new model of the protein-mRNA interaction.

Graber is now embarking on a collaborative study entitled *Genome Dynamics: Evolution, Organization, and Function*, with other researchers at The Jackson Laboratory. The project, which focuses on the analysis of genomic patterns in inbred laboratory mice, is one of only seven NIH funded Centers for Systems Biology. Graber’s excitement about their study is palpable. “Doing computational analysis is great,” he says, “but doing it here, where we have the mice to experimentally validate our analysis, is fantastic. We can take our models back to the living organism.”

Braulio Peguero: Bowdoin Junior Biomedical Research Fellow

As part of its participation in the INBRE program, Bowdoin College has created a unique opportunity for its students – a “Junior Biomedical Researcher” fellowship. The position allows graduating seniors to continue to work for an additional year on their undergraduate research projects at Bowdoin and prepare them for publication. Fellows gain the opportunity to pursue their research in greater depth and to act as mentors to other students.

Braulio Peguero was Bowdoin’s first fellowship recipient. Graduating

in 2005 with honors in Neuroscience, he jumped at the chance to continue his research. “Before I came to Bowdoin, I didn’t know that a career in biological research existed – I thought of biomedical careers as being restricted to practicing medicine.”

Dr. Patsy Dickinson, the director of Bowdoin’s neuroscience program, was Peguero’s first biology professor and quickly became his mentor and advisor. Her class in comparative neurobiology was his favorite undergraduate course, because it was small, emphasized investigation, and

involved a lot of interaction with other students.

Peguero says his early work in Dickinson’s lab was a “big learning experience.” There were many wash-out experiments, but he found that persistence and patience paid off, because “sometimes it takes awhile to see results.” Small successes motivated him to keep asking questions and searching for answers. His excitement about lab work grew.

Guest Column: Steve Katona

As most of you know, my tenure as president of College of the Atlantic (COA) ended in June. In reflecting on these past thirteen years I want to say that participating in the BRIN/INBRE program has been one of the most rewarding experiences of my presidency. It is certainly one of the best things that has happened for our college.

Both the Mount Desert Island Biological Laboratory (MDIBL) and The Jackson Laboratory have long and distinguished histories in the field of biomedical research. Indeed both also have significant histories in biomedical education, particularly at the graduate level. The BRIN/INBRE program has extended the educational thrust of both laboratories to serve undergraduates, first at College of the Atlantic, Bates, Bowdoin and Colby colleges and The University of Maine, and now at a number of other undergraduate campuses. Thanks to BRIN/INBRE-sponsored courses in functional genomics and molecular genetics offered by MDIBL, summer research fellowships, symposia and other opportunities for

research training, our students' level of preparedness for biomedical research has significantly increased.

These experiences have enabled students to gain research assistantships with senior scientists at both MDIBL and The Jackson Laboratory, where they have worked in the field of functional genomics, toxicogenomics and bioinformatics. Thanks to this training, we have seen an increase in the number of COA graduates going on to medical school, veterinary medical school and biomedical research.

One important side effect of the BRIN/INBRE program has been forcing the participating liberal arts colleges to come to grips with how best to incorporate cutting-edge scientific research into curricula that have traditionally been focused nearly exclusively on teaching in the classroom. It would not be reasonable to expect such culture to change quickly, nor should it do so without thoughtful dialogue. COA has not yet fully resolved this tension, but I can verify that the program has stimulated important discussions and useful progress toward the goal of strengthening the role of research without compromising our core responsibility to provide excellent, student-centered teaching.

My successor, David Hales, recently

met with Patricia Hand, the Principal Investigator of the Maine INBRE, and John N. Forrest, Jr., the Director of the MDI Biological Laboratory, and toured the laboratory. Afterwards David told me how impressed he was with all that he had seen and heard. I am confident that he will be a strong supporter of the BRIN/INBRE program.

In closing, let me say how deeply grateful I am for the extraordinary leadership that the Mount Desert Island Biological Laboratory provides to the BRIN/INBRE program. The program is exemplary in every way. It is enhancing the quality and quantity of biomedical research and education; it is training the next generation of biomedical scientists; and it will, in the end, save lives and reduce human suffering from disease. I am proud to have worked with all of you and played a small role in this remarkable program.

Steve Katona was one of four full-time founding faculty members who established the College of the Atlantic in 1972. He also founded the Marine Mammal Research arm of COA's program of study. Dr. Katona served as COA's President from 1993 – 2006. His thoughtful and steady presence inspired many students and colleagues alike – he will be missed.

2006 INBRE Student Fellows

Talented undergraduates are invited to participate in summer research programs of established scientists in a network-wide competitive program. Selection of students is based on a combination of prior academic success, letters of recommendation and research interests. Below are our 2006 undergraduate student research fellows, their institutional affiliation, and mentor.

| | | |
|--------------------|--------------------------|--|
| Michelle Buckley | U of Maine – Machias | Dr. George Kidder, MDIBL |
| Benjamin Burpee | U of Maine – Orono | Dr. Andrew Christie, MDIBL and the Univ. of Washington |
| Tobin Carson | U of Maine – Farmington | Dr. Julie Millard, Colby College |
| Jared Cassin | Bates College | Dr. Mary Kate Worden, MDIBL and the Univ. of Virginia |
| Anne Cuttler | Colby College | Dr. Andrea Tilden, Colby College |
| Zinaida Dedeic | College of the Atlantic | Dr. MiMi DeVries, The Jackson Laboratory |
| Tamlyn Frederick | Bowdoin College | Dr. Glen Lawson, Bates College |
| Katherine Gassman | U. of Maine – Farmington | Dr. Chuck Ostemeier, The Jackson Laboratory |
| Nathaniel Jillette | U of Maine – Machias | Dr. Raymond Henry, MDIBL and Auburn University |
| Charles Johnson | Bowdoin College | Dr. Bruce Kohorn, Bowdoin College |
| Laura Lalemand | U of Maine – Farmington | Dr. Franklin Epstein, MDIBL and Beth Israel Medical Center |
| Elizabeth Mitchell | U of New England | Dr. Petra Lenz, MDIBL and the Univ. of Hawaii Manoa |
| Teagan O'Toole | U of Maine – Orono | Dr. Rebecca Van Beneden, The U of Maine |
| Peter Pavicevic | College of the Atlantic | Dr. David Barnes, MDIBL |
| Elizabeth Petit | Colby College | Dr. Robert Preston, MDIBL and Illinois State University |
| Gregory Sousa | Bates College | Dr. Andrew Christie, MDIBL and the Univ. of Washington |
| Rebecca Wood | U of New England | Dr. Susan Edwards, MDIBL and James Cook Univ. |

2006 INBRE Courses

Molecular Biology of Crustacean Neuropeptides: January 15 – 22; March 18 – 25

Host: MDIBL, for Bowdoin College students
 Faculty: Andrew Christie, Ph.D., the University of Washington
 Patsy Dickinson, Ph.D., Bowdoin College
 David Towle, Ph.D., MDIBL

Molecular Biology Research Techniques: February 20 – 24

Host: MDIBL, for U of Maine, Farmington and U of M, Machias students
 Faculty: David Towle, Ph.D., MDIBL

Functional Genomics of Membrane Transport: March 6 – 17

Host: MDIBL, for U of Maine, Orono, students
 Faculty: Criss Hartzell, Ph.D., Emory University School of Medicine
 Keith Hutchinson, Ph.D., The University of Maine
 Carol Kim, Ph.D., The University of Maine
 J. Denry Sato, D.Phil., MDIBL
 Bruce Stanton, Ph.D., Dartmouth Medical School
 Simon Watkins, Ph.D., Univ. Pittsburgh School of Medicine

NCBI Field Guide to GenBank and Molecular Biology Resources: March 15 – 16

Host: The Jackson Laboratory, for INBRE scientists, staff and students
 Faculty: NCBI Staff

Molecular Biology Research Techniques – March 19 – 25

Host: MDIBL, for College of the Atlantic students
 Faculty: Charles Wray, Ph.D., MDIBL

Practical Genomics and Bioinformatics – May 8 – 19

Host: MDIBL, for Bates College students
 Faculty: T. Glen Lawson, Ph.D., Bates College
 David Towle, Ph.D., MDIBL
 Charles Wray, Ph.D., MDIBL



MDIBL INSTRUCTOR CHARLES WRAY (FAR RIGHT) WITH COLLEGE OF THE ATLANTIC STUDENTS PARTICIPATING IN THE MARCH COURSE, MOLECULAR BIOLOGY RESEARCH TECHNIQUES.

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

Maine INBRE Director:

Patricia Hand, Ph.D.

Maine INBRE Program Coordinator:

David Barnes, Ph.D.

INBRE External Advisory Committee:

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 James Gentile, Ph.D.
 John G. Hildebrand, Ph.D.
 Lynette Hirschman, Ph.D.
 Leonard I. Zon, M.D.

INBRE Steering Committee:

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 Patsy Dickinson, Ph.D., Bowdoin
 Keith Hutchison, Ph.D., U of Maine
 Barbara Knowles, Ph.D.,
 The Jackson Laboratory
 Chris Petersen, Ph.D., COA
 Edward Yeterian, Ph.D., Colby

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Supported by:

National Center for Research Resources
 National Institutes of Health

*This publication was made possible by
 NIH Grant Number P20 RR-016463
 from the INBRE Program of the
 National Center for Research Resources*

External Advisory Committee Profile: Barbara Beltz



“The most obvious benefit of INBRE,” Barbara Beltz says, “is that it has created an awareness – a public awareness – of science issues, as well as an increase in training.” Dr. Beltz also credits INBRE with spreading resources more broadly and helping isolated researchers and institutions form productive connections.

While it’s too early to tell what the long-term impact of INBRE will be, she is hopeful about the outcome of the program. “Funding lets people dream,” she says “and INBRE was well-planned, making multi-year commitments to research projects.” Beltz points out that there are few places for researchers to go for start-up funding, and INBRE project grants give people enough funding over the course of three or four years to get started in a lab.

As Beltz began her own research career, she quickly made a commitment to her laboratory, coming early to the realization that she would not survive at a small institution like Wellesley without external funding. As part of her commitment, she put some of the NSF funding she obtained towards supporting a post-doctoral position in her laboratory, rather than paying herself a summer salary. That decision helped her gain NSF funding in subsequent years. “They saw that budget item [applied

towards the post-doctoral position] as a way of getting more bang for their buck...it meant a steady twelve months of research rather than what time some undergraduates and I could find in the summer.”

Beltz describes the help she has had in the lab as “gifts falling in my lap.” For example, Jeannie Benton has worked in the Beltz lab for fourteen years bringing a stability and long-term, consistent support that has been a “phenomenal benefit.” Benton has trained others coming through the lab, and serves as the anchor at times when Beltz herself can’t be there. Benton, who is an artist as well as a scientist, also brings sensitive interpretive skills and an aesthetic eye to the work, which Beltz credits with allowing her to see very subtle differences in brain tissue using a confocal microscope.

Beltz also emphasizes the importance of publishing, which spread the word about her work and attracted other associates. Jeremy Sullivan, a postdoctoral researcher, has been with her for five years, and she has hosted visiting scientists from Australia, Germany, and Norway – who brought with them funding from their own governments.

Given her own experience in a relatively small college, Beltz is interested in seeing how INBRE funding will change the participating undergraduate institutions in the long-term. Will it establish a “research culture” in which there is a balance between teaching loads and laboratory time? Will there be institutional support for researchers to pursue their own funding after INBRE?

She sometimes wonders about her own way of dealing with scarce resources, putting her summer salary back into her lab, and asks “why didn’t I question it more?” But she was focused on building the lab and, as she says, “living what I wanted to live.” She speculates that the next generation of scientists will have different pressures regarding resources, especially with the funding climate tighter now than it has been in forty or fifty years.

She is also curious to see what lasting impact INBRE will have on the curricula of participating institutions. The biggest hurdle working with stu-

dents, she thinks, is getting them to take responsibility for their own learning and to realize that learning is not bestowed upon them. Beltz postulates that 90% of learning is up to the individual students; the teacher’s job is primarily to help them find and organize information, manage their resources, and learn what questions to ask. Part of success, she says, is “challenging students to their limits...students should be allowed to fail, and should realize that grades are neither an evaluation of them as human beings nor a measure of what they are capable of. Challenging yourself can be uncomfortable, and experimentation in the lab – with all its ups and downs – can become a lesson in life.”

Dr. Barbara Beltz is Susan M. Hollowell and Ruby Frances Howe Farwell Professor of Biology at Wellesley College. Prior to joining the faculty in 1987, she was a Postdoctoral Fellow and Instructor in the Neurobiology Department at Harvard Medical School. In addition to being an energetic teacher and researcher, she serves on the External Advisory Committees for the Maine, Arkansas and Tennessee INBRE and RIMI (Research Infrastructure in Minority Institutions) grant programs.

Dr. Beltz’s research focuses on the development of the nervous system. Her primary interests revolve around the environmental and physiological controls over neuronal birth and death, and particularly how the day-night cycle influences the life-long turnover of cells in the nervous system. Her most recent experiments elucidate how circadian rhythms and the neurotransmitter serotonin guide neuronal proliferation and differentiation.

Do you have INBRE news?

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

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Research Scientist Profile: Clare Congdon, Colby College



Using evolutionary techniques to study evolution itself is, according to Clare Bates Congdon, “pretty darn cool.” Congdon, a Research Scientist at Colby College, was awarded INBRE support in 2004 to study “Machine Learning Methods for Phylogenetics and Genomics.” In addition to allowing her to explore evolutionary computation, INBRE has provided her with opportunities for new collaborations with scientists in Maine and, she says, given her research deeper meaning.

izations essentially means extracting patterns from a potentially overwhelming mass of data. As humans do from infancy onward, the programs Congdon works with refine their generalizations over time and thus presumably begin arriving at “wiser” decisions. They may even discover solutions that have not occurred to the programmer herself. If the learning transpires in a robotics program, the robot will use what it has learned to modify its behavior.

One way a machine can learn is through “evolutionary computation,” where the program learns through a process of breeding, selection, and mutation. It is the idea of letting this virtual evolutionary process reveal truths about actual biological evolution that Congdon finds so intriguing. Evolutionary computation is particularly useful when a problem is posed that has too many possible solutions for each to be considered individually. If any of those possible

needed help finding an effective software tool to locate commonalities within a huge data set of genetic sequences. That data set includes the genomes of evolutionarily divergent species from humans on the higher end (most evolved) to pufferfish on the lower (least evolved). Her hope is to find patterns or sequences of genetic material that occur in each of these species – sequences that have presumably been conserved throughout evolutionary time. She is looking in the “non-coding” parts of the genome, formerly known as “junk” regions because their function is not apparent, with the expectation that any conserved regions probably serve important functions. Once those regions are discovered another INBRE researcher, Antonio Planchart, will do the benchwork to try to discover their functions.

Congdon’s job is to find the most promising sequences within the data set. She and Mattingly decided to look ini-

Machine learning refers to programs that can adapt and act more knowledgeably as they run or gain experience, which parallels the way humans learn. As humans do from infancy onward, the programs Congdon works with refine their generalizations over time and thus presumably begin arriving at “wiser” decisions.

Congdon works in the general field of artificial intelligence and specializes in machine learning. She earned her Ph.D. at the University of Michigan in 1995 with a thesis on applying genetic algorithms and machine learning to the risk factors associated with coronary artery disease; this was “bioinformatics,” but neither the term nor the field was well-established at that time.

Machine learning refers to programs that can adapt and act more knowledgeably as they run or gain experience, which parallels the way humans learn. It occurs when a programmer asks a question that is too big to be calculated algorithmically – that is, the solution cannot be calculated directly because there are simply too many possible solutions or too much data – and the computer must make “guesses” about which data to include in its calculations or which solutions are most desirable. Essentially, the program must generalize about data, just as humans generalize when making judgments or calculations. Making general-

solutions can be expressed in some simple manner – say, a sequence of twenty nucleotides – then initial solutions can be generated randomly. However, some criteria for assessing the quality of the various possible solutions is needed, so that they can, in effect, be scored. The population of solutions can then begin breeding in a variety of ways, either swapping some of their components or creating “mutations” as they interact. As long as there is some bias in the system making the ones with higher scores more likely to reproduce, successive generations will produce better and better solutions.

Through INBRE, Congdon has found an exciting application for her evolutionary computations. Carolyn Mattingly, an investigator in bioinformatics at MDIBL and recipient of INBRE support for the “Identification of Novel Regulatory Sequences in ABCB and ABCC Subfamily Genes by Comparative Genomic Analysis,” joined forces with Congdon when Mattingly

tially for common sequences of twenty nucleotides or “20mers.” But given that the human genome alone has 3 billion pairs of nucleotides, this is one of those cases where there are just too many options – 420 to be exact – to search algorithmically. Therefore their program must make generalizations and evolve better and better solutions. “This is where artificial intelligence is our friend,” Congdon says, “where we want to be clever about where we look and don’t look.”

Though Congdon and Mattingly have separate INBRE projects, Congdon says “the INBRE brought us together.” She first met Mattingly when she brought a Colby bioinformatics class to MDIBL on an INBRE-funded trip and is thrilled with their collaboration. “This is what INBRE was supposed to do, encourage us to work together. That’s exactly what worked out – we have this wonderful relationship together that just wouldn’t have happened without INBRE.”

Student Profile: Nishad Jayasundara



The first time Nishad Jayasundara was in a lab – “a real lab,” he emphasizes, “before that there was nothing serious” – was during an INBRE short course in molecular biology in at MDIBL in March 2003. Jayasundara was then a sophomore at the College of the Atlantic (COA) majoring in human ecology with a strong interest in biology. He had left his native Sri Lanka four years earlier to complete high school at Mahindra United World College in India before enrolling at COA with a scholarship from the Shelby Cullom Davis Foundation. With the INBRE course and subsequent INBRE research awards, Jayasundara began his work conducting research in “real” labs. Half a planet away from where he grew up, he also got a taste of what being part of a lab community can mean, and a good look at what he might want to bring with him back to Sri Lanka, still very much his home.

During the summer of 2003, Jayasundara received an INBRE Summer Research Fellowship in the MDIBL lab of Dr. John Wise, who had

recently moved his environmental and genetic toxicology lab from Yale to the University of Southern Maine.

With Dr. Wise, he studied the toxicology of heavy metals in marine mammal tissues in comparison to human tissues. The following spring found him in France working with Dr. David Towle of MDIBL, who had taught the INBRE course the preceding year and coincidentally received a Fulbright Scholar grant while Jayasundara was in Scotland for his junior year. Crossing the Channel, Jayasundara spent five weeks with Dr. Towle studying ion transporters and heat shock protein expression in the European shore crab, *Pachygrapsus marmoratus*, before returning to MDIBL and continuing the project stateside.

Back at COA, Jayasundara was awarded an INBRE fellowship to conduct research during his senior year. He worked with Dr. Edward Leiter at The Jackson Laboratory observing the

“It was a great experience working with these veteran researchers. I was impressed by how much responsibility and trust I was given.”

effects of the hormone leptin on Type I diabetes. In particular, he studied mutations of the receptors that bind leptin, which regulates weight, reproduction, and metabolism, and was recently discovered to play a role in immune responses. Dr. Leiter’s lab collaborates with researchers in Europe and Asia, and Jayasundara enjoyed the collegiality. “It was a great experience working with these veteran researchers,” Jayasundara says. “I was impressed by how much responsibility and trust I was given.”

After the fall semester of his senior year, Jayasundara went back to his hometown of Galle in Sri Lanka for the first time since beginning college. On the evening of December 25, he was

on a rooftop with some friends, “admiring the beauty of my city, looking at the white sandy beach we could see a few meters away.” On December 26, the tsunami struck, and his city became “an unorganized, splattered graveyard,” as he wrote in an email to friends in the United States. That’s when another aspect of lab community life revealed itself. Friends at COA and MDIBL were among the first people to make sure he was all right and help gather relief supplies to send to Sri Lanka. “The Lab was amazing,” Jayasundara remembers. “It’s a little group that really cares.”

Jayasundara graduated from COA in May 2005 and returned to Dr. Towle’s lab at MDIBL for a year to study ion transport regulation in crustaceans during salinity changes. This month he starts at Stanford University as a doctoral student in biology.

“We will all miss Nishad when he embarks on his Ph.D. program this fall,” says Dr. Towle, reflecting on Jayasundara’s contributions to MDIBL. “Not only is he a fine research scientist and teacher, he is also a gourmet chef specializing in Sri Lankan dishes.” Jayasundara was awarded a full scholarship to Stanford and plans to continue research on marine organisms.

His marine studies in the Pacific should serve as the perfect complement to his training and experience in Maine. Jayasundara is grateful for the program that introduced him to “real” laboratories and the communities they foster. As he says, “INBRE is the best way for students to get into the lab system in Maine. It helps you meet people and gets you going.”



National IDeA Symposium of Biomedical Research Excellence

Maine's INBRE sent many representatives to the 1st Biennial National IDeA Symposium of Biomedical Research Excellence (NISBRE) in Washington, D.C., July 20 – 22nd. The two-day event, which attracted over 1,000 registrants from INBRE and COBRE states, featured scientific sessions as well as workshops on mentoring and career development. Eight working teams from Maine INBRE presented abstracts at the symposium – their research presentations are listed below.

Cell morphology, motility, cytoskeletal organization and gene presence in long-term cultures derived from sea urchins of the genus *Strongylocentrotus*.

Presented by Ann Czechanski for authors: A. Czechanski, J. Henson, C. Bayne, D. Cheung, R. Henson, D. Forest, A. Parton, and D. Barnes.

Characterization of XM, a novel *Xiphophorus melanoma*-derived cell line.

Presented by Peter Pavicevic for authors: D. Barnes, L. Dowell, D. Forest, A. Parton, P. Pavicevic and S. Kazianis.

Characterization of a novel DNA motif in the *Tctex1* and *Tcp10* gene complexes and its prevalence in the mouse genome.

Presented by Tony Planchart for authors: C. Doukeris and A. Planchart.

Conservation of FGF receptor sequences in vertebrate evolution.

Presented by Denry Sato for authors: J.D. Sato, J.H. Graber, T. Okamoto, J.F. Crow, and R. Nishikawa.

Dioxin Induced Cardiovascular Toxicity and Beta-Adrenergic Receptor Signaling.

Presented by Rebecca Sommer for authors: E.S. Davie, M.W. Carmody and R.J. Sommer.

Identification of Conserved Non-coding Regions in the ATP Binding Cassette Family of Genes.

Presented by Joseph Aman for authors: C. Mattingly, J. Aman, A. Denby, and C.B. Congdon.

Improved mRNA motif characterization using non-negative matrix factorization.

Presented by Joel Graber for authors: S. Murphy, J.M. Brockman, L.N. Hutchins, J. Salisbury, P. Singh, and J.H. Graber.

Integrin regulation of mouse embryonic stem cell self-renewal.

Presented by Denry Sato for authors: J.D. Sato, Y. Hayashi, M. Furue, K. Ohnuma, Y. Myoishi, T. Abe, R-I.Hata, T. Okamoto, and M. Asashima.

Cont. from page 3: Braulio Peguero: Bowdoin Junior Biomedical Research Fellow

Peguero has also enjoyed the opportunity to participate in several INBRE courses. In 2005, he took the Bowdoin and MDIBL course, "Laboratory in Behavioral Neuroscience," taught by Dr. Rick Thompson and Dr. Nancy Curtis. This past year, in his new role as junior biomedical researcher, he accompanied Dr. Dickinson's class back to MDIBL for the course "Molecular Biology of Crustacean Neural Peptides," taught by Dr. Dickinson and Dr. David Towle of MDIBL.

Peguero credits his fellowship experience with improving his laboratory skills. Over the past year, he has been able to practice techniques he learned in his courses in greater detail, including immunohistochemical, molecular biological, and chemical procedures. He has performed and analyzed electrophysiological recordings of neuronal networks and supervised undergraduate students using these procedures.

His fellowship also allowed him to bring some of his research to fruition and publish the results. One of the projects he worked on with other researchers in

Dickinson's lab was just published in the *Journal of Comparative Neurology* as "Identification, Distribution and Physiological Actions of VYRKPPFNGSIFamide (Val¹-SIFamide) in the Stomatogastric Nervous System of the American Lobster, *Homarus americanus*." With Dr. Dickinson's guidance, Peguero also made his first oral scientific presentation. In April, he spoke about the "Identification and Physiological Activity of a New Tachykinin-Related Peptide in *Cancer irroratus*" at the INBRE-sponsored Maine Biological and Medical Sciences Symposium at MDIBL. He also participated in conferences at the Marine Biological Laboratory, the Harvard Medical School and the Society for Neuroscience in Washington, D.C.

Dr. Dickinson was pleased with Peguero's progress in his fellowship year. "He gained enormously in self-confidence," she says. "He became much more comfortable helping to design experiments and ask questions

and had very good ideas. His work was excellent and has contributed to several papers – both published and on the way to being published – as well as to a number of poster presentations at several regional and national meetings."

The year-long fellowship also helped solidify Peguero's desire to go to graduate school. He is currently researching programs and plans to apply this fall. In the meantime, he will stay at Bowdoin one more year, working in the Office of Student Activities. His new position is an extension of his own life as an undergraduate at Bowdoin, where he was involved in the Latin American Students Association and in student government. He will continue conducting research on his own time and is looking forward to having the opportunity to mentor other students in their college careers, just as he was guided and encouraged in his.

You can hear Braulio and his mentor Patsy Dickinson talk about their research at: <http://www.bowdoin.edu/podcasts/audio/the-physiology-of-neurons-in-lobsters.mp3>

Tobin Carson's Unconventional Path to Medical School



Tobin Carson remembers a teacher at the non-traditional school she attended in western Maine who would read aloud and explain articles from the *Scientific American*. At age ten or eleven, "I was hooked." Carson recalls that "one article in particular, about the human immune system and the different cells which make it up, really impressed me and I remember thinking how amazing it was that we know so much." Two years later, when that teacher died of cancer, she started "wondering how we could know so much and still know so little."

Carson's own curiosity, rather than conventional expectations, has always motivated her learning. At 28, she now has an INBRE summer fellowship to conduct cancer research in the laboratory of Dr. Julie Millard at Colby College. She will graduate from The University

of Maine at Farmington (UMF) in December 2006 and plans to apply to medical schools this fall.

Carson lives with her two sons and her husband in a house they built in Starks, Maine. She grew up without much money on a dairy farm and attended the "nonschool" where the philosophy was to provide resources and allow children to study what they wanted. She spent hours poring through books on science, architecture, poetry, and literature. A stint at the local high school ended when she was 15, after the guidance counselor told her to forget her dream of going to medical school, saying, "people like you don't go to places like that." As Carson recalls, "After that, I stopped going to school. I thought, what good would it do me?"

The learning, however, continued. After her children were born, she got her GED certificate and enrolled at UMF full-time as a biology major. As UMF associate chemistry professor Mariella Passarelli says, Carson "studied on her own, figured things out on her own, and relied on herself to get where she is. She has an innate intelligence and a knowledge that goes beyond the classroom." This year she received the Harvey Aft Award for Excellence in Chemistry, a \$1,000 annual award given to a UMF student who has excelled in upper-level chemistry, as well as the INBRE summer fellowship.

"INBRE has given me a wonderful opportunity to see what lab-based

research is like," Carson says. Her mentor, Dr. Millard, studies mustards and epoxides and how they cross-link DNA. Carson is focusing on diepoxybutane. These small molecules attach to both sides of a DNA chain and render the two strands unable to separate and the cell unable to reproduce. Because they influence cell division, these chemicals can both cause and, at times, fight cancer.

However, as Carson says, "cancer research is slow-moving," so she has another project she can "start, finish, and write up" during the time she is in Millard's lab. She is developing and writing up procedures for a lab project for biochemistry students using "forensic samples" like dog hair and saliva, as though the students were studying a crime scene. They will have to handle the specimens appropriately to obtain DNA profiles that assist in the fictional investigation. The same techniques are applicable to many kinds of studies, whether used for forensics or for profiling diversity or relatedness in populations of any type.

Carson intends to be a practicing physician, but says she "can't imagine giving research up altogether." She expects to attend an osteopathic medical school and is now looking into joint D.O./Ph.D programs. As a doctor, she hopes to "help people make good choices," just as she has made the choice to avail herself of the opportunities INBRE, The University of Maine, and her own curiosity have presented.

Maine Biological and Medical Sciences Symposium

The Mount Desert Island Biological Laboratory hosted the 33rd MBMSS April 28th and 29th, 2006. Keynote speaker, Dr. James F. Crow, Professor Emeritus of Genetics at the University of Wisconsin spoke on "*Human Mutation Rates: Some New Wrinkles*." Over 100 members of the Maine IDEA Network attended the two-day symposium which included sessions on Federal Grant Writing; Physiology and Environmental Genetics of Aquatic Species; Bioinformatics and Computational Biology; Genetics and Cancer; and Genetics and Development.

Invited lecturers included Dr. Rodney Nairn, Professor, University of Texas, M.D., Anderson Cancer Center, who spoke on "*Genetic Recombination and Overlapping DNA Repair Mechanisms in Mammalian Cells*;" Phil Yund, Research Associate Professor, University of New England on "*Sex in the Sea: Is Fertilization in Sea Urchins Limited by Sperm Availability?*" and **Carol Bult, Ph.D.**, Staff Scientist, The Jackson Laboratory, who spoke on "*Computing with the Gene Ontology: Putting the Functional in Functional Genomics*." Overall, the speakers included ten faculty members, six undergraduates, and four graduate students.

The meeting concluded in classic Maine style with a lobster bake and traditional music in the MDIBL Dining Hall.

Publications and Presentations from IDeA Network Members

DAVID BARNES, INBRE Program Coordinator, **CAROLYN MATTINGLY**, MDIBL, and fellow researchers A. Parton, L.M. Dowell, C.J. Bayne, and J.N. Forrest, Jr., published “Marine organism cell biology and regulatory sequence discovery in comparative functional genomics” in *Cytotechnology*, 43:123-137, 2005.

RYAN W. BAVIS, Bates College Department of Biology, presented a talk entitled “Hypoxia, hyperoxia and the development of the hypoxic ventilatory response” at the symposium *Respiratory Plasticity after Changes in Oxygen Supply and Demand*, First International Congress of Respiratory Biology, Bonn, Germany, August 2006.

CLARE CONGDON, Colby College, and **CAROLYN MATTINGLY**, MDIBL, published a paper in conjunction with their presentation at the IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology. “Preliminary Results for GAMI: A Genetic Algorithms Approach to Motif Inference,” authors C.B. Congdon, C.W. Fizer, N.W. Smith, H.R. Gaskins, J. Aman, G. Nava, and C. Mattingly, appeared in the symposium’s proceedings, November 2005, pp. 97-104.

The Jackson Laboratory’s **JOEL GRABER**, and The University of Maine’s **KEITH HUTCHISON** and **JESSE SALISBURY**, published their study “A multispecies comparison of the metazoan 3’-processing downstream elements and the CstF-64 RNA recognition motif” in *BMC Genomics*, 7:55 (16 March 2006).

Dr. **GRABER** and his Post-doctoral Researcher **DONGLIN LIU** also published an article entitled “Quantitative comparison of EST libraries requires compensation for systematic biases in cDNA generation,” which appeared in *BMC Bioinformatics* 7:77 (17 February 2006).

NANCY KLECKNER, Bates College Department of Biology, presented two papers on her laboratory’s research at the Society for Neuroscience Annual Meeting in Washington D.C. in November 2005. “Cloning and localization of excitatory glutamate receptors from the central nervous system of *Helisoma trivolvis*,” authors K. Gerhold, A.S. Knox and N.W. Kleckner, appeared in *Society of Neuroscience Abstracts* 486:12; “Glutamate signal transduction pathways causing inhibition in buccal neurons of *Helisoma trivolvis*,” authors J.R. Rafferty and N.W. Kleckner, appeared in *Society of Neuroscience Abstracts* 263.9.

J. DENRY SATO, MDIBL, and the team of Y. Zhang, Y. Hiraishi, H. Wang, K. Sumi, Y. Hayashido, S. Toratani, M. Kan and T. Okamoto published “Constitutive activating mutation of the FGFR3b in oral squamous cell carcinomas” in the *International Journal of Cancer* 117: 166-168, 2005.

NICOLE THEODOSIOU, Bowdoin College Department of Biology, presented “Patterning of the early vertebrate hindgut” at the 65th annual meeting of the Society for Developmental Biology in June 2006, with coauthors D. Hall and A.L. Jowdry.

DAVID TOWLE, INBRE Science Research Core Director, was an organizer and speaker in a symposium *Genomic and Proteomic Approaches in Crustacean Biology* presented as part of the annual meeting of the Society for Integrative and Comparative Biology in Orlando, FL, in January 2006. The paper resulting from that symposium “Gene discovery in *Carcinus maenas* and *Homarus americanus* via expressed sequence tags” will appear in the society’s journal *Integrative and Comparative Biology* published by Oxford University Press in 2006.

Molecular geneticist **CHARLES WRAY**, MDIBL, teamed up with research ecologist James Estes (University of California, Santa Cruz) and evolutionary biologist David Lindberg (University of California, Berkeley) on a study of the interaction between abalones and kelp on the California coast. The results of their collaborative work, “Evolution of Large Body Size in Abalones (*Haliotis*): Patterns and Implications,” were published in *Paleobiology* (v.31, no. 4), 2005.

2006 INBRE Annual Meeting



Maine INBRE-funded investigators gathered at the Mount Desert Island Biological Laboratory on August 13, 2006. They discussed their research projects with the External Advisory Committee, and shared ideas on future research initiatives.

FROM LEFT TO RIGHT, BACK ROW: LEONARD ZON, EAC; BARBARA KNOWLES, THE JACKSON LABORATORY; CLARE CONGDON, COLBY COLLEGE; LYNETTE HIRSCHMAN, EAC; CAROLYN MATTINGLY, MDIBL; LYNN HANNUM, COLBY COLLEGE; NANCY KLECKNER AND REBECCA SOMMER, BATES COLLEGE; CHRISTOPHER BAYNE, EAC; JOEL GRABER, THE JACKSON LABORATORY; J. DENRY SATO, MDIBL; AND REBECCA VAN BENEDEN, U OF MAINE. **FRONT ROW:** DAVID BARNES, ANTONIO PLANCHART AND PATRICIA HAND, MDIBL; CAROL BULT, THE JACKSON LABORATORY; HADLEY HORCH, BOWDOIN COLLEGE; ANDREA TILDEN, COLBY COLLEGE; PATSY DICKINSON, BOWDOIN COLLEGE; AND BARBARA BELTZ, EAC.

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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*Maine's INBRE is supported
by NIH Grant Number
P20 RR-016463 from the
INBRE Program of the
National Center for Research
Resources*

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