MBL Annual Report 2004

MBL Around the Globe
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The year 2004 was one of great excitement for the Marine Biological Laboratory. MBL alumni, faculty, corporation members, and friends from around the world were delighted to learn that the Royal Swedish Academy of Sciences had awarded summer investigator Avram Hershko the 2004 Nobel Prize in Chemistry for his discovery of ubiquitin-mediated protein degradation. The first Israeli (along with his Technion colleague Aaron Ciechanover) to ever win a Nobel Prize, Avram has been a valued member of the MBL summer research community since 1991. I know I speak for all my MBL colleagues when I say how proud we are of Avram’s accomplishments. We look forward to welcoming him and his wife Judy back for another exciting summer of research.

Avram is one of scores of summer investigators, students, and faculty members who travel from around the globe every year to conduct research or participate in courses at the laboratory. In addition, research collaborations take our resident researchers to field sites abroad as well, making the MBL a truly international hub for basic biological, biomedical, and environmental research. I invite you to learn more about the global reach and impact of the MBL’s research and educational programs in subsequent pages of this report.

Chief Academic and Scientific Officer Recruited

An initial strategic planning initiative was the recruitment of a Chief Academic and Scientific Officer who would be responsible for the leadership, planning, and oversight of all academic programs—equivalent to a Provost in a university setting—and the development and oversight of policies relating to scientific research and commercial relations with private enterprise, including intellectual property and technology transfer.

I am pleased to report that William Beers was appointed Chief Academic and Scientific Officer in the Spring of 2004. Bill has more than 25 years of experience working with Boards of Trustees, CEOs, senior administrative staff, and faculty of non-profit research institutions, and comes to us most recently from The Torrey Pines Institute for Molecular Studies in San Diego where he served as vice president of operations and still is a member of the Board of Trustees.

MBL-Brown University Relationship Flourishing

One of Bill’s earliest tasks was overseeing the MBL’s fledgling partnership in graduate education with Brown University. This relationship unites MBL and Brown University’s combined research and education expertise in biology, biomedicine, and environmental sciences and offers talented graduate students the chance to work with scientists at both institutions. It is also enabling MBL investigators and Brown faculty to pursue joint appointments at the two institutions, thereby providing a rich environment for faculty exchanges and research collaborations between the two institutions. The joint graduate program continues to grow and flourish and has already proven quite popular.
among potential students. We welcomed three new graduate students in the fall of 2004, bringing the total number of students enrolled in the nascent program to five. We expect another five students to enter the graduate program in the fall of 2005 as we work toward a fully subscribed program of approximately 25 students over the next four years.

In addition, scientists in the MBL's Ecosystems Center and their colleagues at Brown University are developing two new graduate-level courses for 2006. Senior scientist Ed Rastetter will teach an ecosystems modeling course at the MBL during the Brown intersession next January, and Ecosystems Center scientists, in cooperation with colleagues at Brown, are developing an additional course for advanced undergraduate and graduate students that will focus on human impacts on ecosystem functioning.

Campus Master Site Plan Developed

Another recommendation that emerged from the strategic planning effort was that the MBL must address the need for more and improved facilities to fulfill the strategic objectives that are central to the MBL's mission. The strategic plan identified the need for new and renovated research laboratory space to support new initiatives in research; expanded and updated classroom facilities to address the anticipated growth in our educational programs; new and renovated housing, conferencing, and support space to accommodate an increased volume of scientists, students, and staff on a year-round basis; relief from deferred maintenance and sub-optimal conditions in the Whitman, Lillie, Loeb, and Swope buildings; and additional remote parking and more transportation to mitigate traffic congestion in the village, particularly during the busy summer months.

The architectural firm of Tsoi/Kobus and Associates was hired to develop a comprehensive vision that addresses the needs outlined above. The resulting plan (which can be found on the MBL's strategic planning web site) calls for an overall “greening” of the Woods Hole village campus; additions and renovations to improve efficiency and the Lillie and Loeb buildings; a renovation and possible expansion of the Whitman building; the addition of new classrooms and computer laboratory space in Loeb; additions and renovations to the Swope building to provide new dormitory housing, conference, dining, and support space; and the creation of a park-like area adjacent to the Eel Pond side of the Lillie building for functions and gatherings.

To accommodate the need for additional housing over the next 10 years, the plan calls for the renovation of the cottages at Devil's Lane and Memorial Circle for use by the summer scientist community and the construction of three groups of townhouse units on the Oyster Pond Road campus for year-round, transitional housing. The plan also includes the addition of approximately 200 parking spaces to the Oyster Pond Road parking facility.

Of course, the MBL's Campus Master Plan is a snapshot in time based on current and projected needs. It is a work in progress and entirely contingent on successful fundraising for the various projects it recommends.
Whitman Renovation Project Underway

One of the jewels in the MBL crown is the summer and visiting research program that largely takes place in the Whitman building. Some of the most important basic biological and biomedical research in the world has been conducted here during the summer months, as evidenced by Avram Hershko’s recent Nobel. Unfortunately, our facility for visiting research—the Whitman building—isn’t as modern as the science being conducted there. In fact, as the report of the strategic planning effort noted, the building is woefully inadequate. Renovating Whitman to accommodate 21st century biology was a key recommendation of the strategic plan and has been one of the top priorities of my administration. In 2004 we announced the launch of a campaign to raise $20 million to support the modernization of Whitman.

With $3.8 million in gifts and pledges currently in hand for the Whitman project, we have already been able to complete much of the initial project enabling work: the redistribution and “clean-up” of electrical power on campus, which is also allowing us to upgrade the MBL’s computer network infrastructure and provide wireless access to the internet from most labs, classrooms, housing units and even the Associates Quadrangle this summer. We expect to begin construction on the Whitman renovation in the fall of 2006. Summer investigators can expect to find a substantially upgraded and modernized research facility when they return to Woods Hole in the summer of 2007.

Image and Identity Effort Underway

One of the shared beliefs that emerged early in the strategic planning process was that the MBL needed to expand its external reputation to meet its strategic goals and objectives. To that end, we conducted, in 2003, an audit of the MBL’s existing communications efforts to assess strengths and weaknesses and help determine next steps towards raising awareness of the institution. The audit strongly recommended that the MBL embark on a image and identity effort that would include evaluating the laboratory’s current “brand equity,” developing an overarching communications and marketing plan for the institution; developing strategic positioning messages designed for key constituencies; and developing a new visual identity system for the institution that includes a new, contemporary institutional mark, tagline, and consistent “look and feel” for all MBL publications. Thanks to a generous gift from Rodolfo Llinás during the MBL’s last campaign (targeted specifically for institutional communications efforts), we have engaged the firms of D. R. Giller and Associates and Lasater/Sumpter Design to assist us in this effort, which began in earnest in the late fall of 2004. We expect to begin introducing ideas for our “new look” to the community sometime this summer.
Research

In addition to our outstanding education and summer research programs, the MBL’s resident research programs continue to thrive. Competitive, peer-review funding for these programs was at an all-time high in 2004 with awards totaling $28,730,470 from the federal government. Federal funding of MBL research has risen steadily over the past five years. We hope that this trend can continue, but have some concerns given the long-term outlook for the budget of the National Institutes of Health, which is projected to increase only 0.7% in fiscal year 2006. The outlook for the National Science Foundation—our largest source of federal funding—is even more dire. Because the MBL receives more than 74% of its government grant support from these agencies, we must keep a close eye on these trends as we continue to plan and build for our future.

I am happy to report that private support for our research programs was robust in 2004. Mitch Sogin and the Bay Paul Center received a $900,000 grant from the New York-based Alfred P. Sloan Foundation, for example. This seed grant launched the International Census of Marine Microbes, the first global effort to focus on the biodiversity of single-celled organisms in the world’s oceans. This unprecedented effort to catalog the Earth’s known marine microbes, and explore the ocean’s yet untold microbial diversity, is part of the 10-year, $1 billion Census of Marine Life, a massive collaboration to catalog and map marine species worldwide involving hundreds of scientists in more than 70 countries.

Funding for summer fellowships also increased sharply in 2004. Thanks to gifts from a variety of sources including the Dart Neuroscience Limited Partnership and the Grass Foundation, we awarded 22 fellowships to conduct research at the MBL this past summer.

We were delighted to learn that Bay Paul Center adjunct scientist and corporation member Matthew Meselson was awarded the 2004 Lasker Award for Special Achievement in Medical Science. Matt was recognized “for a lifetime career that combines penetrating discovery in molecular biology with creative leadership in public policy aimed at eliminating chemical and biological weapons,” according to a statement released by the Lasker Foundation. A Harvard professor, Matt maintains a year-round laboratory at the MBL.

On a sadder note, we were disappointed when we were informed that Boston University (BU) had decided not to renew its contract with the MBL to lease space for the Boston University Marine Program (BUMP). Given our 35-year, mutually beneficial relationship with the BUMP program and its faculty members, this is unfortunate news indeed. The MBL has valued its association with BUMP over these many years and looks forward to the program’s continued success. We hope that BUMP faculty will continue to collaborate with the MBL on research and educational efforts and are currently working with BU to accommodate those faculty members who wish to continue to conduct their research at the MBL. The BUMP program will leave the MBL by June of 2006.
Education

As you’ll read later in this report, 2004 was another great year for the MBL’s education program. Once again, hundreds of outstanding students and top faculty came from around the globe to participate in our many courses. Both the revamped Physiology course and the Zebrafish course attracted record numbers of applicants, and funds available for scholarships—and the number of scholarships awarded—were also at an all-time high.

The Semester in Environmental Science (SES), taught by faculty from The Ecosystems Center each fall, enrolled 10 students in 2004, including two undergraduates from Brown. To date, 121 students have participated in the program since its inception, 30% of whom are currently enrolled in or accepted to graduate or professional schools. In addition, eight SES alumni are now employed in scientific or research laboratories, four are employed by environmental consulting firms, and six are working for NGOs or government agencies. Three quarters of SES graduates remain involved in environmental or scientific pursuits.

The Biological Bulletin

The MBL bid a fond farewell to Michael J. Greenberg, who retired as editor-in-chief of The Biological Bulletin, the MBL’s 100+ year-old general biology journal, after outstanding service for 15 years. I’m pleased to report that the MBL has appointed James L. Olds as the 10th editor-in-chief of the journal. He will serve a five-year, renewable term as editor. Jim is the director of the Krasnow Institute for Advanced Study at George Mason University in Fairfax, Virginia, and has had close MBL ties since 1978. An expert in the role nerve cells play in learning and memory, Jim’s research is directed toward understanding and simulating the machinery that permits neurons and neuronal assemblies to store and recall memories, both under normal and diseased conditions. He uses cutting-edge computerized equipment to image and simulate the cells and aims to eventually develop techniques that will reveal the three-dimensional structure and maps of memory function in both animal and human brains in near real-time.

Final Thoughts

As many of you know, I have decided to retire as director and CEO of the Marine Biological Laboratory when my term ends in July of 2006. A committee led by MBL President John Dowling is in the midst of an active and far-reaching search for my successor.

My decision to leave this very special and important institution was not an easy one, but I find it’s time to return to medicine and my professional roots. I hope I have left the MBL a stronger place through our collective efforts at strategic planning, by building an ever more influential and philanthropic Board of Trustees, and enhancing the opportunities the MBL has to have a disproportionate impact on the biological sciences.

— William T. Speck
It is early June in Siberia. The ice that has engulfed the Lena River all winter has melted and the river flows enthusiastically, unbound again at last. It’s a sign of spring to the villagers in the local port of Zhigansk, but to MBL Ecosystems Center scientists Bruce Peterson, Jim McClelland, and Robert (Max) Holmes, it’s an opportunity to examine the potentially serious effects of global warming.

The ice melt signifies peak flow season on the Lena, a key time to study this 2,800-mile river that winds through the heart of Siberia before emptying into the Arctic Ocean. The scientists and their Russian and Canadian colleagues visit the Lena and five other major Arctic rivers several times a year to collect water, sediment, nutrient, and other samples. It’s part of a National Science Foundation-funded project called PARTNERS (Pan-Arctic River Transport of Nutrients, Organic Matter, and Suspended Sediments), a five-year study of how these rivers are affecting the freshwater levels of the Arctic Ocean.

“We’re interested in the total amount of freshwater as well as chemicals in the water that can be used to trace the water once it enters the Arctic Ocean,” says Peterson, the project’s principal investigator. “By sampling at only six sites seven times a year, we can chemically characterize almost two-thirds of the total freshwater inflow from the continents to the Arctic Ocean,” he says.

Since no two rivers are alike, the scientists can create a chemical fingerprint for each river by measuring isotopes, chemicals, and organic matter in the samples.

The PARTNERS study is critical because the Arctic Ocean is getting fresher with global warming and, if the trend continues, it could cause big climate changes, including a major cooling in northern Europe. “We’re looking at continental-scale processes and oceanographic processes,” says Peterson. “The whole point of this is that as humans warm the globe, the hydrologic cycle is changing globally.”

To track this hydrological trend, PARTNERS scientists analyzed Russian data collected between 1936 and 1999 and documented that the combined annual discharge from six major...
Russian rivers into the Arctic Ocean had increased seven percent, a significant number on the scale of things. The findings, which correlate with a 0.6°C increase in global surface air temperature over the past century, were published in 2002 in *Science*, and support the climate-model based hypothesis that freshwater inputs to the Arctic Ocean and North Atlantic will increase with global warming. The warming increases precipitation and the melting of glaciers in the north, which increases the freshwater discharge of the rivers and, ultimately, affects the salinity and circulation of the Arctic Ocean.

Predictions suggesting the globe could warm an additional 2 to 6°C in the next century are a major concern. Oceanographers know that resulting increases in fresh water in the Arctic could change the regional climate by altering the North Atlantic Deep Water formation, a key process behind the great underwater conveyor belt that controls our climate by circulating salt and thermal energy around the globe. This heat and salt pump is called the Thermohaline Circulation, and Peterson and his colleagues say too much fresh water in the pump might plug it up. And that would mean big climate changes for northern Europe.

If people keep using too much fossil fuel, climate changes could come relatively soon. “If the observed positive relationship between global temperature and river discharge continues into the future, Arctic river discharge may increase to levels that impact Atlantic Ocean circulation and climate within the 21st century,” says Peterson. The wild card, he says, is the Greenland ice cap, which scientists say is melting faster than it was 20 years ago. “There is an immense amount of ice and water tied up in that ice,” says Peterson. He and other scientists worry about what will happen as parts of the ice cap melt or break up and slide into the ocean.

Although it’s hard to quantify the exact effects of increased global warming, Peterson says changes occurring in the Arctic show just how real the phenomenon is. He also says understanding the hydrology and chemical composition of the Lena and other large rivers, which contribute as much as 60 percent of the total discharge into the Arctic Ocean, is essential for predicting future changes and impacts to the Earth’s climate.

For his part, Peterson considers storytelling an important part of his job as a scientist. And the global warming story he and other PARTNERS scientists are beginning to tell through the Arctic rivers study is still far from having a definitive ending. “Scientists say this complete stoppage of the Thermohaline Circulation is ‘a low probability but high impact event.’ I think it could happen but I don’t know how likely it is,” he says. “It’s more likely to happen if we’re careless and allow fossil fuel use to increase and continue at a high rate. It’s less likely if we develop international agreements to limit greenhouse gas emissions such as the Kyoto Protocol and keep emissions at a relatively lower level.”

Meet Anya Suslova, Aspiring Siberian Scientist

One of the most ardent participants in the PARTNERS project is 14-year-old Anya Suslova, an aspiring scientist from the river village of Zhigansk whose favorite subjects in school are geography, chemistry, and biology.

Anya is the daughter of the captain of the P406, the 130-foot buoy tender PARTNERS scientists use to collect samples from the Lena River. Ever since she accompanied her father on a two-week PARTNERS sampling cruise in August 2003, Anya has been helping out with the project.

During the cruise, MBL Ecosystems Center scientist Robert (Max) Holmes noticed Anya’s interest in the research and decided to encourage her participation by teaching her to collect and analyze water samples. “Anya amazed everyone with her sharp mind, active participation in sample collection and processing, and rapid grasp of the overall goals of the PARTNERS project,” says Holmes.

So as a parting gift, he gave Anya a set of water sample bottles and asked her if she’d like to help out after the scientists had gone. Anya agreed, and with her father’s help, she has collected samples from the Lena River every two weeks since then. These high-frequency samples, which are shipped to the MBL for analysis, provide data that would otherwise be difficult and expensive to collect.

“Though Anya is the youngest member of the PARTNERS team, she is one of its most important members,” Holmes says.
The scent of Mediterranean summer, that faint fragrance of sea salt and lavender, filled the air last July as neurobiologists Simone Engelender and Herman Wolosker, and their 8-month-old son, Gabriel, wound their way toward the airport in Israel’s northern city of Haifa.

Thanks to Gruss Lipper Family Foundation fellowships that support Israeli scientists, Engelender and Wolosker, M.D.s on the faculty at the Technion-Israel Institute of Technology, were headed toward the MBL and would soon smell seawater and reagents, squid and clams, and the scents of scientific progress that waft through the MBL’s Whitman Center for Summer and Visiting Research during its peak season.

To scientists familiar with Whitman, such smells evoke what many consider the perfect setting for research advancements that seem unique to the MBL.

Summers here mean uninterrupted research and collaboration in a close-knit community of international scientists—and researchers like Engelender and Wolosker often make it a point to work in Whitman at least once, if not repeatedly, during their careers. Fellowships such as those supported by the Gruss Lipper Foundation often help make visiting research possible.

The work of MBL visiting scientists is vital to the world’s understanding of human medical puzzles including cancer, epilepsy, Alzheimer’s disease, and Parkinson’s disease. Using organisms such as squid, surf clams, and zebrafish, the researchers study cellular processes that are the key to life.

Each year, the Whitman Center draws hundreds of scientists from countries including Canada, Argentina, England, Switzerland, and now, increasingly, from Israel.

Engelender and Wolosker, both senior lecturers and researchers at Technion, learned about the MBL and the Gruss Lipper fellowships for Israeli scientists, from their colleague, Avram Hershko.
Hershko, who won the 2004 Nobel Prize in Chemistry (see story on page 36), is a 13-year veteran of MBL summer research. He is one of the 52 Nobel Laureates with MBL affiliations, and one of more than a dozen scientists supported by the Gruss Lipper Foundation.

The fellowship program was founded in 2001, not long after the foundation’s director, Evelyn Gruss Lipper, M.D., met an Israeli scientist while at the MBL. Since then, the foundation has annually underwritten research and education collaborations between the MBL and Israel’s most talented scientists.

The need for the fellowships was underscored by a European boycott of Israeli scientists and academics. The boycott was initiated in 2002 in objection to Israel’s policies toward Palestinians and made it difficult for Israeli scientists to collaborate beyond Israel’s borders.

“I felt it was important for these scientists to be able to study outside of their country,” says Gruss Lipper. “All ideas are enhanced by people coming together and communicating with each other. With all of the education and collaboration that happens at the MBL, it seemed like a natural match.”

Engelender concurs. “The fellowship was an opportunity to hear great scientists talking about their research,” she says. “The U.S. has thousands of excellent scientists, so it is important to be in contact with them.”

An expert in the proteins implicated in Parkinson’s disease, Engelender spent much of her fellowship in Whitman 404, immersed in the study of a new protein she had discovered called synphilin-1. Using biochemical and cell biology techniques, she studied the protein’s relationship with nerve cell junctions called synapses, cellular toxicity, and other proteins. It’s research she hopes will eventually lead to the development of drugs to treat Parkinson’s patients.

Her lab mate, Wolosker, spent the summer studying D-amino acids, chemicals believed to play a role in excitotoxic cell death that occurs after stroke and neurodegenerative conditions.

With on-site room and board, dedicated lab space, access to the latest equipment, and the MBL Neuroscience Institute of nearly 100 other neurobiologists, the Gruss Lipper fellowships seemed to provide Engelender and Wolosker everything they needed to enhance their scientific ideas.

“At the MBL you are free to do our own research, to try different and interesting projects you wouldn’t carry out in your own lab, and to collaborate with senior scientists,” Engelender says. “We’re really grateful for our fellowships. We had a very productive time.”
Before parasitologist Steve Hajduk visited a sweltering makeshift hospital in war-torn South Sudan in the late 1990s, his interest in trypanosomes, the parasites that cause African sleeping sickness, was largely restricted to understanding the basic biology of a highly adaptive organism. But as he walked through room after room filled with patients in varying stages of the disease, he was overwhelmed by the magnitude of the human health problem.

“My brief visit to Sudan in 1999 changed my attitude toward this disease. The suffering caused by sleeping sickness is immense but so is the damage done by the drugs we use to treat the disease,” Hajduk says.

Most of the patients he saw were undergoing treatment with the arsenic-based drug, melarsoprol, a deadly, antiquated medicine that kills 5 - 10% of the patients treated. “It’s a painful and dangerous drug, but left untreated sleeping sickness is inevitably fatal, so there was really no option.”

Understanding infectious diseases such as sleeping sickness is more crucial than ever. Twenty-five percent of all deaths worldwide are caused by bacterial, viral, fungal, and parasitic pathogens. And sleeping sickness, a parasitic disease spread by the tsetse fly, has recently reemerged as a major health problem that threatens 60 million Africans in 36 sub-Saharan countries. It is currently estimated that as many as 500,000 people are infected and 60,000 will die this year.

So when he became director of the Josephine Bay Paul Center’s new Global Infectious Diseases Program in 2003, one of the first things Hajduk did was to use funding from the Ellison Medical Foundation to create the Ellison Visiting Scholars Program. Each year, the program brings 10 scientists from developed and under-developed countries to the Bay Paul Center for several months of collaborative research. The scholarships are available to graduate students, post-doctoral students, and independent investigators.

“Our goal is to increase the world’s understanding of infectious diseases by sharing our cutting-edge research facilities and expertise in using molecular biology, molecular evolution, biochemistry, genetics, and bioinformatics,” explains Hajduk. “Our scientists also have a great deal to learn from the visiting scholars, many of whom have important field knowledge of these diseases.”
This year two sleeping sickness researchers from Nigeria were among the Ellison Scholars. The scientists joined Hajduk and other Bay Paul Center scientists whose research is focused on the parasites behind this disease. “There was a nice synergy of Nigerians and Americans working together,” Hajduk says. “The people of Nigeria are especially aware of the devastating effects of sleeping sickness because it is becoming a public health crisis in several regions of the country.”

One of the scholars, Henrietta Awobode, is a young molecular biologist, immunologist, and faculty member at the University of Ibadan. She has studied sleeping sickness since 1998. Awobode and her colleagues have conducted field surveys that suggest that areas of Nigeria previously devoid of sleeping sickness are now reporting an alarming number of new cases, including an acute form of the disease previously thought to be restricted to East Africa. Her work focuses on the important question of whether acute disease in the Delta states of Nigeria is a consequence of a parasite strain variation or a human-host genetic difference.

While working in the Bay Paul Center, Awobode established a molecular basis for examining the genetic composition of the trypanosome. The work enabled her to develop strategies for testing how human genetic differences influence susceptibility to parasite infection, which she hopes will lead to a viable treatment for her country’s people. “It was a valuable opportunity to work amongst world-class scientists at the MBL and acquire a lot of experience from them,” she says. “It has helped me to more effectively plan and implement my research goals.”

Now that she’s back home, Awobode says she is optimistic that the collaborative relationships she established at the MBL will be mutually beneficial. “I hope there will be a relationship where MBL scientists can visit us, especially for field surveys, and where we can visit the MBL to carry out research we would ordinarily not be able to carry out for lack of facilities,” she says. “We also hope our graduate students will have opportunities to attend courses organized by the MBL.”

The Ellison Scholars Program has helped reinforce the MBL’s role as a scientific catalyst not only in the U.S., but also in areas of the world where scientists need better training and facilities. “The best thing about it is the opportunity given to third-world scientists to carry out their work in such a renowned place,” says Awobode.

Equally important is what Awobode and the other scholars bring to the program. “Scientists who have witnessed the devastating effects of infectious diseases have a unique first-hand perspective to share,” Hajduk says. “The power of seeing people with these diseases can’t be overstated. It’s an important reminder of how necessary this research is.”

2004 Ellison Scholars: Bottom left: Emmanuel Ogbadayi Bottom right: Rudo Kieft (of the MBL) Top left: Gustave Simo Top middle: Henrietta Awobode Top right: Raphael Isokpehi
When Mio Nonaka began her 18-hour journey from historic Kyoto, Japan, to Woods Hole to take the MBL's summer Physiology course, she left behind the elegant temples and sculpted Zen gardens of one of her favorite cities and had to fly through a typhoon. Yet she felt compelled to go.

“I heard about the course’s reputation from my supervisor,” says Nonaka, who was finishing a biophysics degree at Kyoto University’s Graduate School of Science. “I wanted to experience doing research in the best country to do science. And everybody believes the MBL is the magical place to produce good results.”

Words like magical and Mecca have been used more than once to describe the MBL summer course experience, and talented students like Nonaka are flocking here from overseas to get in on the action.

The courses are nestled within the MBL’s signature summer science community—a place where the MBL’s own resident scientific staff converges with more than 1,400 visiting scientists, students, even Nobel laureates, from the best institutions around the world.

Students often spend 60 to 80 hours a week working in their own course with the brightest scientists in the field, but there are also opportunities to interact with other students and scientists through poster sessions, seminars, lectures, and during meals in the MBL's communal dining hall, where mealtime conversations require a scientific vocabulary.

The idea of offering immersive, specialized courses taught by leading scientists isn’t new. In fact, it dates back to the MBL’s first director, Charles Otis Whitman, who saw science instruction and research as natural partners and believed that “other things being equal, the investigator is always the best instructor.” The philosophy was successful from the start, and MBL courses still follow his progressive vision.

In its early years, the MBL offered courses in Invertebrate Zoology, Marine Botany, Physiology, and Embryology. Today’s educational offerings include six summer courses: the Biology of Parasitism, Embryology, Microbial Diversity, Neural Systems & Behavior, Neurobiology, and Physiology, as well as 14 courses on special research topics such as Frontiers in Reproduction or Advances in Genome Technology and Bioinformatics.
As the MBL’s offerings have grown, so has competition for course placements and the list of countries from which the students come. This year, for example, MBL courses drew 473 students from 37 countries, including Argentina, Austria, the Czech Republic, and Senegal, with some course topics seeming to draw more international interest than others.

“Our largest contingent of foreign students is in our Biology of Parasitism and Frontiers in Reproduction courses, both of which have direct impact on countries in South America and Africa,” says MBL education director, Eliezar (Lenny) Dawidowicz.

The Physiology course Nonaka attended also resonated far and wide, luring one-third of its students from foreign countries including the Netherlands, Germany, Israel, and Denmark and one-fourth of the course faculty from abroad.

The all-star faculty for the MBL’s courses, all of whom are leading authorities in their field, is surely one reason the courses are so appealing. Another reason may be as simple as word of mouth.

Nonaka, for instance, says she has shared her MBL experiences with her peers and knows two Japanese students who are planning to enroll in future courses. “My friend Kaoru is enrolled in the 2005 Neurobiology course,” Nonaka says. “She heard about its good reputation from a U.S. principal investigator who was visiting Japan and told her the course would help broaden her scientific view and get a better view of future research.”

Taking the MBL’s Physiology course had just such an effect on Nonaka. Not only did the experience encourage her to pursue her Ph.D., it also altered her scientific path. “I recognized the power of cell imaging combined with computational analysis,” she says. “I’m still interested in neurobiology, but luckily neurons are challenging but attractive objects for this imaging approach. So now I am more focused on making physiological phenomena visible in the neuroscience field.”

Could Nonaka have had a similar experience in Japan or elsewhere? “I don’t think I could find a course like this anywhere else in the world,” she says, adding that she hopes to return for another course or as a research fellow. “Every summer, excellent researchers and students gather in Woods Hole and share enthusiasms in research. The reason why this repeats only at the MBL is its own history and good environment.”
Forty miles west of the chaos of Port-au-Prince, in the shadow of Haiti’s deforested mountains, lies an oasis. It is a courtyard filled with pipes, pumps and filters, and tanks whose water is alive with the swirl of hundreds of small, colorful fish. The fish, a fast-growing, plant-eating species called tilapia, offer hope with fins to the people of the poorest country in the Western Hemisphere.

MBL aquaculture experts Bill Mebane and Scott Lindell have worked inside this oasis—an aquaculture initiative and fish hatchery run by missionaries—many times. The scientists are sharing their fish-rearing talents with the Comprehensive Development Project (CODEP), which has operated in the L’Acul region of Haiti’s northwest coast for the past ten years.

The aquaculture initiative aims to stop hunger among poor, malnourished mountain villagers by teaching them to grow and harvest protein-rich tilapia from hand-built ponds. In a country where the devastated land hardly sustains crops or livestock, and where people barely subsist on mangos and rice, fish farming is a welcome alternative. But malnutrition is a problem for the fish, too.

Though L’Acul’s villagers built some 60 fish ponds by digging barefooted, hauling water buckets on their heads for miles, and walking long distances through the mountains to the hatchery to obtain their brood stock, the fish weren’t being fed properly and they weren’t growing. That’s why Mebane and Lindell got involved.

“We’re trying to teach a technique where people can provide nourishment to themselves by providing nourishment to the fish. But there are a couple of riddles to solve,” says Mebane.
Those riddles center mainly on fish food. Commercial feed, an aquaculture staple, isn’t an option in Haiti. “It’s expensive, hard to transport to remote villages, and spoils quickly,” Mebane says.

So, after seeing this problem firsthand, he and Lindell returned to their lab in the MBL’s Marine Resources Center (MRC) with one goal: to cook up a nutritious fish food the villagers could make cheaply from locally available, non-endangered plants. Eventually, the scientists hope to share the recipe with developing countries, such as those in Central America and Africa, who have similar hunger problems, are on similar latitudes, and have plants similar to those found in Haiti.

Inventing a fish food that might help so many people isn’t as easy as it seems. First, Mebane and Lindell had to determine which local plants they could use. “The real challenge was to find a valueless plant crop the Haitians don’t use or eat,” Mebane says. In their MBL lab, he and Lindell studied dozens of indigenous weeds brought from Haiti. The scientists had many of the plants analyzed to determine their nutritional value, and searched for a plant they could use to bind the fish food together. Because many of L’Acul’s villagers don’t have electricity or basic appliances, the recipe had to be one that could be made with hand-operated, easy-to-repair machinery.

Eventually Mebane’s and Lindell’s work paid off. Their labors produced a small green pellet made with a hand grinder from Haiti’s Calliandra, Leucaena, and Moringa plants and bound together with cassava root. During MRC feed-trials, the pellet has been a hit with tilapia, which are eating the food and growing. “We’re getting about a 6:1 feed conversion ratio,” says Mebane. The numbers represent the amount of plant matter fed per pound of flesh that grows.

Before Mebane and Lindell got involved, L’Acul’s villagers weren’t getting much of a feed conversion ratio at all. “The fish basically weren’t growing,” Mebane says. “They were staying alive by foraging on the minimal algae that grew in the ponds and any unfortunate bug that flew too close to the water,” he says. So the new pellet is a giant step toward better fish farming.

This winter, Mebane and Lindell brought their new recipe to L’Acul and taught the villagers how to use it. The scientists also started searching for any locally available nuts, berries, or plant material that might help fulfill the important amino acid complement of their pellet and increase its nutritional value. “That will help us achieve our targeted feed conversion ratio of one pound of fish for every two pounds of plant matter,” says Mebane.

Ultimately, Mebane and Lindell hope to measure the MBL’s contributions to the aquaculture initiative not in feed conversions or little green pellets, but in the health of Haiti’s people. “Malnutrition is big problem, especially among the children,” says Mebane. “You can see it in the reddish tint of their dark hair, which indicates a vitamin deficiency; in their eyes; and in their stomachs,” he says. “I’d like to go back there one day and see no red-haired kids, far-away stares, or pot bellies,” he says. “That would be a true measure of success.”
On a cattle ranch overlooking pasture and rolling hills in Rondônia, Brazil, MBL Ecosystems Center scientists Christopher Neill, Linda Deegan, and their Brazilian colleagues wade into a muddy stream. They sample the water; measure its depth and discharge; study algae growth; and seine fish that they count, weigh, and measure before returning them to the water with a *plop*.

Neill and Deegan have been studying how extensive clear-cutting, which has been altering this classic Amazon River Basin locale since the late seventies, is affecting this important ecosystem. One facet of this work is the study of Rondônia's streams, a project that is part of the NASA-funded Large-Scale Biosphere-Atmosphere Experiment in Amazonia.

“Our ultimate goal is to understand how ecosystems work,” says Neill, explaining that an intact ecosystem like Rondônia’s is the perfect natural laboratory for this work. And because it’s an area being rapidly converted from rainforest to pasture for agriculture, Rondônia also offers an unprecedented opportunity to see the domino effect of such change firsthand.

Small streams, it turns out, are an important piece of the puzzle, and Rondônia has thousands of miles of them. “The streams start in intimate contact with soils and ground water seepage and therefore link the state’s upland and aquatic ecosystems,” says Deegan. Rondônia’s streams also feed larger rivers, which eventually feed the Amazon itself some 2,000 miles downstream. But these important aquatic bodies have changed dramatically following deforestation, and MBL scientists are attempting to understand the extent, and ultimate impact, of these changes.

Since he first started his research in Rondônia in 1992, Neill has watched the area’s rainforest streams literally transform before his eyes.

To illustrate this, he holds up before-and-after photographs. The “before” image depicts a textbook rainforest stream. It is lush with plants and trees that offer just the right amount of shade, and its inviting sandy bottom supports a juicy smorgasbord of small invertebrates that feed the fish.
The “after” image depicts a stream that looks more like it belongs in a New England pasture than in Amazonia. “There is a series of events that happens after deforestation,” says Neill. “You take away the trees and suddenly the streams are in the sun. The grass can now grow in the channel, it starts creeping in, and the stream accumulates sediments and organic material, which is basically dead grass. The grass is prolific so it reaches very high biomass. Under those conditions, that organic material uses up all the oxygen,” he says. “So all of a sudden you’ve gone from a stream with a nice sandy bottom and high oxygen levels to a stream with a mucky bottom that supports a different kind of insect community.”

And that, of course, affects the fish. “In a half mile of forest stream we found about 35 species of fish. In an equivalent pasture stream, we found just one species,” says Deegan, who specializes in the impacts of ecosystems changes on fish and other animals.

“Like doctors hoping to diagnose a patient, Neill and Deegan are carefully documenting these and other clear-cutting related symptoms in Rondônia’s streams—factors such as decreases in the water’s nitrogen levels that affect algae growth, and sediment buildup that changes how the streams flow—so they can eventually understand how problems in these smaller systems are impacting one of the most important ecosystems in the world.”

“The streams in Rôndonia are typical of the many thousands of miles of streams in the Amazon,” says Deegan. “They are connected to land and influenced by deforestation in fundamentally similar ways. This means we can use what we learn from these streams to extend our work to the broader Amazon River Basin.”

Wading into Brazilian streams to understand ecosystems may seem like the ultimate job, but Neill and Deegan are quick to point out that it’s painstaking work filled with long hours and even the occasional electric eel. It also takes patience, since piecing together environmental puzzles is science done over a lifetime, not a couple of years. But it’s work these MBL scientists and their Brazilian colleagues are clearly committed to for the long haul. And for now they’re taking it stream by stream, fish by fish.
Forget the beautiful view of South Australia’s greenish-blue Spencer Gulf and the craggy Flinders Ranges that rise sharply in the distance. What Roger Hanlon loves most about the five-mile boat ride from the town dock in Whyalla to a restricted area of rocky reef called Black Point is what he sees when he arrives. “You can literally look over [the side of] the boat and in ten feet of water you might see 10 to 30 large cuttlefish. You can see them fighting, you can see them mating, and you can see it right from the boat. It’s amazing!”

Hanlon, a cephalopod expert and senior scientist in the MBL’s Marine Resources Center, has been studying the behavioral ecology of Australian giant cuttlefish (Sepia apama) at Black Point for the past five years. It is the only known spawning aggregation of cuttlefish in the world. And thanks to funders including the Sholley Foundation and the National Geographic Society, Hanlon and his research team regularly dive eye-to-eye with hundreds of these 2- to 22-pound creatures, which gather annually during the late May to early June mating season. “The beauty of this study site is that you don’t sit around and not see much behavior. It’s nearly non-stop sex and fighting, not necessarily in that order,” says Hanlon.

With its shallow, clear water and close proximity to shore, Black Point is indeed the perfect natural laboratory. Using underwater video cameras, a special identification system, and DNA fingerprinting techniques, Hanlon’s research team has gathered “a mountain of data” on the cuttlefish that mate there. “I’m interested in animal behavior, particularly behavioral ecology,” he says. “So my approach is to first study the animal’s behavior in its natural ecosystem.”

Hanlon is especially interested in sexual selection theory as described by Darwin and has been comparing squid and cuttlefish mating systems throughout his career. In the past decade Hanlon has amassed an impressive body of work on cuttlefish reproduction, including concepts such as female choice, male fighting behavior, and other critical aspects of sexual selection that were previously undocumented.
Cuttlefish mating, which includes head-to-head copulation, is undeniably captivating. “The female lays one egg at a time, she lays them serially, she has temporary boyfriends, and there’s multiple paternity on a daily basis,” says Hanlon. And since the sex ratio on the breeding ground averages 8 to 11 males per female, and because the female holds sperm for fertilization after copulation, the so-called “sperm competition” is fierce.

Thanks to Black Point, Hanlon and his team have learned, among other things, that giant cuttlefish mating is a complicated undertaking, where the males resort to fighting, sneaking, and female impersonation.

In fact, in a recent *Nature* paper, the scientists presented behavioral and genetic data demonstrating that small male cuttlefish that disguise themselves as females are highly successful in tricking their larger competitors and fertilizing the female’s eggs. Behavioral ecologists call this sexual mimicry, and while it’s been widely reported among many species in the natural world, Hanlon and colleagues were the first to document fertilization success in an animal using this tactic.

Until 1999, much of Hanlon’s cuttlefish work was done in a lab, where he cultured European cuttlefish (*Sepia officinalis*) for neuroscience research and studied these animals under artificial conditions. But after searching for 25 years for a spawning aggregation he could study in the wild, an Australian graduate student, Karina Hall, told him about Black Point. “I’ve followed every nebulous lead and gone to places like Tahiti, Italy, and South Africa to find cuttlefish populations, but this is the only one that ever materialized,” says Hanlon.

From the start, he and the Black Point giant cuttlefish have had a somewhat symbiotic relationship. Hanlon and colleagues have published numerous scientific papers on the fascinating natural behavior of these animals, and resulting media and public interest may have ultimately saved them.

When Hanlon first learned about Black Point, fishermen, who saw easy prey in the large numbers of animals that gathered there annually, were decimating the cuttlefish. “The fishermen would use squid jigs to catch the cuttlefish by the hundreds and thousands, and they were sending them to China for 39 cents a pound. Little did they realize what a unique event this was,” Hanlon says.

Today, thanks to widespread interest in the cuttlefish, the small town of Whyalla has turned itself into an ecotourism center that is far more lucrative than the small fishing industry was. “I consider it a wonderful example of a biological discovery and human cleverness,” says Hanlon. “You can’t read that in any of the scientific papers and I think it’s the coolest part of the story in many ways.”
Throughout its history, the MBL has been a place where the world’s top biologists can focus on their research, not distracted by departmental affairs, committee work, or other aspects of university life. The MBL provides both the resource support and the intellectual environment that enable many scientists to do their best work.

Today 58 Ph.D.-level investigators and their staff conduct research at the Laboratory year-round in areas such as cellular, developmental, and reproductive biology; molecular biology and evolution; neurobiology and sensory physiology; ecology and ecosystems studies; global infectious diseases; and marine biotechnology and aquaculture.

The population of investigators grows dramatically each summer when hundreds of distinguished scientists from around the world gather at the MBL’s Whitman Center to do research.

During a typical MBL summer, researchers look for basic principles of life in organisms from squid to surf clams to zebrafish. They ask how nerve cells communicate, how cells regulate their complex processes, and how they proliferate. They explore how organisms reproduce and develop, how they fight disease, how sense organs gather information, and how brains process it. The investigators who gather each summer bring a diversity of approaches and questions. Along with the large number of faculty associated with the summer courses, they make the MBL the largest and most exciting biological laboratory in the world.
Investigators in the Josephine Bay Paul Center for Comparative Molecular Biology and Evolution seek to understand the molecular basis and origin of disease mechanisms, the evolution of microbial communities, and the influence of single-cell organisms on planetary processes. They study microbes from all three domains of life (Archaea, Bacteria, and Eukarya), their evolutionary history, their interactions with each other and macroscopic forms of life, and how members of diverse microbial communities contribute and respond to environmental change. The Josephine Bay Paul Center’s interlocking programs in Global Infectious Diseases, Molecular Evolution, and Molecular Microbial Diversity foster a special environment that rarely, if ever, occurs in medical centers or university departments. Linkages between these biological disciplines have far-reaching implications for identifying and one day predicting origins and dispersal mechanisms of pathogenicity, and the development of systems-level approaches to environmental microbiology.

The Josephine Bay Paul Center supports these programs through its operation of state-of-the-art facilities for high-throughput DNA sequencing, DNA microarraying, and large-scale computational facilities within the W.M. Keck Ecological and Evolutionary Genetics Facility. The National Institutes of Health provides major funding to investigate molecular processes and resistance to African trypanosomes, which cause human sleeping sickness, gene expression studies in the human parasites Giardia, Trypanosoma, and Schistosoma, the influence of endosymbiotic relationships on bacterial genome evolution, the relationships between diverse eukaryotic genera through genome-wide comparisons of expressed genes, and marine-related studies of human disease through the new Woods Hole Center for Oceans and Human Health. The National Science Foundation provides support for molecular evolution studies of endosymbionts, development of digital resources for describing microbial diversity, and molecular evolution studies of rotifer and microsporidial genomes. The National Aeronautic and Space Administration supports the Josephine Bay Paul Center’s membership in the astrobiology community, while the Department of Energy continues to support our bioinformatics initiative that focuses on annotation and evolution of gene families in the metal-reducing microbe Shewanella oneidensis.

Continuing support from the G. Unger Vetlesen Foundation underpins growth and stability of the center, and the Alfred P. Sloan Foundation has recently committed resources to support an International Census of Marine Microbes (ICoMM). This new initiative seeks to organize the international community in its effort to understand the diversity and role of microbes throughout the world’s oceans. This is a collaborative project that engages investigators from around the world and is managed jointly by the Josephine Bay Paul Center and the Royal Netherlands Institute for Sea Research – NIOZ.

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Bay Paul Center evolutionary biologist Jessica Mark Welch and her colleagues David Mark Welch and Matthew Meselson have confirmed that a group of microscopic animals has evolved for tens of millions of years without sexual reproduction. Their results, published in the February 10, 2004 issue of *Proceedings of the National Academy of Sciences*, provide the strongest evidence to date that a higher-ranking taxon has evolved without sexual reproduction and demonstrate a radical exception to the biological rule that abandonment of sexual reproduction is an evolutionary dead end.

While almost all multicellular organisms reproduce sexually, this form of reproduction is much less efficient than asexual reproduction (or mitosis) whereby females effectively make clones of themselves. Although asexual organisms often enjoy short-term success as compared to their sexual ancestors, they are rarely found as higher-order taxa, implying that they cannot survive in evolutionary time.

While many hypotheses have addressed this problem, the paradox raises one of the most perplexing questions in biology: If asexual reproduction is more efficient than sexual reproduction, why does sexual reproduction predominate so thoroughly? Jessica Mark Welch’s results may help scientists come closer to an answer.

The researchers studied the bdelloid rotifer, a microscopic animal found throughout the world in almost all aquatic habitats. Bdelloids appear to have given up sex about 50 million years ago, yet the organism has evolved into 370 described species. While Mark Welch and her colleagues have previously demonstrated that bdelloid genomes contain two or more divergent gene copies, an observation consistent with long-term asexual reproduction, a significant shortcoming of their approach was the inability to detect nearly identical gene pairs, as might result from inbreeding or other rare forms of sexual reproduction.

To overcome this methodological shortcoming and conclusively demonstrate that bdelloids are, in fact, completely asexual, Mark Welch and her colleagues painstakingly analyzed the genome of the bdelloid species, *Philodina roseola*. Using a method called fluorescent *in situ* hybridization, they scoured the genome, looking for chromosome partners, also called homologous pairs. Identification of these would be a clear indication of sexual reproduction as each member of the chromosome pair is derived from a different parent.

The scientists identified four copies of a target *P. roseola* marker gene, however each gene was on a separate chromosome, and all were quite a bit different from each other. These results, consistent with asexual reproduction, eliminate the possibility that bdelloids reproduce sexually and thus confirm that the organism has evolved without sexual reproduction or genetic exchange for tens of millions of years.
What drives early extinction, and why it can be averted by sex, remains one of the central mysteries of biology, the resolution of which is likely to have far-reaching impact on scientists’ understanding of basic biological and evolutionary processes. “Sex and genetic recombination are obviously tremendously important for life,” says Jessica Mark Welch, “but we don’t understand why they are so important.” When we do eventually understand, it could have practical consequences we can’t yet imagine.”

Mark Welch and her colleagues will continue to study bdelloids as they offer an ideal model system in which to explore the effects of asexual reproduction. Their hope is to better understand how the animals have evolved without sexual reproduction and escaped extinction. “We can now use bdelloid rotifers to test the theories about why sex is important,” says Mark Welch. “Any good theory will now have to account for why the bdelloids are an exception.”

Matthew Meselson

Receives Special Achievement Lasker Award

Marine Biological Laboratory adjunct scientist and Corporation Member Matthew Meselson received the Albert Lasker Award for Special Achievement in Medical Science from The Albert and Mary Lasker Foundation in October, 2004. The Award honored Meselson “for a lifetime career that combines penetrating discovery in molecular biology with creative leadership in public policy aimed at eliminating chemical and biological weapons.”

The Lasker Awards are the nation’s most distinguished honor for outstanding contributions to basic and clinical medical research. Often called “America’s Nobel,” the Lasker Award has been presented to 68 scientists who went on to receive the Nobel Prize.

In 2001 Meselson, a Harvard professor since 1960, established a satellite laboratory in the MBL’s Josephine Bay Paul Center for Comparative Molecular Biology and Evolution, where he is trying, with colleagues Jessica and David Mark Welch, to unravel the mystery behind one of the most perplexing questions in biology: What drives the early extinction of asexual organisms, and why it can be averted by sexual reproduction?

“The MBL, in particular Mitch Sogin and the Bay Paul Center, have provided a stimulating intellectual environment for me, David Mark Welch, and Jessica Mark Welch in our work with bdelloid rotifers,” said Meselson. “The Bay Paul Center provides us with high throughput DNA sequencing facilities and computing facilities not available to me at Harvard. Because of this, postdoctoral fellows and students from my Harvard Lab often journey to Woods Hole to pursue their research. Without the Bay Paul Center, and Mitch Sogin’s generous hospitality and interest, we would be seriously disadvantaged.”

Tiny Invertebrate Evolves without Sex, cont.

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The Ecosystems Center, founded in 1975, operates as a collegial association of scientists under the leadership of co-directors John Hobbie and Jerry Melillo. Its mission is to investigate the structure of ecosystems and how they function, to predict their response to changing environmental conditions, to apply this knowledge to the preservation and management of natural resources, and to educate both future scientists and concerned citizens.

Because the complex nature of modern ecosystems research requires a multidisciplinary and collaborative approach, center scientists work on projects with experts from other MBL centers and from other institutions. Together they conduct research to answer a variety of questions at field sites ranging from Alaska, Sweden, and Russia to Brazil; and from the Arctic streams to the sandplains of Martha’s Vineyard.

In 2004, Ecosystems Center scientists Paul Steudler, Jerry Melillo, and colleagues from other institutions studied methane consumption rates in soils in temperate forests to try to understand why some soils consume more methane than they produce. This is important because soil methane consumption counteracts the accumulation of the gas in the atmosphere. Methane is a far more potent greenhouse gas than carbon dioxide and will have 21 times more effect on global warming over the next century than carbon dioxide.

Conducting their experiments at the Harvard Forest Long Term Ecological Research site in central Massachusetts, center scientists looked at disturbances that added nitrogen to the soils. These include atmospheric deposition (rain and snow) due to the burning of fossil fuels and the use of fertilizers. The added nitrogen affected microbes in the soils, resulting in less methane consumption. Either the methane-consuming microbes actually decreased due to the nitrogen addition or the microbial population changed to a species that does not use methane as a carbon source. Decreases in methane consumption are observed shortly after nitrogen is added and persist for decades after the nitrogen additions have been discontinued.

These results have important long-term implications for the methane consumption capacity of temperate forest soils. It appears that even moderate levels of nitrogen deposition may diminish the potential for these soils to slow the future growth in atmospheric methane.

Microbes were also the focus of research at another Long Term Ecological Research project, the Plum Island Ecosystem site in northeastern Massachusetts.

Some species of bacteria are found only in salt water while others are found only in fresh water. Scientists have wondered whether there
are other bacteria that are unique to estuaries, where salt water comes in from the ocean and gradually mixes with fresh water from a river. Center scientists John Hobbie, Chuck Hopkinson, and Byron Crump collaborated with Bay Paul Center’s Mitch Sogin to study the microbes found in the Parker River estuary.

Using a molecular technique involving the gene for ribosomal RNA, which allows identification of bacteria, they determined that there is indeed a unique estuarine bacterial community. It exists, however, only in the summer and fall, when there is a long residence time of water in the estuary and the bacteria are able to grow quickly due to warm water temperatures and abundant nutrients. In the spring, when the water flows in and out of the estuary at a more rapid rate, bacteria are washed out before they have a chance to grow.

The development of molecular methods to identify bacteria is an important first step in linking bacteria in nature to their functions in ecosystems.

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MBL Ecosystems Center senior scientist Gus Shaver focuses his research on Alaskan tundra ecosystems, where cold temperatures, low light, scarce nutrients, and a short growing season all interact to limit plant growth. For more than 20 years, Shaver has conducted experiments in large plots of tundra near Toolik Lake, at the Arctic Long Term Ecological Research (LTER) site in the foothills region of Alaska’s North Slope. Since 1981, the plots have been continuously fertilized with nitrogen and phosphorous as a way to mimic the increased nutrient availability that is expected to occur in the soil as a result of global warming.

Scientists had long assumed that as tundra soils respond to climate change, more nutrients would be made available in the soils, leading to larger plants which would, in turn, absorb more carbon dioxide from the atmosphere and help lessen the effects of global warming. Results of a long-term fertilization experiment, published in the September 23, 2004, issue of the journal Nature by Shaver and his colleagues from the University of Florida and the University of Alaska, have revealed that this assumption is not the silver lining that some had hoped for.

The researchers found that tundra plants and soils responded to increased nutrient availability in opposite ways. While the plants grew larger and stored more carbon, as expected, under the fertilized conditions, loss

Long-Term Arctic Study Yields Surprising Results

Tundra Thaw Could Release More CO₂ to Atmosphere than Expected

Continued…
of carbon and nitrogen from deep soils was substantial and more than offset the increased carbon stored aboveground.

Previous nutrient manipulation studies projected that total carbon storage would be enhanced in tundra ecosystems as a result of increased nutrient availability and higher plant productivity. However, the inferences were based on aboveground and surface soil measurements only. Armed with resources that only a long-term experiment could provide, Shaver and his colleagues were able to dig deeper, literally and figuratively, to investigate how deep soils responded to the fertilization.

“The changes that we observed were the net result of 20 years of relatively small annual changes in many interacting processes that added up to a large, cumulative change,” says Shaver. “In a shorter-term study, we could never have measured these changes in component processes with sufficient precision to accurately predict their long-term effects.”

Normally, decomposition is slow in wet and cold high-latitude environments and carbon accumulates in thick layers of organic matter on top of mineral soils. In fact, more than one-third of the world’s global soil carbon pool is stored in northern latitudes—an amount equivalent to two-thirds of all of the carbon found in the earth’s atmosphere.

Shaver and his colleagues discovered over the course of their experiment that lower layers of soil organic matter decreased in thickness, an indication of decomposition. They hypothesize that microbes were stimulated by the increased availability of nutrients, leading to accelerated rates of decomposition in the older, deeper soil layers.

“Most previous researchers have concluded that soil organic matter decomposition is limited more by the availability of high-quality carbon substrates than by other elements such as nitrogen,” says Shaver. “Our results suggest that decomposition as well as plant growth are strongly nutrient-limited in northern ecosystems, and that predictions of change in carbon balance in these systems must account for the effects of limitation on carbon cycling by other elements.”

The results of Shaver’s study suggest that in a warmer climate, decomposition of tundra soils will be stimulated more than plant production. As such, more carbon could be lost from the ecosystem than is taken up and stored. Carbon lost from the soils as carbon dioxide could create a positive feedback, further enhancing global warming.

Because vast amounts of carbon are stored in northern latitudes, there is considerable interest in understanding how arctic soils will respond to global warming. The discoveries made by Shaver and his colleagues in this experiment provide a glimpse into the effects climate change may have on tundra ecosystems. Their results also have important implications for simulation models, which must now account for a net carbon loss from tundra ecosystems under warming conditions. In their future research, the researchers plan to investigate in more detail the particular mechanisms by which increased availability of nitrogen and phosphorus allowed soil fungi and bacteria to break down the complex carbon compounds in deep soil.
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This has been a landmark year for the Whitman Center, home to hundreds of biologists who come to Woods Hole each summer to conduct their research in the uniquely productive environment of the MBL.

In 2004, based on recommendations emerging from the MBL's strategic planning initiative, plans were finalized for the remodeling of the Whitman laboratory. The four-story 32,000 gross square foot building has served as the home of summer research at the MBL for over 40 years. The rewards of visiting scientists working in the Whitman laboratory over the years have been grand. Discoveries made there have led to Nobel Prizes and have enhanced the frontiers of research and their impact on advancing human health. But to keep the MBL the premier destination for basic biological inquiry, the quality of the facility must keep pace with the quality of the research being done within its walls.

The renovation of the Whitman laboratory is an exciting and long-overdue project that will allow the MBL to provide the modern research facilities that are essential for attracting outstanding summer and non-summer visiting scientists from all over the world. The space and systems renovations also will expand the use of the Whitman building beyond the summer months and allow scientists to meet and pursue their research year-round. The demands for time and resources placed on scientists today require the MBL to provide versatile, high-quality facilities that are always available and provide a community of...
resources collectively engaged in advancing biological research and applications.

The curiosity and collaboration that define the MBL’s summer scientist program have transformed our knowledge and understanding of the natural world and had an enormous impact on the quality of human health. Each new discovery prompts a host of new questions, and the MBL seeks to continue to provide the outlet through which the issues of our day will be investigated, and our world made a better place.

Fundraising for the $20 million project was approved by the MBL Board of Trustees and launched last summer. As of winter 2005, the MBL has raised $3.8 million towards the Whitman project. As a result of this fundraising, the first phase of the project, except for spring landscaping, has been completed. Phase One involved the reconfiguration of most of the MBL’s outside electric infrastructure. The goal is to complete the entire project by spring of 2007.

The Whitman Center continued to attract a large number of distinguished investigators and their research associates, graduate students, and postdoctoral fellows in 2004. One hundred thirty-three principal investigators and 171 other researchers from 133 institutions and 14 countries made the MBL their summer research home. All of the Whitman laboratories were filled and the results of work done there have produced scores of publications in peer-reviewed journals (see page 45).

The MBL summer fellowship program supported many Whitman investigators in 2004. Eleven fellowships totaling $160,000 were awarded to outstanding scientists in several areas including neurobiology, cell, and developmental biology. Additional funds were also awarded to two Dart Scholars in Learning and Memory; nine scientists were given Grass Faculty Awards in 2004.

Most notably, a long-time summer investigator, Dr. Avram Hershko, of Technion-Israel Institute of Technology, was awarded the Nobel Prize in Chemistry for his pioneering work on the ubiquitin-mediated protein degradation pathway. Hershko spends his summers studying the role of ubiquitin in regulating the cell cycle in the oocytes of the surf clam, Spisula solidissima. He has also spearheaded the development of the clam project in collaboration with Bob Goldman of Northwestern University, Feinberg School of Medicine; Yossi Gruenbaum of Hebrew University; and Bob Palazzo of the Rensselaer Polytechnic Institute. This project is funded through the generous support of The Gruss Lipper Family Foundation.

Whitman Renovation Advisory Committee

Robert Goldman, Northwestern University, Feinberg School of Medicine, Chair
Peter Armstrong, University of California, Davis
George Augustine, Duke University
Leah Haimo, University of California, Riverside
Avram Hershko, Technion-Israel Institute of Technology
Dan Johnston, Baylor College of Medicine
Roger Sloboda, Dartmouth College
Richard Cutler, MBL Director of Facilities and Services
E. A. Dawidowicz, MBL Director of Education
Andrew Mattox, MBL Director of Environmental Health & Safety
Jonathan Cohen, Architect, Tsoi/Kobus & Associates
In an effort that may someday lead to the treatment of hearing loss and balance disorders, Whitman Center investigators Jeffrey Corwin and Stefan Heller and their colleagues are working to develop methods to make large numbers of stem cells from mice and chicks “grow” into inner ear sensory hair cells—acoustic receptors that are a critical part of the auditory system. Corwin and Heller first convened at the MBL in the summer of 2004 and are planning to return in the summer of 2005 to continue their efforts to understand hearing loss at the cellular level.

In humans, inner ear sensory hair cells are a precious commodity. We are born with only about sixteen thousand of these sound detectors in each ear, which can be easily damaged by age, certain illnesses, exposure to loud sounds, and some medications. Once damaged, the cells do not grow back. And with the cell loss comes so-called irreversible hearing loss.

Corwin and Heller’s research, in combination with recent advances in understanding the genes that inhibit the regeneration of hair cells, offers hope for the treatment of hearing loss and balance disorders, which currently affect some 28 million Americans. This is the first step toward the ultimate goal of creating implantable human hair cells that will thrive and grow; eventually repairing damaged hearing and restoring balance.

Corwin, a neuroscience professor from the University of Virginia School of Medicine, and Heller, an associate professor at Harvard Medical School, will be joined in 2005 by Mark Warchol, a first-time MBL Whitman investigator, who is a professor at the School of Medicine at Washington University in St. Louis. “Nearly all of the scientists who worked in our group are returning,” says Corwin. “Several were first time MBL-ers and all seemed sold on the lab as a great place for the kind of work we are doing.”

Corwin, Heller, and Warchol will be working during the summer of 2005 to develop new methods to expand and maintain stem cells isolated from chicken embryos and the mouse inner ear to establish long-term stable cell lines. The ultimate goal? To learn how to eventually repair people’s damaged hearing and restore their balance.

The scientists’ MBL collaboration is part of the Albert and Ellen Grass Faculty Grant Program.
Whitman investigator Avram Hershko was awarded the 2004 Nobel Prize in Chemistry for “the discovery of ubiquitin-mediated protein degradation.” Hershko, a professor of biochemistry at the Technion-Israel Institute of Technology in Haifa, Israel, shared the award with Aaron Ciechanover also of the Technion, and Irwin Rose of the University of California, Irvine. Rose is an alumnus of the MBL’s Embryology course.

The 2004 Nobel Prize in Chemistry honored the discovery of the ubiquitin system of regulated protein degradation, a fundamental process that influences key cellular events such as the cell cycle, malignant transformation, and responses to inflammation and immunity.

Ubiquitin is a protein found within cells that targets other proteins for elimination. Scientists have long known that all cells manufacture and subsequently discard an array of proteins involved in a variety of cellular processes. Although many scientists over the years have focused their research on learning more about how cells make proteins, until recently few have explored how cells go about discarding proteins, and the impact that process has on disease.

More than thirty years ago, Avram Hershko took a road less traveled in science and began studying how cells rid themselves of unwanted or damaged proteins. With the help of his colleagues, Hershko discovered the ubiquitin system and eventually determined that it impacts major physiological processes in the body. Scientists now know that it is involved in regulating cell division, aids in controlling embryonic development, and helps maintain the immune system. It is implicated in a number of diseases as well, including cervical cancer caused by the human papilloma virus. Because it is involved in the body’s inflammatory response to invading microbes, it may also play a role in autoimmune diseases.
Hershko has been a summer investigator at the Marine Biological Laboratory since 1991. He was drawn to the MBL when he became interested in learning more about the role that ubiquitin plays in the cell division cycle.

“Many important regulators of the cell cycle are degraded in a programmed fashion, which allows the cell cycle to progress,” explains Hershko. The first of these proteins, known as cyclin B, was discovered by Tim Hunt, Joan Ruderman, and their colleagues working independently at the MBL in the early 1980s. (Hunt won the Nobel Prize in 2001 for this discovery.)

By 1989, MBL scientists had developed a means of studying cyclins and the cell cycle in the test tube using the eggs of local surf clams as models. It turned out to be exactly the system that Hershko needed to study what role, if any, ubiquitin played in the process. In collaboration with Robert Palazzo, now at Rensselaer Polytechnic Institute, Hershko determined that cyclin is degraded by the ubiquitin system during the cell cycle. Working with Joan Ruderman of Harvard University, he later identified a specific ubiquitin ligating complex that “targets cyclin B for degradation at the end of mitosis”—the final phase of cell division.

Today Hershko is studying that ubiquitin ligating complex in both clam eggs and cultured human cells in hopes of learning even more about cell division in general and cancer more specifically.

“Changes in the mechanisms that control the activity of this complex lead to chromosome instability, and ultimately to cancer,” Hershko says. “Thus, work done at the MBL on the mechanisms of cell division in clam eggs may provide novel insights into their aberration in human cancer.”

At the MBL, Hershko is also leading an effort to sequence some of the surf clam’s active genes—an effort, Hershko says, that is vital to the future of his research. “We are reaching a barrier in our work, unless we obtain this molecular knowledge,” he said.

The effort, called the Clam Project, is the first step toward sequencing the entire clam genome, and its goal is to provide scientists with better knowledge of the clam’s active DNA. Such information is crucial to the study of the basic cellular processes involved in many diseases. The scientists plan to use the new genetic information to create antibodies. And they hope to begin experiments impossible without those antibodies as soon as the project is complete.

“Sequencing the clam genome will be a quantum leap for our research,” said Hershko.
Haimo, Leah, University of California, Riverside
Hardwick, Marie, Johns Hopkins Medical School
Harrington, John, State University of New York at New Paltz
Heart, Emma, Boston University
Heck, Diane, Rutgers University
Heller, Stefan, Harvard Medical School
Hershko, Avram, Technion-Israel Institute of Technology, Israel
Hightstein, Stephen M., Washington University School of Medicine
Hilfiker, Sabine, Consejo Superior de Investigaciones Cientificas, Spain
Hill, Susan, Michigan State University
Hines, Michael, Yale University School of Medicine
Holmgren, Miguel, National Institutes of Health
Jeffery, William, University of Maryland
Jonas, Elizabeth, Yale University School of Medicine
Jones, Teresa, National Institutes of Health
Jovanovic, Jasmina, University of London, United Kingdom
Kaczmarek, Leonard, Yale University School of Medicine
Kaplan, Ilene M., Union College
Kaupp, U.B., Institut fur Biologische Informationsverarbeitung, Germany
Khodjakov, Alexey, Wadsworth Center
Kirschner, Marc, Harvard Medical School
Koester, Helmut, Baylor College of Medicine
Kuhns, William, The Hospital for Sick Children, Canada
Lafer, Eileen, University of Texas Health Science Center
Langford, George, Dartmouth College
Larkum, Matthew, University of Bern, Switzerland
Laskin, Jeffrey, University of Medicine & Dentistry of New Jersey
Lauffer, Hans, University of Connecticut
Lauzon, Robert, Union College
LeBaron, Richard, University of Texas, San Antonio
Levine, Alex, The Hebrew University, Israel
Li, Huawei, Harvard Medical School
Lichtman, Jeff, Washington University
Llinás, Rodolfo R., New York University Medical Center
Lovett, Donald, The College of New Jersey
Magee, Jeff, Louisiana State University
Marshall, John, Brown University
Martinez, Joe, University of Texas, San Antonio
McNeil, Paul, Medical College Georgia
Mensinger, Allen, University of Minnesota, Duluth

**FELLOWSHIPS**

Eleven scientists received fellowships from the Marine Biological Laboratory totaling $160,000 to conduct research at the laboratory in 2004:

**Jan Ellenberg, Ph.D.**
European Molecular Biology Laboratory, Germany
“Meiotic chromosome dynamics in echinoderms”
Dr. Ellenberg was supported by the Evelyn and Melvin Spiegel, Frederik B. and Betsy G. Bang, Lucy B. Lemann, Robert Day Allen, and Herbert W. Rand Fellowships.

**Simone Engelender, M.D., Ph.D.**
Technion-Israel Institute of Technology, Israel
“Study of synphilin-1 function and its contribution to Parkinson’s disease”
Dr. Engelender was supported by a Gruss Lipper Family Foundation Fellowship.

**John H. Henson, Ph.D.**
Dickinson College
“Cytoskeletal mechanisms underlying retrograde flow and spindle assembly in sea urchin cells”
Dr. Henson was supported by an MBL Associates Fellowship.

**Eileen M. Lafer, Ph.D.**
University of Texas Health Science Center at San Antonio
“Basic mechanisms underlying neurotransmission”
Dr. Lafer was supported by the Herbert W. Rand, H. Burr and Susie Steinbach, James A. and Faith Miller, Erik B. Fries, Charles R. Crane, Ann E. Kammer Memorial, and Plum Foundation John E. Dowling Fellowships.

**Matthew E. Larkum, Ph.D.**
University of Bern, Switzerland
“Characterization of the active dendritic properties of the pyramidal cells of turtle cortex—Part 2”
Dr. Larkum was supported by a Nikon Fellowship.

**Alex Levine, Ph.D.**
The Hebrew University of Jerusalem, Israel
“The role of reactive oxygen species (ROS) and nitric oxide (NO) in zebrafish mating”
Dr. Levine was supported by a Gruss Lipper Family Foundation Fellowship.
Donald L. Lovett, Ph.D.
The College of New Jersey
“Physiological significance of methyl farnesoate in osmoregulation by crabs”
Dr. Lovett was supported by the John O. Crane and Baxter Postdoctoral Fellowship Funds.

Eduardo A. Perozo, Ph.D.
University of Virginia Health Sciences Center
“Identification and characterization of novel ion channels from marine prokaryotes”
Dr. Perozo was supported by the MBL Associates, Stephen W. Kuffler, Frank R. Lillie, and M. G. F. Fuortes Fellowship funds.

Ehud Razin, Ph.D.
The Hebrew University Hadassah Medical School, Israel
“Lysyl tRNA synthase and Ap4A: New roles in the regulation of the activity of transcription factors”
Dr. Razin was supported by a Gruss Lipper Family Foundation Fellowship.

Charles B. Shuster, Ph.D.
New Mexico State University
“Spatio-temporal regulation of cytokinesis in echinoderm embryos”
Dr. Shuster was supported by Laura and Arthur Colwin Endowed Summer Research Fellowship Fund.

Herman Wolosker, M.D., Ph.D.
Technion-Israel Institute of Technology, Israel
“Role of endogenous D-serine in the brain”
Dr. Wolosker was supported by a Gruss Lipper Family Foundation Fellowship.

2004 Albert and Ellen Grass Faculty Grant Program

Nine investigators were awarded Grass Faculty Awards at the MBL in 2004. The goal of this program is to take advantage of the collaborative environment of the MBL and bring together neuroscientists at the assistant or associate professor level from different institutions to work together to conduct specific research.

Helmut J. Koester, Ph.D., an instructor in the Division of Neuroscience at Baylor College of Medicine, and Jackie Schiller, Ph.D., an associate professor in the Department of Physiology and Biophysics at the Technion Medical School, Israel, collaborated on a project titled “Active dendritic integration in cortical sensory processing in vivo.”

Jasmina N. Jovanovic, Ph.D., a lecturer and group leader in the Department of Pharmacology, The School of Pharmacy at the University of London, UK, and Sabine Hilfiker, Ph.D., a Ramon y Cajal Fellow and group leader at the Instituto de Parasitología y Biomedicina ‘Lopez-Neyra,’ Spain, collaborated on a project titled “Dissecting the roles of protein phosphorylation in vesicle trafficking and secretion.”

Stefan Heller, Ph.D., an associate professor in the Department of Otolaryngology at Harvard Medical School, Huawei Li, Ph.D., a professor in the Mass Eye and Ear Infirmary at Harvard Medical School, and Jeffrey Corwin, Ph.D., a professor in the Departments of Neuroscience and Otolaryngology at the University of Virginia School of Medicine, collaborated on a project titled “Quiescent stem cells in the mouse utricle.”

William N. Green, Ph.D., an associate professor in the Department of Neurobiology, Pharmacology and Physiology at the University of Chicago, and John Marshall, Ph.D., an associate professor in the Department of Molecular Pharmacology, Physiology and Biotechnology at Brown University, returned to the MBL to continue their collaborative project titled “Targeting and trafficking of glutamate receptors by PDZ domain proteins.”

Mitchison, Timothy, Harvard Medical School
Moore, John W., Duke University Medical Center
Nasi, Enrico, Boston University School of Medicine
Palazzo, Robert, Rensselaer Polytechnic Institute
Pant, Harish, National Institutes of Health
Peretz, Eduardo, University of Virginia
Qian, Haohua, University of Illinois at Chicago
Quigley, James, Scripps Research Institute
Rabbitt, Richard, University of Utah
Rakowski, Robert F., Ohio University
Razin, Ehud, Hebrew University - Hadassah Medical School, Israel
Reese, Tom, National Institutes of Health
Rhodes, Paul, New York University Medical School
Rieder, Conly, Wadsworth Center
Ripps, Harris, University of Illinois at Chicago
Rome, Lawrence, University of Pennsylvania
Ross, William, New York Medical College
Ruderman, Joan, Harvard Medical School
Salmon, Edward, University of North Carolina, Chapel Hill
Schiller, Jackie, Technion Medical School, Israel
Shalinsky, Mark, Dartmouth College
Shuster, Charles, New Mexico State University
Sloboda, Roger D., Dartmouth College
Sluder, Greenfield, University of Massachusetts Medical School
Soares, Daphne, University of Maryland
Spiegel, Melvin, Dartmouth College
Spiegel, Evelyn, Dartmouth College
Steinacker, Antoinette, University of Puerto Rico
Sturley, Stephen, Columbia University Medical Center
Sugimori, Mutsuyuki, New York University Medical Center
Telzer, Bruce, Pomona College
Tong, James, University of California, Irvine
Umino, Yumiko, SUNY Upstate Medical University
Weidner, Earl, Louisiana State University
Weissman, Famil, Columbia University
Wolosker, Herman, Technion-Israel Institute of Technology
Yeckel, Mark, Yale University School of Medicine
Zecevic, Dejan P., Yale University School of Medicine
Zimmerberg, Joshua, National Institutes of Health
Zottoli, Steven, Williams College
Zukin-Bennett, R. Suzanne, Albert Einstein College of Medicine
Eleven young scientists received fellowships from the Grass Foundation to conduct research in neurobiology at the MBL during the summer of 2004. The program was directed by Susan Barry, Mount Holyoke College. Daphne Soares, University of Maryland, was the program’s associate director.

Rachel Mary Berquist, Ph.D., University of Minnesota, Duluth
“Response dynamics of saccular afferent fibers in free-swimming toadfish, Opsanus tau”

Manuel Estrada, Ph.D., Yale University School of Medicine
“Effects of steroid hormones on intracellular Ca2+ signaling in a neuronal cell line”

Michael A. Farries, University of Washington Medical Center
“Long-term synaptic plasticity in nucleus RA of the zebra finch: A possible substrate for song learning”

Robert Crooks Froemke, University of California, Berkeley
“The cellular mechanisms and synaptic organization of neocortical receptive fields”

Eric Briant Gonzales, University of North Texas Health Science Center
“Kinetic determinants of the second transmembrane domain 7’ position in the glycine alpha1 receptor”

Emma Heart, Ph.D., Evans Biomedical Research Center
“NAD(P)H oscillations in pancreatic islet cells and their modulations by metabolic and electric stimuli”

Leib Litman, Brooklyn College
“In search of a model organism for complex forms of implicit learning: Exploring crypsis and the serial reaction time task in cuttlefish”

Mark H. Shalinsky, Ph.D., Dartmouth College
“An electrophysiological study of the lung rhythm in the bullfrog, Rana catesbeiana, as an evolutionary precursor to gasping in mammals”

James Jiayuan Tong, Ph.D., University of California, Irvine
“Mitochondria dynamics in synaptic plasticity and learning”

Yumiko Umino, Ph.D., SUNY Upstate Medical University
“Processing of visual information of Limulus brain”

Tamily A. Weissman, Columbia University
“The Alzheimer’s disease pathway meets neural development: Does presenilin process the reelin receptor and regulate neuronal migration?”

2004 Grass Fellows

2004 Dart Foundation Scholars Program in Learning and Memory

Sponsored by a generous grant from the Dart Foundation, the Dart Scholars Program brings top scientists in the field of learning and memory together to conduct research at the MBL for the summer. Two scientists were named Dart Scholars in Learning and Memory in 2004:

Daniel Johnston, Ph.D., is a professor in the Division of Neuroscience at the Baylor College of Medicine. His research project was “Calcium imaging in hippocampal neurons.”

Mark F. Yeckel, Ph.D., is an assistant professor in the Department of Neurobiology at the Yale University School of Medicine. His research project was “Endoplasmic reticulum as a sensor for neuronal activity.”
**Domestic Institutions Represented**

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**OTHER RESEARCH PERSONNEL**

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<tr>
<td>Alber, Merryl</td>
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<td>Chiao, Chuan-Chin</td>
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<td>Chun, Jong Tai</td>
<td>Stazione Zoologica “A Dohn,” Italy</td>
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<td>Clarkson, Melissa</td>
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<td>Commons, Kathryn</td>
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<td>Corona, Kaitlin</td>
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<td>Cuello, Luis</td>
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<td>Daigle, Nathalie</td>
<td>European Molecular Biology Laboratory, Germany</td>
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<td>De Stefano, Rosanna</td>
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<td>DeGiorgis, Joe</td>
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<td>Deutch, Jamie</td>
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<td>DiMaio, Michael</td>
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<td>Donnelly, Erin</td>
<td>Boston College</td>
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<td>Duchalsky, Scott</td>
<td>Detroit Receiving Hospital</td>
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Continued...
Friday Evening Lecture Series

June 18
**Kenneth Miller**, Brown University
“Time to Abandon Darwin? The Challenge from ‘Intelligent Design’”

June 25
**Jerry Melillo**, Marine Biological Laboratory
“Biology, Earth’s Atmosphere, and Climate Change: Making Connections and Looking to the Future”

July 2
**Catherine Carr**, University of Maryland
“Sound Localization in Owls and Alligators”

July 9 – Keith Porter Lecture
**Ron Vale**, University of California, San Francisco
“Molecular Motor Proteins: A Story Home-Grown from the Marine Biological Laboratory”

July 16
**Mark Hughes**, Genesis Genetics Institute
“Preimplantation Genetic Diagnosis: The Technology, the Medicine and the Bioethics”

July 21 and 22 – Forbes Lectures
**Marc Tessier-Lavigne**, Genentech
“Wiring the Brain: The Logic and Molecular Mechanisms of Axon Guidance and Regeneration” and “Brain Development and Brain Repair: Molecules and Mechanisms that Control Nerve Growth”

July 23 – Glassman Lecture
**Arnold Levine**, Institute for Advanced Study, and the Cancer Institute of New Jersey
“Genetic Predispositions for Cancers in Humans”

July 30
**Elisabetta Ullu**, Yale University
“Tiny RNAs as Powerful Regulators of Gene Expression: Insights from Protozoan Parasites”

August 6 – Lang Lecture
**Russell Fernald**, Stanford University
“The Influence of Behavior on Brain Structure and Function”

August 13
**Amar Klar**, National Cancer Institute
“Genetics of Human Handedness, Schizophrenia, and Bipolar Traits”
Foreign Institutions Represented

Barcelona, University of, Spain
Bern, University of, Switzerland
Brain Science Institute, Japan

Consejo Superior de Investigaciones Científicas, Spain

Department of Fisheries, Australia

European Molecular Biology Laboratory, Germany

Florence, University of, Italy
Friedrich Miescher Institute, Switzerland

Hebrew University - Hadassah Medical School, Israel
Hebrew University, Israel

Hong Kong University of Science and Technology, China
Hospital for Sick Children, Canada

International Atomic Energy Agency, Austria
Instituto de Investigacion Medica “Mercedes y Martin Ferreyra,” Argentina
Institut für Biologische Informationsverarbeitung, Germany
Instituto Venezolano de Investigaciones Científicas, Venezuela

Kyoto University, Japan

London, University College, United Kingdom
London, University of, United Kingdom

Medical Research Council, London, United Kingdom

Napoli “Federico II,” Universita di, Italy
Naples, University of, Italy
National Tsing Hua University, Taiwan
Novartis International AG, Switzerland

Rudolf Magnus Institute for Neurosciences, The Netherlands

Sheffield, University of, United Kingdom
Stazione Zoologica “A Dohrn,” Italy
Sussex, University of, United Kingdom

Technion Medical School, Israel
Technion-Israel Institute of Technology, Israel
Tokyo, University of, Japan
Tsukuba University, Japan

Jeylous, Okun, University of Chicago
Johnson, Whitney, Williams College
Kaltenbach, Jane, Mount Holyoke College
Kidder, Sarah, Union College
King, Curtis, University of Utah
Kosmidis, Efstratios, Yale University

Lahey, Bridget, Illinois State University
Lasser-Ross, Nechama, New York Medical College
Latham, Erika, Williams College
Lee, Joan, The College of New Jersey
Lee, Ying, Dartmouth College
Lenart, Peter, European Molecular Biology Laboratory, Germany
Levy, Carmit, Hebrew University, Israel
Li, Yulong, Duke University
Liao, Paul, Robert Wood Johnson Medical School
Loshkajian, Gina, Skidmore College
Lund, Amanda, Rensselaer Polytechnic Institute
Lyton, William, SUNY Downstate Medical Center
Mabuchi, Issei, University of Tokyo, Japan
Malchow, Robert, University of Illinois at Chicago
Mancke, Morgan, Harvard University
Manzana, Ehrine, University of Chicago
Marangoni, Maria, University of Illinois at Chicago
Marion, Gordon, Rutgers University
McNeil, Anna, Medical College of Georgia
Miller, Andrew, Hong Kong University of Science and Technology
Miyake, Katsuya, Medical College of Georgia
Mori, Kazuo, SUNY Upstate Medical University
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Morfini, Gerardo, University of Illinois at Chicago

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Morris-Smith, Lianne, Wesleyan University
Moshe, Yakir, Technion-Israel Institute of Technology, Israel

Muta, Hideki, Harvard Medical School
Myers, Aaron, Cornell University
Needleman, Leigh, Brown University
Neufeld, Mike, Salk Institute
Nicolay, Nils, Yale University
Novotney, Debbie, Illinois State University

Ogden, David, Medical Research Council, UK
Opalch, Katie, University of Connecticut

Papa, Michele, University of Naples, Italy
Perlman, Zachary, Harvard Medical School
Pielak, Rafal, Hunter College
Pocovi, Maria, Instituto Venezolano de Investigaciones Científicas, Venezuela
Pollema, Sarah, University of Illinois at Chicago
GENERAL SCIENTIFIC MEETINGS AWARDS

The MBL’s General Scientific Meetings have, for decades, been providing an informal forum for the presentation of research carried out at the MBL, thereby fostering scientific exchange within the MBL community. The 2004 meetings were held August 9 to 10 in the Lillie Auditorium and were co-chaired by Karen Crawford (St. Mary’s College of Maryland), Kenneth Foreman (MBL), Robert Gould (University of Illinois at Chicago), and Robert Paul Malchow (University of Illinois at Chicago). Awards were given for the best papers in the following categories.

Senior Investigator

WINNER  
Peter B. Armstrong with Margaret T. Armstrong, Steven M. Theg, Nikolai Braun, Norman Wainwright, and R. Pardy  
Histochemical evidence for lipopolysaccharide (endotoxin) in eukaryotes

HONORABLE MENTION  
Robert M. Gould with Hilary Morrison, Robert Campbell, and Edwin Gilland  
Evolution of myelin proteins

Junior Investigator

WINNER  
Robert C. Froemke with Dan Yang  
Transient NMDA receptor suppression induces long-lasting synaptic depression

HONORABLE MENTIONS  
Chuan-Chin Chiao with Emma J. Kelman and Roger T. Hanlon  
Disruptive body patterning of cuttlefish (Sepia officinalis) requires visual information on edges and brightness of objects on natural substrate backgrounds

James J. Tong  
Mitochondrial dynamics in synaptic plasticity in Drosophila melanogaster

Graduate Student

WINNER  
Daniel E. Golden with Stephen L. Hajduk  
Cis editing in Trypanosoma brucei; brucei as a model for understanding guide-RNA structural and functional requirements

HONORABLE MENTION  
Omicron L. Ma with Sarah E. Webb and Andrew L. Miller  
Imaging patterns of Ca²⁺ transients during the blastula period in zebrafish embryos

Undergraduate Student

WINNERS  
Patrick Flight with Gabriele Gerlach and Jelle Atema  
Sperm load impact on female courtship behavior in the American lobster (Homarus americanus)

Leanna R. Heffner with Mirta Teichberg, Sophia Fox, and Ivan Valiela  
Nitrate reductase and glutamine synthetase activity and growth in Ulva lactuca in Waquoit Bay: A time sequence of responses to differences in nitrogen supply

HONORABLE MENTION  
Clarissa A. Sabella with Ellen E. Faszewski, Jane C. Kaltenbach, William J. Kuhns, Max M. Burger, and Xavier Fernandez Busquets  
Immunocytochemical detection of integrins 3 and B1 in allografts of the marine sponge, Microciona prolifera
The Architectural Dynamics in Living Cells Program (ADLC), established at the MBL by Shinya Inoué in 1992, continues the pioneering research and educational activities in biophysical inquiries directly in living cells that Inoué started at Princeton University in 1949. The program focuses on architectural dynamics in living cells: the timely and coordinated assembly and disassembly of macromolecular structures essential for the proper functioning and differentiation of cells, the spatial and temporal organization of these structures, and their physiological and genetic control.

The program is also devoted to the development and application of powerful new imaging tools that permit such studies directly in living cells and functional cell-free extracts. Program members have special expertise in the use of polarized light for analyzing the local arrangement of molecular bonds and fine structure in biological specimens. Unique instrumentation developed by program members includes the universal light microscope, centrifuge polarizing microscope, the liquid-crystal based LC-PolScope, and related technology. Biological phenomena currently under investigation include mitosis/meiosis and related motility, amoeboid movement, microtubule-centrosome interaction, and optical properties of green fluorescent protein. The Architectural Dynamics in Living Cells Program

DISTINGUISHED SCIENTIST
Shinya Inoué

SENIOR SCIENTIST
Rudolf Oldenbourg

ASSISTANT RESEARCH SCIENTIST
Michael Shribak

POSTDOCTORAL SCIENTISTS
Brigitte de Saint Phalle
Yuki Kagawa

RESEARCH ASSISTANT
Grant Harris
Program is an active component of the MBL’s resident cell research group and promotes interdisciplinary research and training among its resident core researchers, visiting investigators, and collaborating manufacturers.

During 2004, program members published articles and made conference presentations on: (a) mechanisms of chromosome positioning during meiosis in insect spermatoctyes, (b) cell division dynamics of *Drosophila* kc cells without functional mitotic centrosomes, (c) mapping polymer birefringence in three dimensions using a polarizing microscope with oblique illumination, and (d) orientation-independent unbiased DIC microscopy. In addition, students of the Physiology course and many visitors (see Whitman investigator list) took advantage of the special instrumentation for exploratory projects, including the analysis of the rapid stalk contraction in *Vorticella* exposed to centrifugal forces, stratification of the cytosol in red blood cells (centrifuge polarizing microscope), analysis of filament alignment in f-actin-based comet tails of *Listeria*, and liquid-crystal ordering in solutions of bacterial flagella (LC-PolScope).

**VISITING INVESTIGATORS**
Kenneth Breuer, Brown University
Lisa Cameron, University of North Carolina at Chapel Hill
William D. Cohen, Hunter College of the City University of New York
Danielle Cook, Massachusetts Institute of Technology
Zvonimir Dogic, Harvard University
Susan Gerbi, Brown University
Makoto Goda, Kyoto University, Japan
John Henson, Dickinson College
Joseph Hoffman, Yale University School of Medicine
Ted Inoue, New Hope, Pennsylvania
David Keefe, Women & Infants Hospital of Rhode Island
James LaFountain, University of Buffalo
Lin Liu, Women & Infants Hospital of Rhode Island
Issei Mabuchi, University of Tokyo, Japan
Tim Megrew, University of North Carolina
Andrew Millard, University of Connecticut
Tim Mitchison, Harvard University
Ted Salmon, University of North Carolina
Charles B. Schuster, New Mexico State University
Julie Theriot, Stanford University
James Valles, Brown University

**ADMINISTRATIVE STAFF**
Jane MacNeil, Executive Assistant

**Publications**


LaFountain, JR, Jr; Oldenbourg, R. 2004. Maloriented bivalents have metaphase positions at the spindle equator with more kinetochore microtubules to one pole than to the other. *Mol Biol Cell* 15: 5346-55.

The Boston University Marine Program (BUMP) offers undergraduate and graduate studies in marine biology leading to B.A., M.A., and Ph.D. degrees. The program places a strong emphasis on individual achievement in hands-on field and laboratory work. Students work with BUMP faculty and MBL scientists as well as scientists from other marine institutions in Woods Hole including the Woods Hole Oceanographic Institution and the National Marine Fisheries Service. In 2004 BUMP celebrated its 35th anniversary. Although this was a milestone year for BUMP in terms of accomplishments, casting a shadow over the program at year’s end was the likelihood that after 35 years at the MBL, Boston University may move BUMP to its Charles River campus in mid-2006.

Of particular note, 2004 saw the naming of a new BUMP director. In August Jelle Atema stepped down from the position he had held since 1990 to devote more time to his research. Replacing him as director ad interim is Vince Dionne who joined BUMP in 1993. Dionne is a neurobiologist with research interests in olfaction and the biophysics of ion channels. Prior to his appointment as director ad interim, Dionne had served as Director of Graduate Studies and Acting Director of the Program; in 2001 his lab moved from the MBL to BU’s Charles River campus. Atema’s contributions to BUMP were celebrated at the Program’s 35th Anniversary and Awards Dinner attended by faculty, staff, students, alumni, and guests at the J. Erik Jonsson Center.

The laboratories of the BUMP resident faculty were well funded and active during 2004, providing support for many of the 20 graduate students associated with the program. Atema, known for his work on the sensory biology of marine arthropods, began work on a major new project examining odor-guided behavior in sharks. Supported by DARPA, his studies examine the acute chemosensitivity of the animals.
Gil Rosenthal studies the evolution of visual communication in fishes. His laboratory has been examining the relation between the banding patterns of coral reef fish (important for visual communication) and contaminants that reduce water clarity. Their work in freshwater streams indicates that contaminants may interfere not only with water clarity, but with chemical signaling in fishes, leading to interspecies mating and hybridization.

Paul Barber works on marine population dynamics. He received a five-year CAREER grant to study the origins of marine biodiversity in the Indo-Pacific. He also developed and funded a program that takes under-represented minority students into the field in Indonesia and into his laboratory in Woods Hole. Two students working with Barber won competitive awards: Josh Drew received a Tegner Fellowship for marine conservation work in Fiji, and Eric Crandall received both a Lerner Gray Grant and a grant from the Concologists of America.

Phil Lobel’s laboratory continued to play an important research role studying the military impact on marine environments in the Pacific during 2004. He also expanded ongoing work on visual and aural communication in reef fishes and on shark behavior.

Ivan Valiela studies the ecological impact of land use on coastal estuaries and waters. Using data on population density, waste water release, estuarine nitrogen, and other measures acquired over several decades, he and his students have modeled these processes to predict future impacts and consequences of present-day land-use and land-management decisions. Among their results, they also found that petroleum residues spilled over 30 years ago in salt marshes on Cape Cod continued to have measurable biological effects on feeding and behavior of fiddler crabs, pointing out the long-term consequences of many contaminants. The laboratory also began a study on the role of mangrove estuaries and the impact of deforestation on coastal ecosystems in Panama.
Publications


Cole, ML; Valiela, I; Kroeger, KD; Fry, B; Tomasky, GL; Cebrian, J; Wigand, C; McKinney, RA; Grady, SP; Carvalho da Silva, MH. 2004. Assessment of a $^{15}$N isotopic method to indicate anthropogenic eutrophication in aquatic ecosystems. *J Environ Qual* 33:124-132.

Cole, ML; Kroeger, KD; McClelland, JW; Valiela, I. 2004. Macrophytes as indicators of land-derived wastewater: Application of a $^{15}$N method in aquatic systems. *Can J Fish Aquat Sci*


Roney, KE; Cuthbertson, BJ; Godwin, UB; Kazianis, S; Della Coletta, L; Rosenthal, GG; Ryan, MJ; Schmidt, M; McConnell, TJ. 2004. Alternative splicing of major histocompatibility complex II DXB transcripts in *Xiphophorus* fishes. *Immunogenetics* 56:462-466.


Serveiss, VB; Bowen, JL; Dow, D; Valiela, I. 2004. Using ecological risk assessment to identify the major anthropogenic stressor in the Waquoit Bay watershed, Cape Cod, Massachusetts. *Environ Manag* 33:730-740.


The tactics and mechanisms of camouflage are being elucidated by studying how cuttlefish choose among their numerous body patterns when confronted with different backgrounds. A visual sensorimotor bioassay has been refined to study the animals' visual perception of backgrounds. At the level of the skin, we have been measuring reflectance in tiny skin patches, and relating these optical effects to skin ultrastructure.


For squid fishery management, we developed an acoustic methodology to map the distribution and abundance of squid eggs, which provide a proxy for recruitment potential.

We defined some major time domains of short-term, and long-term consolidated memory in the nudibranch mollusc, Hermissenda, using behavioral analyses and molecular pathway inhibitors. We published results defining two different forms of long-term memory: one lasting 24 hours, and a second, long-term consolidated memory that persists for at least six days. Via behavioral and electrophysiology studies, we discovered that the anti-cancer drug, bryostatin (now in phase-2 human oncology testing), can enhance the acquisition and retention of memory in Hermissenda. Our results extend the potential usefulness of bryostatin from cancer therapy to use in treating dementia.

DNA microsatellite analyses showed very limited gene flow between cod populations on Western and Eastern Georges Bank. Fish from both populations spawn at different times of the year suggesting that they should be managed separately. We demonstrated that larval reef fishes use olfactory cues to differentiate between reefs when they are about to settle. Populations at adjacent reefs differed genetically, which might indicate homing behavior to natal reefs.
Program in Scientific Aquaculture

A major disease concern for many cultured marine fish species, nodavirus, has affected commercial culture of Atlantic cod. We have developed specific and sensitive viral detection techniques using real-time PCR that are proving useful for understanding the etiology of the disease. Methods to effectively disinfect eggs have been developed to prevent vertical transmission of the virus. Practical methods are being developed to use hydrogen peroxide as a treatment to help prevent disease in fish and shellfish grown in recirculating aquaculture systems.

Research was completed on characterizing genes regulated during larval metamorphosis in the bay scallop. Additionally, a suite of microsatellite and other DNA markers were developed and characterized for the bay scallop. These genetic markers were used to show genetic diversity of scallop populations on Cape Cod and New England, and demonstrated the contribution of hatchery-reared scallops in population enhancement efforts.

Using PCR detection methods, we are conducting environmental studies of sediment, water column, and marine snow samples to identify reservoirs of Quahog Parasite Unknown (QPX—a disease-causing agent in hard clams), and how the QPX content of those reservoirs vary with environmental factors (with Becky Gast, WHOI). Studies are underway to develop real-time PCR quantification methods of QPX, and to determine the best growing conditions for hard clams in an area known to be infected with QPX.

We initiated a scientific and humanitarian project titled, “Feed the Fish to Feed the People” to develop fish diets from native vegetation in Haiti. Diets were made by simple means from combinations of Haitian leaves, seeds and roots, and tested in feeding trials to replicate tanks of the fish, tilapia. Early trial results suggest that six pounds of previously unvalued vegetation can yield one pound of high-quality fish protein to feed malnourished Haitians.
Publications


Biga, PR; Cain, KD; Hardy, RW; Schelling, GT; Overturf, K; Roberts, SB; Goetz, FW; Ott, TL. 2004. Growth hormone differentially regulates muscle myostatin1 and -2 and increases circulating cortisol in rainbow trout (Oncorhynchus mykiss). Gen Comp Endocrinol 138(1):32-41.


Forsythe, JW; Kangas, N; Hanlon, RT. 2004. Does the California market squid, Loligo opalescens, spawn naturally during the day or at night? A note on the successful use of ROVs to obtain basic fisheries biology data. Fish Bull 102:389-392.


McCaulay, L; Goecker, C; Parker, P; Rudolph, T; Goetz, F; Gerlach, G. 2004. Characterization and isolation of DNA microsatellite primers in the spiny dogfish (Squalus acanthias) Mol Ecol Notes 4(3):494-496.


Roberts, SB; Barry, T; Malison, J; Goetz, FW. 2004. Production of a recombinantly-derived growth hormone antibody and the characterization of growth hormone levels in yellow perch. Aquaculture 232/1-4:591-602.


Laboratory of Frederick Goetz
STAFF
Frederick Goetz, Senior Scientist
Peggy Biga, Postdoctoral Investigator
Linda McCauley, Research Assistant

Laboratory of Steven Roberts
STAFF
Steven Roberts, Assistant Research Scientist
Phoenix Becker, Summer Research Assistant
Christina Romano, Research Assistant
Raquel Sussman, Investigator

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Adam Bissonne, St. Anselm College
Kristen Ettenson, Dartmouth College

Laboratory of Roxanna Smolowitz
STAFF
Roxanna Smolowitz, Veterinarian and Associate Scientist
Daniel Johnson, Animal Care Assistant, Mammalian Animal Care
Jet Stukey, Research Assistant, Mammalian Animal Care
Kevin Uhlinger, Research Assistant

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Amy Dearborn, Massachusetts Maritime Academy
Carolyn Emery, Falmouth High School
Maïlle Lyons, Graduate Student, University of Connecticut
Morgan Porter, Southampton College
Katie Szymanska, Dedham High School

Laboratory of Scott Lindell
STAFF
Scott Lindell, Marine Resources Center Manager and Interim Director, Scientific Aquaculture Program
Phoenix Becker, Summer Research Assistant

INTERNS
Carly Allen, University of Hawaii
Eric Pilsmaker, Massachusetts Maritime Academy
The goal of the Program in Molecular Physiology (PMP) is to advance our knowledge of basic and biomedical problems through the study of cellular dynamics in the living cell. An important component of these studies is the development and application of techniques for the detection of specific molecules and structures. A key, indeed critical, event of the past year has been the successful competitive renewal of the BioCurrents Research Center for five years. The grant was fully funded, and included the purchase of a spinning disc confocal, and low light imaging system, both to be installed on electrophysiology platforms. This represents a major new initiative within the program, bringing in advanced imaging technologies to our development and collaborative activities.

A further development in 2004 was the arrival of Robert Greenberg as a member of the PMP. Robert works on the molecular biology and channel biophysics of schistosome parasites, a major and debilitating disease in several parts of the world. Robert’s appointment forms a new bridge between the PMP and the Program in Infectious Diseases in the Bay Paul Center.

Studies within the PMP continue to be diverse, most focusing on mechanisms underlying trans-membrane transport. Broadly, our interests lie in secretory events along with vesicle transport and docking—notably in diabetes; channel biophysics; the characterization, molecular biology, and pharmacology of pumps and porters; cellular metabolism and messenger molecules; reproductive biology and development; and infectious disease. Members of the program hosted approximately 40 visiting investigators this year.
Several new developments in instrumentation and signal processing were launched this year, notably the use of ion selective electrodes to follow channel activity and amperometric techniques for analysis of transport through the multidrug resistant transporters. Our bioinformatics project, Pharmabase, continued to expand in 2004 (www.pharmabase.org) with future plans to include a graphic interface.

Members of the program continue to provide support for numerous educational ventures and external investigators. This reporting year PMP members wrote in support of several joint grants (11 from NIH). Our Small Business Innovation Research (SBIR) grant, with previous center collaborator, R. Nuccitelli, moved to Phase II with the goal of producing a clinically applicable skin diagnostic tool.

**Publications**


Liu, L; Franco, S; Spyropoulos, B; Moens, PB; Blasco, MA; and Keefe, DL. 2004. Irregular telomeres impair meiotic synapsis and recombination in mice. PNAS 101: 6496-6501.


**INFORMATICS MANAGER**
David Remsen

**SUPPORT ENGINEER**
Robert Lewis

**RESEARCHER**
David Compton

**SUMMER INTERNS**
Michael Dacey
James Pringle

**Laboratory of Robert Greenberg**

**ASSOCIATE SCIENTIST**
Robert Greenberg

**POSTDOCTORAL SCIENTIST**
Joseph Consiglio

**RESEARCH ASSISTANT**
Christina Evola

**Laboratory for Reproductive Medicine**

**DIRECTOR/ADJUNCT SCIENTIST**
David Keefe, Brown University

**ADJUNCT SCIENTISTS**
Eva Czerwiec, Brown University
Lin Liu, Brown University
James Trimarchi, Brown University
Our goal is to use marine animals as biomedical models. We have explored mechanisms of neurotoxicity using surf clam embryos (*Spisula solidissima*). We have discovered that a mixture of chemicals found in polluted wells in Brick, New Jersey, causes an increase in an enzyme critical for neuronal development. By focusing on the p53 gene family, we have proven that p73 (not p53) may be exclusively expressed by *Spisula* neurons. Whether or not p73 is a molecular target of environmental neurotoxins remains to be determined.

In our second model, we define the impact of environmental contaminants on a leukemia developed by blue mussels (*Mytilus edulis*). In collaboration with Environment Canada, we have discovered that industrial chemicals plus untreated human waste results in much higher levels of leukemia throughout a polluted harbor in Pictou, Nova Scotia. We have also discovered leukemia in *Mytilus trossolus* in Vancouver Harbor, British Columbia.

We use both molecular and cellular assays to determine the level of toxicity and carcinogenicity in these molluscan species. Currently we are examining mechanisms of action using zebrafish embryos where more powerful and accurate probes are available for our research.

**Publication**

Kreiling, J; Stephens, R; Reinisch, CA. 2005. Mixture of environmental contaminants increases cAMP-dependent protein kinase A expression in *Spisula* embryos. Env Toxicol Pharmacol 19: 9-18. (Published online in 2004.)
γ-Carboxyglutamic acid (Gla) is a calcium-binding amino acid that is found in the conotoxins of the cone snail, Conus. This laboratory investigates the vitamin K-dependent biosynthesis of this amino acid in Conus and the structural role of γ-carboxyglutamic acid in the conotoxins. This satellite laboratory relates closely to the main laboratory, the Center for Hemostasis and Thrombosis, at Harvard Medical School in Boston.

The marine cone snail is the sole invertebrate known to contain the vitamin K-dependent amino acid, γ-carboxyglutamic acid. We have cloned and compared the γ-glutamyl carboxylase, the enzyme required to synthesize Gla from vertebrates and invertebrates, and demonstrated marked sequence similarity despite evolutionary divergence over 500 million years ago. These results demonstrate the vitamin K-dependent biosynthesis of Gla is a highly conserved function in the animal kingdom. To identify novel Gla containing proteins conserved in animal species, we are identifying the vitamin K proteome using fluorescence-based differential imaging gel electrophoresis (DIGE), computer-based image analysis and electrospray mass spectroscopy.

Publications

Grant, MA; Hansson, K; Furie, BC; Furie, B; Stenflo, J; Rigby, AC. 2004. The metal-free and calcium-bound NMR structures of a Gla-containing contryphan from Conus marmoreus, Glacontryphan-M. J Biol Chem 279:32464-32473.

Hansson, K; Ma, X; Eliasson, L; Furie, B; Furie, BC; Rorsman, P; Stenflo, J. 2004. The first Gla-containing contryphan: A selective L-type calcium ion channel blocker isolated from the venom of Conus marmoreus. J Biol Chem 279:32453-32463.

The mission of this laboratory is to understand the molecular defense mechanisms exhibited by marine invertebrates in response to invasion by bacteria, fungi, and viruses. Their primitive immune systems demonstrate unique and powerful strategies for survival in diverse marine environments. The key model has been the horseshoe crab *Limulus polyphemus*. *Limulus* hemocytes exhibit a very sensitive LPS-triggered protease cascade that results in blood coagulation. Several proteins found in the hemocyte and hemolymph display microbial binding properties that contribute to antimicrobial defense. *Limulus* amebocyte lysate (LAL) is being adapted for use as a tool to assess bioburden on spacecraft and to search for microbial life in the universe. Collaborations with several NASA centers are actively developing technology in the field of astrobiology.

**Publication**
Maule, J; Fogel, M; Steele, A; Wainwright, N; Pierson, D; McKay, DS. 2004. Antigen-antibody interactions during altered gravity: Implications for immunosorbent assay during spaceflight. *J Gravitational Physiol* 10(2): 47-56.
Finally, CASSLS coordinated a unique training workshop in the Summer of 2004. Directed by astronaut Dan Barry, the goal of the workshop was to increase space station and shuttle crewmembers' scientific autonomy through lectures, hands-on laboratory activities, discussions, and collaboration with leading scientists. Approximately 130 hours of training activities were provided over three weeks. Specific areas of laboratory investigation included cell and molecular biology using yeast and fruit fly model systems, cardiovascular measurement, ultrasound investigation, planetary protection, life detection, and in situ resource extraction.

Throughout these investigations students interacted directly with working scientists and tested specific hypotheses, applying scientific method to arrive at their conclusions.

At the end of October, 2004, the center ceased its activities. The center's web site will remain online through 2005.
The MBL’s outstanding educational programs have a global reach, attracting top tier students and faculty from around the world. In 2004, 473 students from 292 institutions and 38 countries came to the MBL to study a range of biological topics with some of the world’s best scientists serving as course faculty and lecturers. The courses’ 575 faculty members and staff and 193 lecturers represented 267 institutions and 33 countries.

In 2004, the MBL’s summer courses in Physiology (directed by Ron Vale and Tim Mitchison), Neurobiology (directed by Ed McCleskey and Rae Nishi), Microbial Diversity (directed by Tom Schmidt and Bill Metcalf), and Molecular Biology of Aging (directed by Gary Ruvkun and Steve Austad) had a spectacular year under new leadership. Applicant pools were stronger than ever, and new sources of funding were obtained. The Physiology course was one of six programs selected for funding under the NIH Director’s Roadmap Initiative “Short Programs for Interdisciplinary Research Training.” The Microbial Diversity course received funding from a new source, the Gordon and Betty Moore Foundation. In addition, the Ellison Medical Foundation renewed funding for the Molecular Biology of Aging course.

The MBL said farewell to Rick Levine and Catherine Carr, who did a wonderful job directing the Neural Systems & Behavior course for the past five years. We are very fortunate that Sarah Bottjer and Mike Dickinson have agreed to take on the role as course directors for NS&B. Will Talbot also completed his term as co-director of the Zebrafish course. He will be succeeded by Mary Mullins, who will co-direct the course with Cecilia Moens, making the Zebrafish course the first in the history of the MBL to be directed exclusively by women.
SUMMER COURSES

Biology of Parasitism:
Modern Approaches
June 9 – August 7, 2004

COURSE DIRECTOR
Bangs, Jay, University of Wisconsin-Madison

FACULTY
Artis, David, University of Pennsylvania
Barry, Dave, University of Glasgow
Crabb, Brendan, The Walter and Eliza Hall Institute
Hunter, Christopher, University of Pennsylvania
Johnson, Patricia, University of California, Los Angeles
Matthews, Keith, University of Edinburgh
McFadden, Geoff, University of Melbourne
Reiner, Steven, University of Pennsylvania
Scherf, Artur, Institut Pasteur
Sinai, Anthony, University of Kentucky
Tarleton, Rick, University of Georgia

LECTURERS
Andrews, Norma, Yale University
Belkaid, Yasmine, Cincinnati Children’s Hospital Research
Beverley, Stephen, Washington University
Boothroyd, John, Stanford University
Carucci, Daniel, Naval Medical Research Center
Dobbelare, Dirk, University of Bern
Doering, Tamara, Washington University Medical School
Doolan, Denise, Naval Medical Research Center
Englund, Paul, The Johns Hopkins School of Medicine
Ferguson, Michael, University of Dundee
Goldberg, Daniel, Washington University
Goldenberg, Samuel, Fundação Oswaldo Cruz
James, Anthony, University of California, Berkeley
Kirk, Kieran, Australian National University
Lightowlers, Marshall, University of Melbourne
Lujan, Hugo, National University of Cordoba
McConville, Malcolm, University of Melbourne
Pearlman, Eric, Case Western Reserve University
Phillips, Meg, Southwestern Medical Center, University of Texas
Riley, Eleanor, London School of Hygiene and Tropical Medicine
Roos, David, University of Pennsylvania
Rudenko, Gloria, University of Oxford
Shapiro, Theresa, The Johns Hopkins School of Medicine
Sher, F. Alan, National Institutes of Health
Striepen, Boris, University of Georgia
Tschudi, Christian, Yale Medical School
Ward, Gary, University of Vermont
Waters, Andy, Leiden University Medical Center
Wynn, Thomas, National Institutes of Health

TEACHING ASSISTANTS
Bastida-Corcuera, Felix, University of California, Los Angeles
Martin, Diana, University of Georgia
Mayho, Matthew, University of Manchester
Molestina, Robert, University of Kentucky
Peck, Ron, University of Wisconsin-Madison

Pew, Marion, University of Pennsylvania
Ralph, Stuart, Institut Pasteur
Van Dooren, Giel, University of Melbourne

COURSE ASSISTANTS
Normand, Danielle, University of New Hampshire
Tarleton, Jessica, Marine Biological Laboratory

STUDENTS
Casanova, Carlo, University of Bern
Conte, Ianina, Fundacion Instituto Leloir
Dossin, Fernando, Federal University of Sao Paulo
Fouts, Ashley, Stanford University
Harder, Simone, Bernhard Nocht Institute for Tropical Medicine
Kafsaçk, Björn, Johns Hopkins University
Kats, Lev, Monash University
Korbel, Daniel, London School of Hygiene and Tropical Medicine
Kwok, Lai Yu, University of Geneva
Lavazec, Catherine, Pasteur Institute
Long, Gráinne, University of Edinburgh
Oberholzer, Michael, University of Bern
Okumura, Cheryl, University of California, Los Angeles
Pakpour, Nazzy, University of Pennsylvania
Stephens, Jennifer, The Johns Hopkins School of Medicine
Vincensini, Laetitia, Institut Pasteur

Embryology
June 12 – July 25, 2004

COURSE DIRECTORS
Harland, Richard, University of California, Berkeley
Rothman, Joel, University of California, Santa Barbara

FACULTY
Bronner-Fraser, Marianne, California Institute of Technology
Collazo, Andres, House Ear Institute
Dunaway, Marietta, University of California, Berkeley
Ettensorh, Charles, Carnegie Mellon University
Fraser, Scott, California Institute of Technology
Halpern, Marnie, Carnegie Mellon University
Henry, Jonathan, University of Illinois
Holland, Peter, University of Oxford
Krumlauf, Robb, Stowers Institute for Medical Research
Levine, Michael, University of California, Berkeley
Martindale, Mark, University of Hawaii
Niswander, Lee, Sloan-Kettering Institute
Patel, Nipam, University of California, Berkeley
Rokhsar, Daniel, University of California, Berkeley
Rothenberg, Ellen, California Institute of Technology
Sanchez Alvarado, Alejandro, University of Utah, School of Medicine
Sherwood, David, California Institute of Technology
Telford, Max, University College London
Wessel, Gary, Brown University
Wiedemann, Leanne, Stowers Institute for Medical Research
Wieschaus, Eric, Princeton University
Zeller, Robert, San Diego State University

LECTURERS
Furutani-Seiki, Makoto, Japan Science and Technology Agency
Keller, Ray, University of Virginia
McGinnis, William, University of California, San Diego
Nagy, Lisa, University of Arizona
Pourquie, Olivier, Stowers Institute for Medical Research
Sanes, Joshua, Harvard University
Schupbach, Trudi, Princeton University
Trainor, Paul, Stowers Institute for Medical Research
Yelon, Deborah, Skirball Institute, New York University School of Medicine

S. MERYL ROSE LECTURER
Davidson, Eric, California Institute of Technology

TEACHING ASSISTANTS
Baker, Clare, University of Cambridge
Chang, Chenbei, University of Alabama, Birmingham
Cheeks, Rebecca, University of Oregon
Cooper, Kimberly, Fred Hutchinson Cancer Research Center
Extavour, Cassandra, University of Cambridge
Fletcher, Russell, University of California, Berkeley
Gamse, Joshua, Carnegie Institution of Washington
Glickman, Nathalia, New York University School of Medicine
Gross, Jeffrey, Harvard University
Lee, Jen-Yi, University of North Carolina, Chapel Hill
Macurak, Michelle, Carnegie Institution of Washington
Matus, David, University of Hawaii
Monsoro-Burq, Anne-Helene, University of California, Berkeley
Murata, Patricia, University of Hawaii, Manoa
Nouri, Ali, Princeton University
Pang, Kevin, University of Hawaii
Parchem, Ron, University of California, Berkeley
Sandell, Lisa, Stowers Institute for Medical Research
Seaver, Elaine, University of Hawaii
Wilson, Sara, Columbia University
Wolfe, Adam, University of Illinois, Urbana-Champaign

COURSE ASSISTANTS
Broussard, Christine, University of La Verne
McCluskey, Kathryn, St. Lawrence University
Peralta, Kristina, University of La Verne

STUDENTS
Ahnfelt-Ronne, Jonas, Hagedorn Research Institute
Bastock, Rebecca, Sheffield University
Brauchle, Michael, New York University
Cone, Angela, San Diego State University
D’Aniello, Salvatore, Stazione Zoolologica Anton Dohrn
Doyle, Michelle, University of Colorado Health Science Center
Feigin, Michael, State University of New York, Stony Brook
Fernandez Serra, Montserrat, Stazione Zoolologica Anton Dohrn
Johnson, Aaron, Arizona State University
Kamei, Noriko, University of California, Irvine
Klein, Ophir, University of California, San Francisco
Ma, Leung-Hang, Hong Kong University of Science and Technology
Modrell, Melinda, University of California, Berkeley
Nechiporuk, Alex, University of Washington
Paul, Sarah, Northwestern University
Peyrot, Sara, University of California, Berkeley
Roffers, Juliane, University of Minnesota
Rolo, Ana, University of Virginia
Saudemont, Alexandra, CNRS
Tapanes-Castillo, Alexis, University of Miami School of Medicine
Thomas, Elizabeth, Cold Spring Harbor Laboratory
Wagner, Teresa, University of Washington
Waxman, Josh, University of Washington
Wise, Sarah, University of Colorado at Boulder
Microbial Diversity
June 12 – July 30, 2004

COURSE DIRECTORS
Metcalf, William, University of Illinois
Schmidt, Tom, Michigan State University

FACULTY
Breznak, John, Michigan State University
Garcia, Amaya, Rocky Mountain College
Garcia-Pichel, Ferran, Arizona State University
Whitaker, Rachel, University of California, Berkeley

LECTURERS
Bazylinski, Dennis, Iowa State University
Bryant, Don, Pennsylvania State University
Buckley, Dan, Cornell University
Cavanaugh, Colleen M., Harvard University
DeLong, Ed, Massachusetts Institute of Technology
Harwood, Caroline, University of Iowa
Katz, Laura, Smith College
Kolter, Roberto, Harvard Medical School
Kuenen, J. Gijs, Delft University of Technology
Lewis, Kim, Northeastern University
Lidstrom, Mary, University of Washington
Lovley, Derek, University of Massachusetts
Martin, Mark, Occidental College
Miller, Eric, North Carolina State University
Reznikoff, William, University of Wisconsin
Woese, Carl, University of Illinois
Wolfe, Ralph, University of Illinois

TEACHING ASSISTANT
Warnecke, Falk, Max Planck Institute for Marine Microbiology

COURSE COORDINATOR
Lewis, Wynne, Michigan State University

STUDENTS
Blazejak, Anna, Max Planck Institute for Marine Microbiology
Bonilla-Findji, Osana, Laboratoire d’Oceanographie de Villefrance, Station Zoologique
Conover, Adele, Freelance Journalist
Dalmacio, Leslie, University of the Philippines
Ekstrom, Eileen, Princeton University
Gontang, Erin, University of California, San Diego
Huang, Jean, California Institute of Technology
Hunt, Dana, Massachusetts Institute of Technology
Lennon, Jay, Dartmouth College
Luna, Gian Marco, Polytechnic University of Marche
Milerstedt, Kim, University of Illinois at Urbana-Champaign
O’Mullan, Gregory, Princeton University
Oberg, Craig, Weber State University
Powers, Jennifer, State University of New York, Stony Brook
Reed, Heather, University of Colorado at Boulder
Roelseers, Guus, Delft University of Technology
Santibáñez Bustos, Juan, Universidad de Concepcion
Simmons, Sheri, Woods Hole Oceanographic Institution
Smith, Eric, University of Washington
Walsh, David, Dalhousie University
Wier, Andrew, University of Wisconsin, Milwaukee

Neural Systems & Behavior
June 12 – August 7, 2004

COURSE DIRECTORS
Carr, Catherine, University of Maryland
Levine, Richard, University of Arizona

FACULTY
Calabrese, Ronald, Emory University
Chitwood, Raymond, Baylor College of Medicine
Davis, Graeme, University of California, San Francisco
Ewer, John, Cornell University
French, Kathy, University of California, San Diego
Glanzman, David, University of California, Los Angeles
Golowasch, Jorge, New Jersey Institute of Technology
Keith, Julian, University of North Carolina at Wilmington
Knierim, James, University of Texas, Medical School at Houston
Kristan, William, University of California, San Diego
Markham, Michael, Florida International University
McAnelly, Lynne, University of Texas
Nadim, Farzan, Rutgers University
Philpot, Ben, University of North Carolina
Prusky, Glen, University of Lethbridge
Reyes, Alex, New York University
Sillar, Keith, University of St. Andrews
Simon, Jonathan, University of Maryland
Stein, Wolfgang, Universitaet Ulm
Szczupak, Lidia, Universidad de Buenos Aires
Weeks, Janis, University of Oregon
Wennig-Erkleben, Angela, Emory University
Wilson, Richard, University of Calgary
Wood, Debra, Case Western Reserve University
Zakon, Harold, University of Texas, Austin

LECTURERS
Eisthen, Heather, Michigan State University
Friedrich, Rainer, Max Planck Institute for Medical Research
Hildebrand, John, University of Arizona
Marder, Eve, Brandeis University
Murphey, Rod, University of Massachusetts
Taylor, Adam, Brandeis University
Trussell, Larry, Oregon Health & Science University

TEACHING ASSISTANTS
Albin, Stephanie, University of California, San Francisco
Bregman, Kevin, University of California, San Diego
Buch, Dirk, Brandeis University
Chen, Shaping, House Ear Institute
Crozier, Robert, Massachusetts Institute of Technology
Neurobiology
June 6 – August 7, 2004

COURSE DIRECTORS
McCleskey, Edwin, Oregon Health and Science University
Nishi, Rae, University of Vermont

SECTION DIRECTOR
Vogel, Steven, National Institutes of Health

FACULTY
Avery, Leon, University of Texas, Southwestern Medical Center
Balice-Gordon, Rita, University of Pennsylvania, School of Medicine
Bergles, Dwight, Johns Hopkins University
Blank, Paul, National Institutes of Health
Commons, Kathryn, Pennsylvania Children's Hospital of Philadelphia
Fieber, Lynne, University of Miami
Khodakhah, Kamran, Albert Einstein College of Medicine
Kuner, Thomas, Max-Planck-Institute for Medical Research
Lambert, Nevin, Medical College of Georgia
Lichtman, Jeff, Washington University
Maue, Robert, Dartmouth Medical School
Noebels, Jeffrey, Baylor College of Medicine
Pereda, Alberto, Albert Einstein College of Medicine
Saugstad, Julie, Legacy Research
Smith, Corey, Case Western Reserve University
Smith-Maxwell, Catherine, Axon Instruments, Inc.
Svoboda, Karel, Cold Spring Harbor Laboratory
Tanouye, Mark, University of California, Berkeley
Terasaki, Mark, University of Connecticut, Health Center
Yau, King-Wai, Johns Hopkins School of Medicine
Zenisek, David, Yale University

LECTURERS
Armstrong, Clay, University of Pennsylvania
Augustine, George, Duke University Medical Center
Bezanilla, Francisco, University of California, Los Angeles
Blatz, Andrew, Axon Instruments, Inc.
Campagnola, Paul, University of Connecticut, Health Center
Chalfie, Martin, Columbia University
Charlton, Milton, University of Toronto
D'Arcangelo, Gabriella, Baylor College of Medicine
Darnell, Robert, The Rockefeller University
DeWeer, Paul, University of Pennsylvania
Dickinson, Mary, California Institute of Technology
Ellis-Davies, Graham, Drexel University
Fischbach, Gerald, Columbia University
Gadbury, David, The Rockefeller University
Garcia, Maria, Merck Research Laboratories
Glowatzki, Elisabeth, The Johns Hopkins School of Medicine
Goldstein, Lawrence, University of California, San Diego, and HHMI
Halpern, Marnie, Carnegie Mellon University
Heidelberger, Ruth, The University of Texas Medical School at Houston
Hopkins, Nancy, Massachusetts Institute of Technology
Jay, Daniel, Tufts University School of Medicine
Jorgensen, Erik, University of Utah
Kramer, Richard, University of California, Berkeley
Kravitz, Edward, Harvard Medical School
Madison, Daniel, Stanford University School of Medicine
Meisler, Miriam, University of Michigan
Meredith, Andrea, Stanford University School of Medicine
Price, Donald, Johns Hopkins School of Medicine
Ramawami, Mani, University of Arizona
Reese, Thomas, National Institutes of Health
Regehr, Wade, Harvard Medical School
Selkoe, Dennis, Harvard Medical School
So, Peter, Massachusetts Institute of Technology
Spiro, John, Nature Publishing Group
Tsien, Roger, University of California, San Diego
Weinberg, Richard, University of North Carolina
Yellen, Gary, Harvard Medical School

TEACHING ASSISTANTS
Alvina, Karina, Albert Einstein College of Medicine
Boegle, Aimee, Dartmouth Medical School
Cachope, Roger, Albert Einstein College of Medicine
Clark, Michael, Medical College of Georgia
Cushman, Kenneth, Oregon Health and Science University
Digby, Gregory, Medical College of Georgia
Dussor, Greg, Ohio State University
Gibbs, Sarah, University of Pennsylvania, School of Medicine
Hekmat-Scafe, Daria, University of California, Berkeley
Hendricks, Susan, University of Vermont
Hess, Sam, National Institutes of Health
Hruska, Martin, University of Vermont
Irons, Hillary, Georgia Tech/Medical College of Georgia
Panzar, Jessica, University of Pennsylvania, School of Medicine
Porter, Donna, Dartmouth Medical School
Prescott, Elizabeth, Yale University
You, Young-jai, University of Texas, Southwestern Medical Center

COURSE ASSISTANTS
Brush, James, Middlebury College
Ene, Smaranda, Middlebury College

STUDENTS
Balu, Ramani, Case Western Reserve University
Bright, Rachel, Stanford University School of Medicine
Cheng, Ning, The Johns Hopkins School of Medicine
Corbo, Joseph, Harvard Medical School/Brigham and Women’s Hospital
Davis, Denise, Yale University School of Medicine
Doan, Thuy, University of Washington
Dominguez, Reynaldo, University of Southern California
Glykys, Joseph, University of California, Los Angeles
Lin, John, University of Auckland
Merlo, Emiliano, Ciudad Universitaria
Sann, Sharon, University of California, San Diego
Wienisch, Martin, Max Planck Institute for Biophysical Chemistry

Physiology: Modern Cell Biology Using Microscopic, Biochemical and Computational Approaches
June 12 – July 24, 2004

COURSE DIRECTORS
Mitchison, Tim, Harvard Medical School
Vale, Ronald, University of California, San Francisco/HHMI

FACULTY
Bray, Dennis, University of Cambridge
Heald, Rebecca, University of California, Berkeley
Hunt, Tim, Cancer Research UK
Khan, Shahid, Molecular Biology Consortium, Chicago
Li, Rong, Harvard Medical School
Mahadevan, Lakshminarayan, Harvard University
Meyer, Tobias, Stanford University
Mullins, Dyche, University of California, San Francisco, Medical School
Murray, Andrew, Harvard University
Nedelec, Francois, European Molecular Biology Laboratory
O’Shea, Erin, University of California, San Francisco/HHMI
van Oudenaarden, Alexander, Massachusetts Institute of Technology
Stuurman, Nico, University of California, San Francisco
Waterman, Clare, The Scripps Research Institute

LECTURERS
Ferrell, James, Stanford University
Gorbsky, Gary, Oklahoma Medical Research Foundation
Groves, Jay, University of California, Berkeley
Hahn, Klaus, The Scripps Research Institute
Kirschner, Marc, Harvard Medical School
Pollard, Thomas, Yale University
Taylor, Ed, Northeastern University
Theriot, Julie, Stanford University School of Medicine
Waters Shuler, Jennifer, Harvard Medical School
Xie, Sunney, Harvard University
Yaffe, Michael, Massachusetts Institute of Technology

IRVIN EISENBURG LECTURER
Murray, Andrew W., Harvard University

GERTRUDE FORKOSH WAXLER LECTURER
Raff, Martin, Medical Research Council Laboratory of Molecular Biology

ARTHUR K. PARPART LECTURER
Hunt, Tim, Cancer Research UK

TERU HAYASHI LECTURER
Hyman, Tony, Max Planck Institute of Molecular Cell Biology and Genetics

TEACHING ASSISTANTS
Akin, Orkun, University of California, San Francisco
Goshima, Gohta, University of California, San Francisco
Groen, Aaron, Harvard Medical School
SPECIAL TOPICS COURSES

Advances in Genome Technology & Bioinformatics
October 5 – November 3, 2004

COURSE DIRECTORS
Fraser, Claire, The Institute for Genomic Research
Jaffe, David, Broad Institute - Massachusetts Institute of Technology
Sogin, Mitchell L., Marine Biological Laboratory

FACULTY
Bertonati, Claudia, Columbia University
Feldblyum, Tamara, The Institute for Genomic Research
Hoffman, Eric, Children’s National Medical Center
Keeling, Patrick, University of British Columbia
Lee, Norman, The Institute for Genomic Research
McArthur, Andrew, Marine Biological Laboratory
Morrison, Hilary, Marine Biological Laboratory
Nieman, William, The Institute for Genomic Research
Olsen, Gary, University of Illinois
Pearson, William, University of Virginia
Pop, Mihai, The Institute for Genomic Research
Quackenbush, John, The Institute for Genomic Research
Salzberg, Steven, The Institute for Genomic Research
Tettelin, Herve, The Institute for Genomic Research
Tolonen, Andrew, Massachusetts Institute of Technology
White, Owen, The Institute for Genomic Research

LECTURERS
Churchill, Gary, The Jackson Laboratory
Gentleman, Robert, Dana-Farber Cancer Institute
Gill, Steven, The Institute for Genomic Research
Kirkness, Ewen, The Institute for Genomic Research
Majoros, William, The Institute for Genomic Research
Pickett, Siobhan, Molecular Devices
Punta, Marco, Columbia University

TEACHING ASSISTANTS
Andersson, Tove, The Institute for Genomic Research
Bhagabati, Nirmal, The Institute for Genomic Research
Birkeland, Shanda, Marine Biological Laboratory
Cipriano, Michael, Marine Biological Laboratory
Davidsen, Tanja, The Institute for Genomic Research
Fox, Richard, Marine Biological Laboratory
Gill, John, Venter Institute
Graham, Leslie, Marine Biological Laboratory
Hammar, Kasia, Marine Biological Laboratory
Liang, Wei, The Institute for Genomic Research
Olsson, Bertil, Marine Biological Laboratory
Rubio, Renee, The Institute for Genomic Research
Saeed, Alexander, The Institute for Genomic Research
Sharov, Vasily, The Institute for Genomic Research
Tallon, Luke, The Institute for Genomic Research
White, Joseph, The Institute for Genomic Research
STUDENTS
Adkins, Scott, USDA-ARS-USHRL
Aguilera, Angeles, Centro de Astrobiologia
Aley, Stephen, University of Texas at El Paso
Anderson, Sedrick, Meharry Medical College
Biermann, Christiane, Portland State University
Cheung, Wang-Kit, University of Hawaii Cancer Research Center
Chu, Shenghui, Eastern Michigan University
de Miguel, Natalia, Instituto Tecnologico Chascomus (INTECH)
Djimde, Abdoulaye, University of Bamako
Escobar, Viviana, Instituto de Biotecnologia, UNAM
Etchebarne, Brett, Michigan State University
Hullar, Meredith, University of Washington
Isokpehi, Raphael, Jackson State University
Li, Sheng, Illinois State University
Pommier, Thomas, Kalmar University
Summers, Anne, University of Georgia
Thompson, Dawn, Harvard University
Weigt, Lee, Smithsonian Institution, National Museum
Whistler, Cheryl, University of New Hampshire

Analytical and Quantitative Light Microscopy
May 6 – May 14, 2004

COURSE DIRECTORS
Sluder, Greenfield, University of Massachusetts Medical School
Wolf, David, Sensor Technologies

FACULTY
Axelrod, Daniel, University of Michigan
Cardullo, Richard, University of California, Riverside
Heintzmann, Rainer, Max Planck Institute for Biophysical Chemistry
Hinchcliffe, Edward, University of Notre Dame
Inoue, Shinya, Marine Biological Laboratory
Murray, John, University of Pennsylvania
Salmon, Edward, University of North Carolina, Chapel Hill
Silver, Randi, Weill Medical College, Cornell University
Spring, Kenneth
Swedlow, Jason, University of Dundee
Tran, Phong, University of Pennsylvania

LECTURERS
Bowser, Samuel, Wadsworth Center
Keller, H. Ernst, Retired from Carl Zeiss
Oldenbourg, Rudolf, Marine Biological Laboratory
Straight, Aaron, Stanford University School of Medicine

TEACHING ASSISTANTS
English, Christopher, University of Massachusetts Medical School
Uetake, Yumi, University of Massachusetts Medical School

COURSE COORDINATOR
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STUDENTS
Adams, Dany, The Forsyth Institute
Bicek, Andrew, University of Minnesota
Brisch, Ellen, Minnesota State University Moorhead
Carricaburu, Valerie, Boston Biomedical Research Institute
Escuin, Daniel, Emory University
Galanopoulou, Aristea, Albert Einstein College of Medicine
Heetderks, Julia, Pennsylvania State University
Jowsey, Ian, University of Dundee
Kagawa, Yuki, Marine Biological Laboratory
Kline, Erik, Emory University
Kruchtien, Anne, Mayo Clinic School of Medicine
Kumar, Ashish, University of California, Santa Barbara
Kyoung, Minjoung, Pennsylvania State University
Lacayo, Catherine, Stanford University
Liu, ChaoTuan, University of California, Los Angeles
Marcus, Adam, Emory University
Masek, Katherine, University of Pennsylvania
Michie, Sara, Stanford University
Nagarajan, Naveen, Massachusetts Institute of Technology
Novak, Ivana, Karolinska Institutet
Peretti, Diego, Weill Medical College, Cornell University
Peterman, Kaye, Wellesley College
Rabino, Claudia, Millennium Pharmaceuticals, Inc.
Reid, Alicia, Weill Graduate School, Cornell University
Sanders, Lori, University of Illinois at Urbana-Champaign
Seo, Hee-Chan, University of Bergen
Shieh, Ru-Chi, Institute of Biomedical Sciences
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Frontiers in Reproduction
May 16 – June 27, 2004

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Yao, Humphrey, University of Illinois
Ying, Ying, Women and Infants' Hospital of Rhode Island

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Medical Informatics: Spring Session
May 30 – June 6, 2004

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Remsen, David, Marine Biological Laboratory
Stout, Amy, Marine Biological Laboratory
Uhlinger, Eleanor, Marine Biological Laboratory

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Reddy, Chanda, Indian Health Service
Rhodes, Catherine, University of North Texas Health Science
Richart, Robert, Madigan Army Medical Center
Rockstraw, Leland, Drexel University
Shah, Jayesh, San Mateo Medical Center
Smith, Lisa, University North Texas Health Science Center
Stone, David, VISICU
Tirmizi, Syed, Department of Veterans Affairs
Zender, Paul, University of Cincinnati

Medical Informatics: Fall Session
September 26 – October 3, 2004

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Shortliffe, Edward, Columbia University
Starren, Justin, Columbia University
Stead, William, Vanderbilt University
Stout, Amy, Marine Biological Laboratory
Uhlinger, Eleanor, Marine Biological Laboratory

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Chakravorty, Bonnie, Tufts University
Clark, Nancy, VA North Texas Health Care System
Creasey, Graham, Case Western Reserve University
Crossette, Jonathan, The Children’s Hospital of Philadelphia
Dahlman, Sandra, Spectrum Health Sciences Library
DuPont, Ginny, Department of Veterans Affairs
Feria, Rommel, University of the Philippines
Fussell, Eugene, CHW St. Johns Regional Medical Center
Goldman, Larry, University of Chicago
Guo, Ruiling, Idaho State Health Sciences Library
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Kraev, Igor, Ellis Hospital
Kreit, Leah, Houston Academy of Medicine-Texas Medical Center
Lauffer, Brian, Alaska Department of Veteran Affairs
Madigan, Elizabeth, Case Western Reserve University
Murphy, Robert, Norton Healthcare
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Porter, Charles, University of Kansas Hospital
Porter, Kathy, University of South Alabama
Rana, Gurpreet, University of Michigan
Rosenblatt, Ellen, Partners HealthCare System
Sellers, Norma, Stimson Library, U.S. Army Medical Department
Snell, Alan, St. Joseph Regional Medical Center
Snelling, Charlene, Chicago State University
Torsher, Laurence, Mayo Clinic College of Medicine
Van Moorsel, Timothy, Stony Brook University - Health Sciences
Wilkerson, Myra, Geisinger Medical Center
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Methods in Computational Neuroscience
August 1 – August 29, 2004

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Kunec, Steve, Boston University
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Solla, Sara, Northwestern University
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Suter, Kelly, Emory University
Trana, Rachel, Northwestern University
Turaga, Srinivas, Massachusetts Institute of Technology
Winograd, Milena, Universidad Miguel Hernandez
Yang, Zhongshu, University of Connecticut

Molecular Biology of Aging
August 2 – August 21, 2004

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Ruvkun, Gary, Massachusetts General Hospital

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Pletcher, Scott, Baylor College of Medicine
Rossianni, Anja, Normandale Community College
Samuelson, Andrew, Massachusetts General Hospital
Siwe, Jessica, University of Texas Health Science Center at San Antonio
Molecular Mycology: Current Approaches to Fungal Pathogenesis
August 5 – August 22, 2004

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Mitchell, Aaron, Columbia University

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Silver, Peter, Seattle Biomedical Research Institute

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Cocheme, Helena, University of Cambridge
Curran, Sean, University of California, Los Angeles
Ding, Quxing, University of Kentucky

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Armstrong-James, Darius, Imperial College London
Bambach, Adrienne, Georgetown University
Campbell, Leona, University of Sydney
Cramer Jr., Robert, Colorado State University
Diezmann, Stephanie, Duke University Medical Center
Galuska, Stefan, Merck Research Laboratories
Liu, Yajuan, University of Washington
Magill, Shelley, The Johns Hopkins School of Medicine
Martin, Charles, Rutgers University
Olson, Gillian, Tulane University Medical Center
Palmer, Glen, Louisiana State University Health Science Center
Reedy, Jennifer, Duke University
Robertson, Emma, University of Southern Denmark
Rutherford, Julian, University of Utah
Shea, John, Medical University of South Carolina
Strijbis, Karin, University of Amsterdam
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Xu, Jinling, Massachusetts General Hospital

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Tower, John, University of Southern California
Weindruch, Richard, University of Wisconsin
Wolkow, Catherine, National Institute on Aging/NIH

COURSE COORDINATOR
Podlutsky, Andrej, University of Texas Health Science Center at San Antonio

STUDENTS
Carvalho, Gil, California Institute of Technology
Chen, Howard, Boston College
Cocheme, Helena, University of Cambridge
Curran, Sean, University of California, Los Angeles
Ding, Quxing, University of Kentucky

STUDENTS
Armstrong-James, Darius, Imperial College London
Bambach, Adrienne, Georgetown University
Campbell, Leona, University of Sydney
Cramer Jr., Robert, Colorado State University
Diezmann, Stephanie, Duke University Medical Center
Galuska, Stefan, Merck Research Laboratories
Liu, Yajuan, University of Washington
Magill, Shelley, The Johns Hopkins School of Medicine
Martin, Charles, Rutgers University
Olson, Gillian, Tulane University Medical Center
Palmer, Glen, Louisiana State University Health Science Center
Reedy, Jennifer, Duke University
Robertson, Emma, University of Southern Denmark
Rutherford, Julian, University of Utah
Shea, John, Medical University of South Carolina
Strijbis, Karin, University of Amsterdam
Tarcha, Eric, Medical College of Ohio
Tournu, Helene, Flanders Interuniversity Institute for Biotechnology
Neural Development and Genetics of Zebrafish  
August 15 – August 28, 2004

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Schneider, Valerie, University of Pennsylvania  
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Neuroinformatics  
August 14 – August 29, 2004

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Victor, Jonathan, Weill Medical College, Cornell University

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Arceci, Robert, The Johns Hopkins University  
Aula, Nina, Folkhalsan Institute of Genetics  
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Noche, Ramil, Case Western Reserve University  
Owens, Kelly, University of Washington  
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Saar, Sigal, Technion-Israel Institute of Technology
Smock, Chelsea, Boston University
Srinivasan, Lakshminarayan, Massachusetts Institute of Technology
Vinje, William, National Institutes of Health
Wang, Ping, The Salk Institute
Yeung, Luk Chong, Brown University

Optical Microscopy and Imaging in the Biomedical Sciences
October 5 – October 14, 2004

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Murray, John, University of Pennsylvania
Oldenbour, Rudolf, Marine Biological Laboratory
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Sigurdson, Wade, SUNY, Buffalo

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Coyle, Brad, University of Miami School of Medicine
Damijanovic, Vesna, University of North Carolina, Chapel Hill
Duley, Matthew, Miami University
ElSibai, Mirvat, Albert Einstein College of Medicine
Entenberg, David, Memorial Sloan-Kettering Cancer Center
Gudme, Charlotte, Memorial Sloan-Kettering Cancer Center
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Selph, Catherine, Oregon Health & Science University
Severson, Tonya, Platypus Technologies
Weil, Timothy, Princeton University
Young, Kevin, Ottawa Health Research Institute
Zamora, Debra, University of Texas at San Antonio

Fundamental Issues in Vision Research
August 8 – August 21, 2004

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Papermaster, David, University of Connecticut, Health Center

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Beebe, David, Washington University
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Gehring, Walter, Biozentrum, University of Basel
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Horwitz, Joseph, University of California, Los Angeles
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LaVail, Jennifer, University of California, San Francisco
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Linden, Michael, Mount Sinai School of Medicine
Masland, Richard, Harvard Medical School
Mircheff, Austin, Keck School of Medicine, University of Southern California
Moritz, Orson, University of British Columbia
Rada, Jody, University of Oklahoma
Robinson, Michael, Columbus Children’s Research Institute
Stepp, Mary Ann, The George Washington University
Medical Center
Strettoi, Enrica, Italian National Research Council (CNR)
Tam, Beatrice, University of British Columbia

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Arshavsky, Vadim, Harvard Medical School
Barlow, Robert, Upstate Medical University
Green, Carla, University of Virginia
Hunter, Chyren, National Eye Institute
John, Simon, The Jackson Laboratory
Moses, Marsha, Harvard Medical School/Children’s Hospital
Niederkorn, Jerry, University of Texas Southwestern Medical Center
Raviola, Elio, Harvard Medical School
Schwartz, Michal, Weizmann Institute of Science
Sugrue, Stephen, University of Florida, College of Medicine
Wasson, Paul, Massachusetts Eye & Ear Infirmary
Wiggs, Janey, Harvard Medical School

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STUDENTS
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Baker, Sheila, Massachusetts Eye and Ear Infirmary
Benezra, Miriam, Mount Sinai School of Medicine
Bosco, Alejandra, Albert Einstein College of Medicine
Calamusa, Martina, Italian National Research Council
Cerveny, Kara, Johns Hopkins University
Cheng, Catherine, University of California, Berkeley
Conley, Shannon, University of Arizona
Cook, Tiffany, New York University
Curtiss, Jennifer, Mt. Sinai School of Medicine
Eggers, Erika, Washington University
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Gould, Douglass, The Jackson Laboratory
Gross, Alecia, Baylor College of Medicine
Hoang, Quan, University of Illinois at Chicago
Kummer, Terrance, Washington University School of Medicine
Panda, Satchidananda, Genomics Institute of the Novartis Research Foundation
Ross, James, University of California, Davis
Rutenberg, Michael, University of Florida
Tieg, Gilad, Technion-Israel Institute of Technology
Wenger, Kristin, Washington University School of Medicine
Wu, Kaijin, University of Southern California

Summer Program in Neuroscience, Ethics, and Survival (SPIINES)
June 19 – July 17, 2004

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Townsel, James, Meharry Medical College

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Barea-Rodriguez, Edwin, University of Texas, San Antonio
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Jones, James, American Psychological Association
LeBaron, Richard, University of Texas, San Antonio
Pate, William, American Psychological Association
Thompson, Kenira, University of Texas, San Antonio
Trujillo, Keith, California State University San Marcos
Valdez, Avelardo, University of Houston
Yakel, Jerrel, NIEHS/National Institutes of Health
Zottoli, Steven, Williams College

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Augustine, George, Duke University Medical Center
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Hernandez, Ruben, University of Texas, San Antonio
Jarvis, Erich, Duke University Medical Center
Johnston, Daniel, University of Texas, Austin
Kravitz, Edward, Harvard Medical School
Langford, George, Dartmouth College
Mensingr, Allen, University of Minnesota
Molina, Patricia, Louisiana State University Health Sciences Center
Zakon, Harold, University of Texas, Austin

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Ricoy, Ulises, University of Texas, San Antonio

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Baker, Melinda, Princeton University
Boone, Ericka, Emory University
Cornejo, Brandon, University of Colorado Health Sciences Center
Fountain, Maurice, Morgan State University
Garcia, Angelo, Mount Sinai School of Medicine
Goyazu, Pilar, Universidad Nacional Autonoma de Mexico
Jackson, Tamara, Emory University
Khoboko, Thabelo, University of Cape Town
Lauriat, Tara, Mount Sinai Medical School
Liu, Chao-Tuan, University of California, Los Angeles
Mercado, Jose, University of Wisconsin, Madison
Merino, Stephen, University of Michigan
Richardson, Kimberlei, The Johns Hopkins Hospital
Salinas, Felipe, University of Texas Health Science Center
Stewart, Richard, JD Gladstone Institute of Neurological Disease
Thompson, Analisa, Meharry Medical College
Vidal, Ivan, Ponce School of Medicine
Winbush, Ari, University of Oregon
Winchester, Jeanna, Florida Atlantic University

Workshop on Molecular Evolution
July 25 – August 6, 2004

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Edwards, Scott, Harvard University
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Felsenstein, Joseph, University of Washington
Fraser, Claire, The Institute for Genomic Research
Kuhner, Mary, University of Washington
Lewis, Paul, University of Connecticut
Meyer, Axel, University of Konstanz
Miyamoto, Michael, University of Florida
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Johns Hopkins Bayview Medical Center
Johns Hopkins University, The
Johns Hopkins Hospital, The
Johns Hopkins School of Medicine, The

Kalmar University
Kansas, University of, Medical Center
Karolinska Institutet
Kentucky, University of
Kitasato University
Konstanz, University of
Kyoto University

Laboratoire d’Oceanographie de Villefranche, Station Zoologique
Lethbridge, University of
London School of Hygiene and Tropical Medicine
Louisiana State University Health Science Center

Madigan Army Medical Center
Maine, University of
Marine Biological Laboratory
Marquette General Health System/Michigan State University
Maryland, University of
Massachusetts Eye and Ear Infirmary
Massachusetts Institute of Technology
Mathematical Biosciences Institute
Max Planck Institute for Chemical Ecology
Max Planck Institute for Marine Microbiology
Max Planck Institute for Biophysical Chemistry
Mayo Clinic College of Medicine
McGill University
Medical College of Ohio
Medical University of Innsbruck

Medical University of South Carolina
Meharry Medical College
Memorial Health University Medical Center
Memorial Sloan-Kettering Cancer Center
Merck Research Laboratories
Miami University
Miami, University of, School of Medicine
Michigan State University
Michigan, University of
Millennium Pharmaceuticals, Inc.
Minnesota State University Moorhead
Minnesota, University of
Missouri, University of, St. Louis
Monash University
Montana State University
Montreal, University of
Morgan State University
Mount Sinai School of Medicine
Mt. Desert Island Biological Laboratory

National Autonomous University of Mexico
National Institutes of Health
National Research Council
National University of Cordoba
Nevada, University of, School of Medicine
New Hampshire, University of
New Jersey, University of Medicine and Dentistry of
New Mexico State University
New York Medical College
New York University
New York University School of Medicine
New York, State University of, Downstate Medical Center
New York, State University of, Stony Brook
NH-Dartmouth Family Practice Residency Program
Nijmegen, University of, NCMLS
North Carolina, University of, Chapel Hill
North Texas Health Science Center, University of
North Texas, University of, Health Science
Northwestern University
Northwestern University Medical School
Norton Healthcare

Ohio State University
Oregon Health & Science University
Oregon, University of
Oslo, University of
Ottawa Health Research Institute
Ottawa, University of

Padova, University of
Partners HealthCare System
Pennsylvania State University
Pennsylvania, University of
Philippines, University of, The
Pittsburgh, University of
Platypus Technologies
Polytechnic University of Marche
### INSTITUTIONS REPRESENTED (faculty)

- Aberdeen, University of
- Alabama, University of, Birmingham
- Albert Einstein College of Medicine
- American Psychological Association
- Arizona State University
- Arizona, University of
- Australian National University
- Axon Instruments, Inc.
- Babraham Institute, The
- Baylor College of Medicine
- Bern, University of
- Biozentrum, University of Basel
- Boston College
- Boston IVF
- Boston University
- Brandeis University
- British Columbia, University of
- Broad Institute - Massachusetts Institute of Technology
- Brown University
- Buenos Aires, University of
- California, University of
- California, University of, Berkeley
- California, University of, Davis
- California, University of, Davis Health System
- California, University of, Irvine
- California, University of, Los Angeles
- California, University of, Riverside
- California, University of, San Diego
- California, University of, San Francisco
- California, University of, San Francisco, Medical School
- California, University of, Santa Barbara
- Cambridge, University of
- Cancer Research UK
- Canterbury, University of
- Carnegie Institution of Washington
- Carnegie Mellon University
- Case Western Reserve University
- Chicago, University of
- Children's Hospital Research Foundation
- Children's National Medical Center
- Cincinnati Children's Hospital Research
- Cincinnati, University of
- Cold Spring Harbor Laboratory
- Colorado, University of
- Columbia University
- Columbus Children's Research Institute
- Connecticut, University of
- Connecticut, University of, Health Center
- Cornell University
- Dalhousie University
- Dana-Farber Cancer Institute
- Dartmouth College
- Dartmouth Medical School
- Delft University of Technology
- Drexel University
- Duke University
- Duke University Medical Center
- Dundee, University of
- Edinburgh, University of
- Emory University
- European Molecular Biology Laboratory
- Florida Institute of Technology
- Florida International University
- Florida State University
- Florida, University of
- Florida, University of, College of Medicine
- Fred Hutchinson Cancer Research Center
- Frontiers Fund
- Fundação Oswaldo Cruz
- George Washington University Medical Center
- Georgetown University Medical Center
- Georgia Tech/Medical College of Georgia
- Georgia, University of
- Glasgow, University of
- Hannover, University of
- Harbor-UCLA Medical Center
- Harvard Medical School
- Harvard Medical School/Children's Hospital
- Harvard University
- Hawaii, University of
- Hawaii, University of, Manoa
- Hebrew University of Jerusalem
- House Ear Institute
- Houston, University of
- INSTITUTIONS REPRESENTED (faculty)

- Aberdeen, University of
- Alabama, University of, Birmingham
- Albert Einstein College of Medicine
- American Psychological Association
- Arizona State University
- Arizona, University of
- Australian National University
- Axon Instruments, Inc.
- Babraham Institute, The
- Baylor College of Medicine
- Bern, University of
- Biozentrum, University of Basel
- Boston College
- Boston IVF
- Boston University
- Brandeis University
- British Columbia, University of
- Broad Institute - Massachusetts Institute of Technology
- Brown University
- Buenos Aires, University of
- California, University of
- California, University of, Berkeley
- California, University of, Davis
- California, University of, Davis Health System
- California, University of, Irvine
- California, University of, Los Angeles
- California, University of, Riverside
- California, University of, San Diego
- California, University of, San Francisco
- California, University of, San Francisco, Medical School
- California, University of, Santa Barbara
- Cambridge, University of
- Cancer Research UK
- Canterbury, University of
- Carnegie Institution of Washington
- Carnegie Mellon University
- Case Western Reserve University
- Chicago, University of
- Children's Hospital Research Foundation
- Children's National Medical Center
- Cincinnati Children's Hospital Research
- Cincinnati, University of
- Cold Spring Harbor Laboratory
- Colorado, University of
- Columbia University
- Columbus Children's Research Institute
- Connecticut, University of
- Connecticut, University of, Health Center
- Cornell University
- Dalhousie University
- Dana-Farber Cancer Institute
- Dartmouth College
- Dartmouth Medical School
- Delft University of Technology
- Drexel University
- Duke University
- Duke University Medical Center
- Dundee, University of
- Edinburgh, University of
- Emory University
- European Molecular Biology Laboratory
- Florida Institute of Technology
- Florida International University
- Florida State University
- Florida, University of
- Florida, University of, College of Medicine
- Fred Hutchinson Cancer Research Center
- Frontiers Fund
- Fundação Oswaldo Cruz
- George Washington University Medical Center
- Georgetown University Medical Center
- Georgia Tech/Medical College of Georgia
- Georgia, University of
- Glasgow, University of
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- Harbor-UCLA Medical Center
- Harvard Medical School
- Harvard Medical School/Children's Hospital
- Harvard University
- Hawaii, University of
- Hawaii, University of, Manoa
- Hebrew University of Jerusalem
- House Ear Institute
- Houston, University of

### COUNTRIES REPRESENTED (faculty)

- Argentina
- Australia
- Brazil
- Canada
- Chile
- China
- Colombia
- England
- France
- Germany
- India
- Indonesia
- Israel
- Italy
- Japan
- Mexico
- Netherlands, The
- New Zealand
- People's Republic of China
- Portugal
- Republic of Korea
- Romania
- Russia
- South Korea
- Spain
- Sweden
- Switzerland
- Taiwan
- Turkey
- United Kingdom
- USA
Idaho, University of
Illinois, University of
Illinois, University of, Chicago
Illinois, University of, Urbana-Champaign
Indiana University, Bloomington
Institut Pasteur
Iowa State University
Iowa, University of
Italian National Research Council (CNR)

Jackson Laboratory, The
Japan Science and Technology Agency
Johns Hopkins School of Medicine, The
Johns Hopkins University, The

Kansas University Medical Center
Keck School of Medicine, University of Southern California
Kentucky, University of
King’s College London

La Verne, University of
Lawrence Berkeley National Laboratory
Legacy Research
Leiden University Medical Center
Lethbridge, University of
London School of Hygiene and Tropical Medicine
Los Angeles Biomedical Research Institute at Harbor-UCLA
Louisiana State University
Louisiana State University Health Sciences Center

Manchester, University of
Marine Biological Laboratory
Maryland, University of
Massachusetts Eye & Ear Infirmary
Massachusetts General Hospital
Massachusetts Institute of Technology
Massachusetts, University of
Massachusetts, University of, Medical School
Massachusetts, University of, Worcester
Max Planck Institute for Biological Cybernetics
Max Planck Institute for Biophysical Chemistry
Max Planck Institute for Marine Microbiology
Max Planck Institute for Medical Research
Max Planck Institute for Molecular Cell Biology and Genetics
Medical College of Georgia
Medical College of Ohio
Medical College of Wisconsin
Medical Research Council
Meharry Medical College
Melbourne, University of
Merck Research Laboratories
Miami, University of
Michigan State University
Microbia Inc.

Middlebury College
Minnesota, University of
Missouri, University of, Columbia
Molecular Biology Consortium, Chicago
Molecular Devices
Monell Chemical Senses Center
Montana State University
Montana, University of
Morehouse School of Medicine
Mount Sinai School of Medicine
MRC Laboratory of Molecular Biology

National Eye Institute
National Institute of Environmental Health Sciences/NIH
National Institute of Mental Health/NIH
National Institute of Neurological Disorders and Strokes/NIH
National Institute on Aging/NIH
National Institutes of Health
National Library of Medicine
National University of Cordoba
Nature Publishing Group
Naval Medical Research Center
Neuralynx, Inc.
New Hampshire, University of
New Jersey Institute of Technology
New York, State University of, Albany
New York, State University of, Buffalo
New York, State University of, Stony Brook
New York University
New York University School of Medicine
New York, City College of
New York, State University of
Normandale Community College
North Carolina State University
North Carolina, University of
North Carolina, University of, Wilmington
North Carolina, University of, Chapel Hill
Northeastern University
Northwestern University
Notre Dame, University of
Occidental College
Ohio State University
Oklahoma Medical Research Foundation
Oklahoma, University of
Oregon Health & Science University
Oxford, University of

Pennsylvania Children’s Hospital of Philadelphia
Pennsylvania State University
Pennsylvania, University of
Pennsylvania, University of, School of Medicine
Pittsburgh, University of
Population Council
Princeton University
Queens University
Rochester, University of
Rockefeller University, The
Rocky Mountain College
Rutgers University
Rutgers University, School of Pharmacy
Saint Louis University
Salk Institute, The
San Diego State University
Scottish Association for Marine Science
Scripps Research Institute, The
Seattle Biomedical Research Institute
Sensor Technologies
Skirball Institute, NYU School of Medicine
Sloan-Kettering Institute
Smith College
Southern California, University of
Southern Illinois University School of Medicine
St. Andrews, University of
St. Lawrence University
Stanford University
Stanford University School of Medicine
Stellenbosch, University of
Stowers Institute for Medical Research
Swiss Federal Institute of Technology

Universidad de Buenos Aires
Universidad Nacional Autonoma de Mexico
Universitaet Konstanz
Universitaet Ulm
Universitat Autonoma de Barcelona
University College London
University of Connecticut Health Center
Upstate Medical University
Utah, University of
Utah, University of, School of Medicine

Vanderbilt University
Vanderbilt University Medical Center
Venter Institute
Vermont, University of
Virginia, University of

Wadsworth Center
Wake Forest University Health Sciences
Walter and Eliza Hall Institute, The
Washington State University
Washington University
Washington University Medical School
Washington, University of
Weill Medical College Cornell University
Weizmann Institute of Science
Wellesley College
Wheaton College
Williams College
Wisconsin, University of
Wisconsin, University of, Madison
Women & Infants' Hospital of Rhode Island
Woods Hole Oceanographic Institution

Yale Medical School
Yale University

Zebrafish International Resource Center
Last year’s report stated that change is ever present in today’s science libraries. During the past three years the MBLWHOI Library has changed in many ways. Today’s scientists are more familiar with online journals, Google, and services such as PubMed, which provide online access to citations from biomedical literature, than the contents of the library shelves. Just one look in our library’s reading rooms and you will notice the shrinking number of slots for recent hardcopy journals. The virtual library has arrived, the information commons, or infosphere, is a reality, and most of the information the library catalogues and disseminates is handled electronically.

Scholarly communication is being transformed in unpredictable ways. We are beginning to manage our own digital assets, and make them more widely available to our patrons. The library is also assuming preservation and asset management responsibilities. We have initiated a new digital repository, called the Woods Hole Open Access Server (WHOAS), which involves digitizing the latest WHOI Technical Reports and making them available through open source software developed at the Massachusetts Institute of Technology.

The library will continue to digitize and present our electronic content through WHOAS and related services. We will also continue our role as a gatherer and manager of the institutional repository, as a licensor of external services, such as electronic journals and databases, and as a facilitator for self-archiving our local resources. While the job of the library as an aggregator has yet to be finalized, we have an opportunity to take a leadership role in developing policies and programs that contribute to a coherent, institutional-wide knowledge management system.

One of our most successful projects is the uBio initiative, the aim of which is to create a comprehensive and collaborative catalog of names of all living (and once-living) organisms. In 2004 uBio received further funding from The Andrew W. Mellon Foundation and the Global Biodiversity Information Facility. The uBio project is a technological innovation that has become a collaborative revolution with input from taxonomists around the globe.
The library’s budget reductions in 2004 brought shared challenges and opportunities as our collection development policies underwent scrutiny. While we were forced to reduce local resources, our outreach efforts to library consortia members increased and collaboration with scientists and publishers was established. Within the past 12 months we have sent and received more than 10,000 interlibrary loans within our consortium of 19 academic libraries.

A science library supports research, learning, and scholarship. It is not an end in and of itself, but must adapt as research and learning behaviors change. Whatever changes lie on the horizon, libraries are a place of social assembly and are vitally important to their communities. The MBLWHOI Library is committed to providing the Woods Hole scientific community with the tools and means to access scientific information no matter what changes lie ahead.

— Catherine N. Norton

Jim Watson and Alex Rich, wearing their ties from the RNA Tie Club, returned to the MBL for the “Summer of ’54 — Science is We” library celebration and exhibit.

Library Researchers

Jayne B. Abbott, Marine Research Inc.
Josephine Adams, Cleveland Clinic Foundation
Vernon Ahmadjian, Clark University
Garland E. Allen, Washington University
Nina S. Allen, North Carolina State University
Tom Allnutt, Advanced BioNutrition Corporation
Andy Applegate, New England Fishery Management Council
Michael Armstrong, Massachusetts Division of Fisheries

Baccio Baccetti, University of Siena
Ruth Barratt, Advanced BioNutrition Corporation
Thomas L. Benjamin, Harvard Medical School
Charles Blake, University of South Carolina
Deirdre Boelke, New England Fishery Management Council
Thomas A. Borgese, Lehman College-CUNY
Heather C. Boyd, MBLWHOI Library
John F. Boyer, Union College
Axel A. Brakhage, University of Hanover
Sabine Brauckmann, Konrad Lorenz Institute
Robert A. Bullis, Advanced BioNutrition Corp
Don Burke, Johns Hopkins University
Arthur H. Burr, Simon Fraser University

Graciela Candela, University of Puerto Rico
Stephen Cannon, University of Texas, Southwestern
Paul Caruso, Massachusetts Division of Marine Fisheries
James Cervino, MBLWHOI Library
Brad Chaise, Massachusetts Division of Marine Fisheries
Frank M. Child, Trinity College
John Chisholm, Massachusetts Division of Marine Fisheries
Kenneth L. Clarkson, Bell Labs, Lucent Technologies
Jewel P. Cobb, California State University
Seymour S. Cohen, American Cancer Society
Jamus Collier, Center for Coastal Studies
R. John Collier, Harvard Medical School
Rena Conti, Harvard Medical School
Steven Correia, Massachusetts Division of Marine Fisheries
John Costello, Providence College
Jeffrey T. Corwin, University of Virginia
Ernest F. Couch, Texas Christian University

Leyla deToledo-Morrell, Rush University
Leah Devlin, Penn State Abington College
Thomas K. Duncan, Nichols College

Peggy Edds-Walton, Parmly Hearing Institute, Loyola University
Herman T. Epstein, Brandeis University
Bruce Estrella, Massachusetts Division of Marine Fisheries

Alan Finkelstein, Albert Einstein College of Medicine
Gerald D. Fischbach, Columbia University
Dan Fraenkel, Harvard Medical School
Kristyna Frenkel, New York University School of Medicine

Robert Galatzer-Levy, University of Chicago
Cem Giray, Micro Technologies, Inc.
David L. Glanzman, The University of California, Los Angeles
Moise Goldstein, Johns Hopkins University
Penelope Greene, Harvard School of Public Health
Joanna Groden, University of Cincinnati

Continued...
Harlyn O. Halvorson, MBLWHOI Library
Moti Harel, Advanced BioNutrition Corporation
Phil Haring, New England Fishery Management Council
Robert Haubrich, Denison University
Peter K. Hepler, University of Massachusetts, Amherst
Theodore T. Herskovits, Fordham University
Michael Hickey, Massachusetts Division of Marine Fisheries
Ann Hochschild, Harvard Medical School
George Holz, New York University School of Medicine
Sadayuki Inoue, McGill University
David Isenberg, MBLWHOI Library
Allan S. Jacobson, UMass Medical School
Denise B. Jacobson, University of Massachusetts
Lionel F. Jaffe, Marine Biological Laboratory
Robert Jaye, Solomon Schechter Day School of Greater Boston in Newton
Daniel Johnston, University of Texas at Austin
Robert Josephson, University of California
Arthur Karlin, Columbia University
Chris Kellogg, New England Fishery Mgmt.Council
Robert E. Kelly, Northwestern University
Robert S. Kennedy, Maria Mitchell Association
Alexander Keynan, Israel Academy of Sciences and Humanities
Rita Khanna, Advanced BioNutrition Corporation
Kenneth King, Woods Hole, MA
Mary Y. King, Columbia University
Donald A. Klein, Colorado State University
Stephen M. Krane, Mass General Hospital-East
Frank B. Krasne, University of California, Los Angeles
David Kyle, Advanced BioNutrition Corporation
Aimlee Laderman, Yale University School of Forestry and Environmental Studies
David Landowne, University of Miami
Edward Leadbetter, University of Connecticut
Jared Leadbetter, California Institute of Technology
Evelyn G. Lipper, New York Presbyterian Hospital
John Lisman, Brandeis University
Skip Little, MBLWHOI Library
Werner R. Loewenstein, Journal of Membrane Biology
Louise Luckenbill-Edds, Ohio University
Luisa A. Marcelino, Massachusetts Institute of Technology
Anne Marfey, MBLWHOI Library
Charles Mayo, Center for Coastal Studies
Maryann McEnroe, Purchase College
Michael E. Mendelsohn, Molecular Cardiology Research Institute
Anna Menini, SISSA
Peter L. Merrill, MicroTechnologies
Roger Milkman, Marine Biological Laboratory
Ralph Mitchell, Harvard University
Merle Mizell, Tulane University
Gregg E. Moore, Center for Coastal Studies
Mark S. Mooseker, Yale University
Thomas Moth-Poulsen, Massachusetts Division of Marine Fisheries
Ronald Nagel, Albert Einstein College of Medicine
Toshio Narahashi, Northwestern University Medical School
John E. Naugle, National Aeronautics & Space Administration
Gary Nelson, Massachusetts Division of Marine Fisheries
Owen Nichols, Center for Coastal Studies
Tom Nies, New England Fishery Management Council
Ronald Pethig, University of Wales
Robert Prendergast, MBLWHOI Library
Michael B. Rabinowitz, Harvard Medical School
George Reynolds, Princeton University
John W. Ripple, Syntnx
Jooke Robbins, Center for Coastal Studies
Lawrence Rome, University of Pennsylvania
Herbert S. Rosenkranz, Florida Atlantic University
Susan A. Rotenberg, Queens College
Robert Rudin, Maria Mitchell Society
Jay M. Schippers, The Housing Resource Foundation
James O. Schwartz, MBLWHOI Library
Sheldon Segal, MBLWHOI Library
Angie L. Senese, Bowdoin College
Frank C. Shephard, Eppler Lung Research Foundation
Osamu Shimomura, MBLWHOI Library
Vivian Siegel, Public Library of Science
Kathleen Swicki, Swarthmore College
Joel Sohn, Pacific Grove, CA
Stephen Spotte, Mote Marine Lab
Lori Steele, New England Fishery Management Council
Frank Striggow, KeyNeurotek
Ann Stuart, University of North Carolina
Gerald J. Sullivan, Savio Prep High School
Eric Sundquist, United States Geological Survey
Frederick Sweet, Washington University School of Medicine
Jay Tashiro, Wolfsong Informatics
Richard R. Taylor, MBLWHOI Library
Lewis G. Tilney, University of Pennsylvania
Mark L. Tykoczinski, University of Pennsylvania
Michael Tytell, Wake Forest University School of Medicine
Deirdre Valentine, New England Fishery Management Council
Kensal E. Van Holde, Oregon State University
Alan A. Walton, Cavendish Lab
Christopher Ward, University of Maryland Baltimore
Leonard Warren, University of Pennsylvania Medical School
Nathaniel J. Weiss, MBLWHOI Library
Gerald Weissmann, New York University School of Medicine
Jay A. Winsten, Harvard School of Public Health
Peter Woodhead, Marine Sciences Research Center
George Woodwell, Woods Hole Oceanographic Institution
Lucille Wurtz, MBLWHOI Library
George J. Yevick, Stevens Institute of Technology
I am pleased to share with you financial highlights from the year 2004. Once again, the MBL’s net assets grew, thanks to continued strong investment returns and judicious “growth by substitution” on the expense side. Although revenues were largely flat in 2004 compared to the previous year, the MBL moved forward with its efforts to implement many of the initiatives recommended by the Strategic Plan.

Balance Sheets

I am especially delighted to report that, for the first time in history, the MBL’s total assets exceeded $100 million. The value of the laboratory’s property and equipment increased more than $4.2 million, a reflection of the improvements we have made to the infrastructure of our campus. Our endowment and similar investments also grew $3.3 million, thanks to a 12.6% return on the MBL’s long-term portfolio. Cash and short-term investments increased as well by more than $2 million. Although our liabilities increased in 2004, it was largely the result of the purchase of a major piece of equipment, a state-of-the-art confocal microscope of great research value to Whitman Center investigators and other members of the Woods Hole scientific community.

The MBL’s total net assets, essentially the equity of the laboratory, increased approximately $2.8 million. Unrestricted net assets grew for the first time since 2000, and our permanently restricted net assets, the MBL’s endowment, grew by more than $1 million.

Operating History

Support for operations, which includes government grants, private contracts, rental and tuition fees, fell slightly in 2004 because of a number of factors. Although the MBL was awarded a record number of new federal research awards in 2004 totaling $28.7 million, actual spending on research (from which we draw overhead) showed only marginal growth of 2.6%, the lowest level in a decade. With the exception of a down-turn in tuition, other sources of support grew a modest 2.2% in 2004.

Operating expenses were controlled effectively in 2004, increasing only 2.9% over the previous year. Only subcontracts, utilities, and equipment expenses increased, the latter being the result of the purchase and expensing of four major research instruments totaling $1.3 million. It is noteworthy that all other expense categories actually declined in 2004, largely due to “belt-tightening” measures implemented by management. In spite of these efforts, the MBL experienced a $910 thousand (2.5%) decline in net assets before non-operating activity in 2004.

Non-Operating Activities

On a positive note, non-operating activities were strong, assisted by robust investment earnings of $5.7 million, which more than covered the $2 million drawn from these earnings to support operations. This helped the laboratory experience a bottom line increase of approximately $2.8 million in net assets.

In terms of performance benchmarks, the MBL’s return on average net assets was an acceptable 3.6% in 2004, and the laboratory’s long-term debt to unrestricted and temporarily restricted net assets was a favorable 30%. These numbers show that the MBL accumulated more wealth in 2004 and has leveraged its financial strength at a reasonable level.

Conclusion

The MBL continues to work towards overcoming operating losses and building revenues to be able to fund depreciation accrual. Management continues to seek ways to enhance revenues and build research programs while implementing cost-saving measures whenever prudent. We expect that such measures will ensure the healthy growth of this institution and the successful implementation of the Strategic Plan.

— Mary B. Conrad
The financial statements of the Marine Biological Laboratory for the fiscal year ending December 31, 2004, were audited by KPMG. Complete financial statements are available upon request from:

Homer Lane
Chief Financial Officer
Marine Biological Laboratory
7 MBL Street
Woods Hole, MA 02543

The Operating and Balance Sheet numbers shown here are unaudited.
The MBL’s recent strategic planning initiative calls for ensuring that the laboratory continues to have a disproportionate impact on the advancement of biological sciences by building upon the strengths of its three core programs: a world-renowned education program; highly regarded resident research programs in the biological, biomedical, and environmental sciences; and an unparalleled summer and visiting science program.

To implement the plan fully, it is clear that the laboratory must take aggressive steps towards acquiring resources and endowment funds to enhance and expand these core programs and provide sustainable support for institutional priorities in perpetuity.

We have already begun taking steps towards meeting these goals and are pleased to acknowledge an ever-broadening community of donors to the laboratory this year. Under the leadership of new annual giving chair Tom Pollard, the Annual Fund had a strong year in 2004 with a record $664,784 raised from 880 donors, an 8.8% increase over 2003. A record number of donors also joined the Director’s Circle by making gifts of $10,000 or more. In addition, one-third of our annual donors in 2004 were alumni, a figure that has grown steadily over the past few years as a result of enhanced outreach efforts.

Special gifts contributed significantly to the MBL’s education endowment. Seventy-eight new individual donors made gifts to named endowed funds in honor of fellow scientists, educators, friends, and mentors. These funds support such events as lectureships and symposia, which complement other programs at the MBL. Also in 2004, the laboratory instituted a “legacy” program intended to acquire critically important and highly valued unrestricted endowment funds that provide flexible support to meet the MBL’s needs. An unrestricted gift reflects a trust in the institution and the administration’s discretion to direct funds where they are most needed and will have the greatest impact. The New Century Society, the MBL’s planned giving program, also continued to grow, proving an attractive giving option for ten donors who expressed their bequest intentions during the year.
Also in 2004, the MBL launched a $20 million fundraising drive in support of the renovation of the Whitman building. The Whitman project is a cornerstone of the strategic plan and is crucial to the continued success of the MBL’s renowned summer and visiting science program. As of winter 2005, the MBL has raised $3,800,000 in gifts and pledges towards this goal. The initial fundraising efforts for this project were further energized by a $500,000 challenge grant from the G. Unger Vetlesen Foundation.

The laboratory’s research and education programs also benefited from the generosity of corporate and foundation support. The Dart Neuroscience Limited Partnership awarded a $1,000,000 grant to support a summer research fellowship program focused on learning and memory. In addition, grants from The Ellison Medical Foundation and The Grass Foundation provided more than $1,000,000 combined in support of the MBL’s celebrated summer courses.

We are also pleased to report that the MBL’s development team is again fully staffed. Wendy King joined the staff in April as director of foundation relations.

On behalf of the Board of Trustees, and especially the scientists and the students who were afforded the unique opportunity to pursue curiosity-driven research and unprecedented peer-to-peer collaborations at the MBL, we extend our sincerest appreciation to those whose names appear on the following pages, and also to those who requested anonymity. Your investment in the laboratory directly contributes to the advancement of biological, biomedical, and environmental science and helps fuel new discoveries leading to a healthier world.

— M Howard Jacobson and William I. Huyett Co-chairs
MAJOR GIFTS

We gratefully acknowledge the important support provided by the following foundations and individuals for our research and education programs.

Highlights

The Dart Neuroscience Limited Partnership awarded a grant of $1,000,000 in support of the Dart Scholars summer research program in learning and memory for the years 2004 through 2008.

Alfred P. Sloan Foundation awarded a grant of $900,000 to Mitchell Sogin and the Josephine Bay Paul Center to support the organization and commencement of the International Census of Marine Microbes, a component of the Census of Marine Life.

The G. Unger Vetlesen Foundation made a challenge grant of $500,000 for the renovation of the Whitman building. This grant is a capacity building grant and contingent on successfully raising 30% of the $20 million to complete the project. The Foundation also renewed its grant of $350,000 in support of the Josephine Bay Paul Center for Comparative Molecular Biology and Evolution; for the program to develop marine models for biomedical research in the MRC; and, to support veterinary services at the MBL.

The Ellison Medical Foundation awarded $739,453 for the continued support of the Molecular Biology of Aging course from 2005 through 2007. They also contributed additional support in the amount of $89,542 for the Biology of Parasitism course, the Molecular Biology of Aging course, and the Global Infectious Diseases Colloquium.

Allen Whitehill Clowes Charitable Foundation, Inc. awarded $819,702 to support the renovation of real estate bequeathed to the MBL by Allen Clowes.

The Estate of Octavia C. Clement bequeathed $300,000 to the MBL General Endowment in memory of Octavia C. and Anthony C. Clement.

The Grass Foundation awarded two grants totaling $255,000. A grant of $135,000 will support the Neural Systems and Behavior course for the years 2005 through 2007. A grant of $120,000 will support the Neurobiology course for the years 2005 through 2007. The Foundation also contributed $10,000 for the purchase of a Leica vibratome for the Grass Laboratory.

The Gruss Lipper Family Foundation renewed funding in the amount of $226,953 for the Gruss Lipper Research and Educational Fund for support of Israeli scientists over a period of three years.

The Andrew W. Mellon Foundation awarded $166,000 to support the MBLWHOI Library uBio Project, specifically the development of NameBank, which promises to be an outstanding resource to scientists, libraries, and other information centers.
Mr. William Golden made a challenge grant in the amount of $200,000 in support endowing the Science Journalism Program. This grant is contingent on the MBL successfully raising $2,000,000 for this endowment.

The Foundation for Research in Cell Biology and Cancer made a commitment of $100,000 in support of the Whitman building renovation. The foundation also contributed $20,000 to the MBL Annual Fund.

Mrs. Freda Kaminer contributed $100,000 to support the Benjamin Kaminer Endowed Scholarship in Physiology. An additional $1,850 was contributed to the Annual Fund and the Associates Program.

The Estate of Edward F. MacNichol, Jr. bequeathed $100,000 to support the H. Keffer Hartline and Edward F. MacNichol Fellowship for Research.

The Keith R. Porter Endowment for Cell Biology awarded $100,000 to endow the Keith Porter Lecture Fund for lectures to be given in conjunction with the MBL Friday Evening Lecture series.

Arthur Ross Foundation made a challenge grant in the amount of $100,000 in support endowing the Science Journalism Program. This grant is contingent on the MBL successfully raising $2,000,000 for this endowment.

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“The Unknown History of Bohemia”
Mary Gluck, Professor of History, Brown University

February 6, 2004
“The Heights of Absurdity, or the Quixotic Life of an Artist in Troubled Times”
Pat Oleszko, Performance Artist

April 16, 2004
“Covering All My Basses: How I Became a Professional Musician”
Benjamin Levy, Double-Bassist, Boston Symphony Orchestra

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<tr>
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