Marine Biological Laboratory
Woods Hole
Massachusetts

One Hundredth Report
for the Year 1997
One-Hundred and Ninth Year

Officers of the Corporation

Sheldon J. Segal, Chairman of the Board of Trustees
Frederick Bay, Co-Vice Chair
Mary J. Greer, Co-Vice Chair
James D. Ebert, President of the Corporation
John E. Burris, Director and Chief Executive Officer
Mary B. Conrad, Treasurer
Neil Jacobs, Clerk of the Corporation
Contents

Report of the Director and CEO ...................... R1
Report of the Treasurer ............................. R7
Financial Statements ............................... R8
Report of the Library Director .................... R19
Educational Programs
  Summer Courses .................................. R22
  Short Courses ................................... R26
  Other Programs .................................. R31
Summer Research Programs
  Principal Investigators .......................... R33
  Other Research Personnel ...................... R34
  Library Readers ................................ R36
  Institutions Represented ...................... R37
Year-Round Research Programs .................... R42
Honors ............................................. R53
Board of Trustees and Committees ................. R59
Administrative Support Staff ..................... R62
Members of the Corporation
  Life Members .................................... R65
  Members ......................................... R66
  Associate Members .............................. R76
Certificate of Organization ....................... R79
Articles of Amendment ............................ R79
Bylaws ............................................. R79

Photo credits:
W. Amos—R19
Beth Armstrong—R2 (top), R34, R37, R43
Ken Foreman—R5 (bottom), R31
Linda Golder—R59, R65
Roger Hanlon—R3 (top), R62
Richard Howard—R4 (top), R5 (top), R22, R26, R30, R78
Tom Kleindinst—R45
Alan Kuzirian—R53
Beth Liles, R49
George Lower—R4 (bottom), R7
Chris Neill, R42
Bruce Peterson—R47
Janice Reed—R1
The Marine Biological Laboratory had another exciting and successful year in 1997. We set our sights high and achieved a number of major goals for the Laboratory. We launched the first Semester in Environmental Sciences program for undergraduates from liberal arts colleges; recruited new investigators for our resident research programs; planned for and established new advanced summer courses; and found new and expanded ways to capitalize on the flexibility and sophistication of the Marine Resources Center.

These endeavors were supported by the tangible and intangible resources and energies generated by the laboratory’s new fundraising campaign, *Discovery: The Campaign for Science at the Marine Biological Laboratory*, which was launched with a public celebration and street fair on August 8, 1997. In my report last year, I discussed the concerted planning process that set the stage for this campaign. By focusing our research and educational directions and priorities, we were able to announce last August a campaign goal of $25 million to be raised by December 31, 2000.

I am pleased to say that, as of the spring of 1998, we have already raised $14.5 million towards that goal. I have every reason to believe that we will meet, if not exceed our goal within the timeframe of the campaign.

**Research at the MBL**

We made great strides in the MBL’s resident research centers and programs during 1997. The avenues for independent research broadened and diversified in each of MBL’s programmatic areas, while our investigators found new ways to work together in various interdisciplinary pursuits.

**The Josephine Bay Paul Center**

Dr. Mitchell Sogin and his colleagues in the Josephine Bay Paul Center for Comparative Molecular Biology and Evolution continued their important studies on the evolution of eukaryotes, most recently focusing on those found in extreme environments. An exciting development is a major grant from the National Institutes of Health to sequence the genome of *Giardia lamblia*, a water-borne human pathogen. Giardiasis is a major contributor to the enormous burden of human diarrheal diseases, which are second only to respiratory infections as causes of mortality and morbidity worldwide. While *Giardia* can be a deadly organism, it is manageable in terms of genome analysis because it has a relatively modest genome size of 12 million base pairs distributed onto five chromosomes.

Dr. Michael Cummings was recruited to the Bay Paul Center in 1997. He comes to the Center to study Mycobacteria as a means of understanding more clearly the evolution of pathogenicity and how various strains of tuberculosis develop drug resistance. Another member of the Bay Paul Center, Dr. Monica Riley, continues to travel world-wide sharing her expertise on the *E. coli* genome. She was a co-author in September on a paper published in the journal *Science* which reports the successful sequencing of the genome of the K-12 strain of the bacterium.

In 1997, Center scientist Dr. Neal Cornell and his co-workers conducted a molecular phylogenetic analysis for 5-aminolevulinate synthase, the first enzyme of heme biosynthesis. The analysis supports the suggestion that alpha-purple bacteria are the closest contemporary eubacterial relatives of eukaryotic mitochondria. The study also indicates that the massive gene duplication required for the evolution of true vertebrates had occurred when non-vertebrate jawless fish appeared, 400 to 500 million years ago.

**The Ecosystems Center**

The MBL’s Ecosystems Center, co-directed by Drs. John Hobbie and Jerry Melillo, continues its leadership in environmental research on local and global scales.
For more than a decade, MBL scientists have led a Long-Term Ecological Research (LTER) project on the arctic tundra around Toolik Lake in Alaska. In 1997, scientists at the Center secured another LTER project grant of nearly $3.4 million over six years from the National Science Foundation to study the Plum Island Sound system in northeastern Massachusetts. An LTER grant is important scientifically and institutionally because it allows long-term data collection and analysis in the same location and provides a solid base of funding with which to recruit scientists and research technicians for the project. We are proud of the Ecosystems Center team because they were the only group that was funded out of 21 proposal submissions nationwide.

In the southern hemisphere, our scientists have also been compiling data for more than a decade on the effects of deforestation on soil fertility and trace gas emissions in the rainforests in Brazil. Their work continues as they evaluate what effects changing and more aggressive agricultural practices are having on the Amazon Basin and the world.

In 1997, the MBL received a challenge grant of $1 million from The Clowes Fund, Inc., of Indiana, to provide support for new and expanded facilities for The Ecosystems Center. Thanks to this grant, the MBL is now in the early stages of planning renovations and expansion that will nearly double the Center’s existing laboratory, field staging, and office space. The plans also call for the creation of a new computer teaching laboratory in the Center.

The Marine Resources Center

Dr. Roger Hanlon has advanced his research agenda in the Marine Resources Center (MRC) with the introduction of the Program in Sensory Biology and Neuroethology and the Program in Scientific Aquaculture. An MRC Advisory Committee has been constituted to review research directions and scientist recruitment strategies. Members of the Committee include Drs. Gerald Fischbach, Harvard Medical School; Irwin Levitan, Brandeis University; and Vilayanur Ramachandran, University of California, San Diego.

In the program on neuroethology, Dr. Hanlon and his colleagues study vision, balance, chemical sensing, and signaling to gain a better understanding of the output of neural activity, i.e., the resultant behavior of an organism that has evolved through natural selection. Towards that end, Dr. Hanlon has recently been awarded research grants that will enable molecular and cellular studies on squid and cuttlefish. These marine organisms possess very large neurons and have evolved dramatic and rapidly changing skin patterning displays as evidence of aggressive and reproductive behaviors. Last summer, Hanlon and his colleagues performed a series of experiments in the MRC in which they discovered that squids are able to detect transparent prey at greater distances thanks to a specialized way of seeing known as polarization vision. The result is enhanced predation and feeding by the squid. Hanlon’s findings appeared in the journal Nature in May 1998.

The second MRC initiative, the Program in Scientific Aquaculture, seeks to select organisms with defined genetic lines or at precise developmental stages for use as biomedical models, to attract industry and
commercial ventures to develop and test products in the MRC, and to study molecular and cellular mechanisms of disease processes and prevention.

Architectural Dynamics in Living Cells Program

MBL scientists continue as leaders in the design and use of advanced imaging systems to study the molecular definition and physical forces that affect the structure and function in living cells. Dr. Shinya Inoué, MBL Distinguished Scientist, received additional honors in 1997 for his contributions to light microscopy and was awarded the Ernst Abbe Award for Microscopy by the New York Microscopical Society. Inoué and his colleagues announced at the 1997 meeting of the American Society of Cell Biology the development of the Centrifuge Polarizing Microscope. This new microscope allows researchers to view architectural changes in cells at the subcellular level when exposed to high gravitational forces. This technical feat was the fruit of collaboration between scientists at the MBL, Olympus Optical Co., and Hamamatsu Photonics Corp.

Dr. Rudolf Oldenbourg and his associate Kaoru Kato, together with Dr. Peter Smith and Katherine Hammar of the BioCurrents Research Center, reported in 1997 on their observations of the dynamic behavior of actin molecules at the tip of growing nerve cells. These observations were made possible by the exceptionally high sensitivity and sharp image quality of Oldenbourg’s Pol-Scope, which was developed in collaboration with Cambridge Research and Instrumentation, Inc.

Laboratory for Reproductive Medicine

Dr. David Keefe, of the Laboratory for Reproductive Medicine of Brown University and the Women and Infants Hospital in Providence, R.I., established a resident laboratory at the MBL in 1997. Here he investigates the mechanisms underlying age-related female infertility. Keefe uses technologies developed at the MBL to seek out clues that indicate whether an egg has been damaged with age and is therefore not viable. With the ion selective probe, developed in Peter Smith’s BioCurrents Research Center, Keefe can detect the flow of certain ions in and out of the cell. This flow may reflect an egg’s potential to develop successfully. He is also using Oldenbourg’s Pol-Scope to study the egg’s spindle; flaws in the spindle may be responsible for the faulty transfer of genetic material during cell division.

Laboratory of Aquatic Animal Health and Pathology

In 1997, scientists from the University of Pennsylvania’s Laboratory of Aquatic Animal Health and Pathology, which is based at the MBL, continued their efforts to identify and treat diseases affecting marine organisms. They identified in toadfish an abscess of the abdominal organs caused by *Pseudomonas* sp. bacteria and a bacterial pericarditis disease caused by *Edwardsiella* sp. Dr. Roxanna Smolowitz continued her effort to culture QPX and describe the pathogenesis of the disease in susceptible strains of clams, while Dr. Robert Bullis and colleagues worked on ways to detect illegal chemical scrubbing of eggs in female lobsters.

Boston University Marine Program (BUMP)

BUMP Postdoctoral Fellow Frank Grasso organized and co-hosted an international workshop on “Plume Tracing” last year. Twenty-five scientists presented and debated the state-of-the-art in our knowledge of animals
following odor plumes to their source of release. Lobsters are animals that locate odor sources (for example, baited traps) under water without visual or auditory signals. Scientists in Dr. Jelle Atema’s laboratory have developed a tool known as Robo-Lobster to perform the plume tracing task and to learn about the sensory input and signal processing used by lobsters.

Summer Research

The MBL’s laboratories were again filled with scientists from all over the world during the summer of 1997. We welcomed back investigators with whom we have worked for a number of seasons and were able to share in the enthusiasm of scientists working here for the first time, either as fellows or as new principal investigators.

More than 400 scientists came to the MBL last summer to do their research, including 23 research fellows who received more than $171,000 in fellowship awards. The summer research season is framed by the Poster Session in June and is capped off by the General Scientific Meetings in August. These events attest to the breadth and diversity of the multidisciplinary work at the MBL where presentations range from papers in ecology and population biology to cellular and molecular biology to vision and biophysics.

One of the highlights of the summer research season was Dr. Stephen Highstein’s (Washington University) continuing work on the vestibular system of toadfish. The toadfish is an excellent marine model for studying how changes in pressure affect balance and equilibrium, because its vestibular system is similar to humans. Such studies teach us about motion sickness and dizziness, which are often signs of vestibular organ dysfunction. Highstein and his colleagues are focusing on the problems of nausea and dizziness experienced by astronauts when they get out beyond the earth’s gravity, a malady known as “space adaptation syndrome.” As I write, four toadfish are passengers aboard the space shuttle Columbia, participants in an experiment designed to help scientists understand what happens in the vestibular system during an extended period in space.

Another area of research that is becoming increasingly important at the MBL is evolution and development or “evo-devo.” Researchers from all over the world come to the MBL to learn more about how the dividing cells in an embryo decide which physiological role they will assume as the organism grows. For example, Drs. Mark Q. Martindale (University of Chicago), Jonathan Q. Henry (University of Illinois), and Barbara Boyer (Union College) take advantage of the wide variety of marine organisms available at the MBL to compare the developmental patterns of different kinds of embryos. They are studying relatively primitive animals like ctenophores whose development is simple enough that scientists can trace how a change in one cell or set of cells affects the whole organism as it grows. Ultimately, they hope to understand more clearly when and how organisms have diverged from their evolutionary ancestors.

The MBL’s General Scientific Meetings are held annually in mid-August. This three-day meeting is an opportunity for summer and resident scientists to report on their most recent research results.

One highlight from the 1997 meeting is the finding from the laboratory of Robert Barlow (SUNY Health Science Center) that the lateral eyes of two species of horseshoe crabs—the Woods Hole species Limulus polyphemus and its Japanese counterpart Tachypleus tridentatus—are similar, but not alike. Both show the same nighttime circadian rhythms, but Barlow and coworkers found that the mechanism responsible for those rhythms differs between the two. The eye of Limulus is larger and contains more ommatidia than that of Tachypleus. As a result, the Limulus lateral eye
becomes more sensitive at night by capturing more photons. The smaller lateral eye of *Tachypleus* is nearly as sensitive, but due to its size it is not able to catch as many photons as its Woods Hole relative. Instead, its photoreceptors make up for this deficiency by increasing gain, or the amount of information absorbed by the photoreceptors.

**Education at the MBL**

**Summer Courses**

The MBL’s educational program in biology and biomedicine continues to be preeminent, with almost 400 students and 400 faculty coming to the MBL each summer for a superb hands-on scientific experience. The MBL now offers 20 courses each summer, three of which were developed in 1997. One of these, *Molecular Mycology: Current Approaches to Fungal Pathogenesis*, was taught for the first time during the summer of 1997. The others, *Frontiers in Reproduction: Molecular and Cellular Concepts and Applications*, and *Neural Development and Genetics of Zebrafish*, will be offered for the first time during the summer of 1998.

Competition for admission to these and all MBL courses is intense. The 368 students enrolled during the summer of 1997 were selected from 833 applications that were culled from 1521 inquiries. Students continue to come to MBL courses from throughout the world, with about 35% to 40% of them from foreign countries.

The popularity of the courses is one indication of their excellence. Another is the peer review process that surrounds the awarding of many of the funds that support the courses. For the first time in my and many of my colleagues’ recollections, one of our summer courses, *Neural Systems and Behavior*, received a perfect score of 100 in its NIH review; *Neurobiology* also received near perfect marks from the NIH. This attests to the vision of the course directors and faculty and the quality of the curriculum that is offered at the MBL.

The generous support of a number of foundations, as well as the Federal government and a large cadre of individual donors is crucial to our ability to offer the best courses to the best students. Admission to many of the courses continues to be on a need-blind basis because of the scholarships we provide from these gifts and grants and from our endowment income.

Five course directors retired in 1997, including David Kleinfeld, University of California, San Diego, and David Tank, Lucent Technologies (Methods in Computational Neuroscience); Steve Hajduk, University of Alabama, Birmingham (Biology of Parasitism); Mark Mooseker, Yale University (Physiology); and Pierre Drapeau, Montreal General Hospital (Neurobiology and Development of the Leech). They will be replaced by William Bialek and Rob de Ruyter, NEC Research Institute (Methods in Computational Neuroscience); Ed Pearce, Cornell University (Biology of Parasitism); Kerry Bloom, UNC, Chapel Hill (Physiology); and Christie Sahley, Purdue University (Neurobiology and Development of the Leech). I thank all retiring course directors for their efforts on behalf of the MBL, and welcome our newest faculty members to the Laboratory.

**Semester in Environmental Sciences**

As I mentioned above, we are buoyed by the success of our first semester-long program in environmental science for undergraduates from liberal arts colleges. We welcomed 16 students for the inaugural semester which was held in the fall of 1997. Twenty-four liberal arts colleges and universities now participate in the consortium of institutions from which these students are drawn. The Ecosystems Center scientists who served as
faculty were impressed by the dedication and intellect of the group. I attended the student presentations before a large audience at semester-end and was impressed by the range and creativity of the research projects that they undertook. The semester proved a satisfying experience for all participants in this innovative new educational program, and it attests to the flexibility and commitment of the MBL in designing new and creative ways to further education in the life sciences.

MBL/WHOI Library

The Library is constantly responding to the challenges of straddling the traditional and the electronic modes of information transfer. This requires both technical achievement and renewal as well as the ongoing commitment to provide access to the best information essential to scientific research and teaching in the diverse Woods Hole scientific community. This charge translates into maintaining the unique, internationally acclaimed archival collection while, at the same time, being responsive to the fast-paced, complex, and demanding forces shaping electronic information delivery. So adept is the MBL/WHOI Library at this synthesis, that its director, Catherine Norton, is serving as President of the Boston Library Consortium, a group of academic, research, and hospital libraries.

Facilities

Our physical plant received significant attention during 1997. Major grants from the National Science Foundation and Colonial Gas Company provided nearly $600,000 to renovate classrooms and laboratories in the Loeb building. Additional monies were spent to reconfigure and modernize research laboratories to accommodate newly appointed MBL scientists and expanded research needs.

MBL Trustees

At their November 1997 meeting, the Board of Trustees of the Marine Biological Laboratory elected Dr. John E. Dowling to serve as President of the MBL Corporation. Dowling succeeds Dr. James D. Ebert, who retired after serving as President for seven years. In recognition of his "outstanding service to the development of American science in general and his long-standing dedication to the Marine Biological Laboratory," the Board has designated Ebert an Honorary Member of the Board of Trustees.

Dr. Dowling is the Maria Moors Cabot Professor of Natural Science at Harvard University, a long-time MBL summer investigator, and former MBL Trustee. His tenure as President of the MBL Corporation began with the March 1998 meeting of the Board.

Two New Trustees Join Board

At that same meeting, Mr. Sydney M. Cone, III, was elected a member of the Class of 2002. He is a partner with the law firm of Cleary, Gottlieb, Steen & Hamilton in New York City. He is also Starr Professor of Law of International Trade and Finance and the Director of the Center for International Law at New York Law School. He has served as a member of the MBL’s Council of Visitors since 1996. Mrs. Robert W. (Jean) Pierce was elected as a member of the Class of 1999. She is a resident of Wellesley. Woods Hole, and Boca Grande, Florida. She is an incorporator of the Heritage Plantation in Sandwich, and serves on the boards of the Women’s Club of Boca Grande and the Penzance Point Road Trust. Her late husband, Robert, served as a member of the MBL’s Board of Trustees from 1990 to 1993.

Five Board Members Reappointed

Mr. John R. Lakian, Chairman of the Board of the Fort Hill Group, Inc.; Dr. Joan Ruderman, Marion V. Nelson Professor of Cell Biology at Harvard Medical School; Dr. Sheldon J. Segal, Distinguished Scientist at the Population Council; Dr. William T. Speck, President and CEO of Columbia-Presbyterian Medical Center; and Mr. Alfred Zeien, Chairman and CEO of Gillette, were also elected in 1997 as members of the Class of 2002.

Council of Scientific Advisors

I owe a debt of thanks to my colleagues here in Woods Hole and to the international network of scientific, philanthropic, and business colleagues who share their time, interest, leadership, and support to keep the Marine Biological Laboratory at the forefront of biology. During 1997, I was especially fortunate to receive input and advice from the Council of Scientific Advisors, a newly constituted group of eminent scientists. They include: Drs. Bruce Alberts, Thomas Eisner, Walter Gilbert, Eville Gorham, Marc Kirschner, and Carla Shatz. With their counsel and that from our Board of Trustees, the MBL Science Council, and all of you, I look forward to a bright and dynamic future for the Marine Biological Laboratory.

—John E. Burris
The year 1997 was a successful one for the Marine Biological Laboratory. The net assets of the Laboratory increased by $6.2 M in 1997, from $54.5 M to $60.7 M. This increase was due to operations, the efforts of the capital campaign, and the success of our investment management activities. In accordance with generally accepted accounting principles, the Laboratory reported the results of operations after depreciation of $1.5 M, resulting in unrestricted net assets decreasing by $.8 M. This practice has masked a comparatively strong and healthy result of operations for the year. The capital campaign was responsible for a $3.1 M increase in net assets and permanently restricted net assets through increased gifts; and our long-term investments increased $4.9 M, resulting in a total return of 18.2% on our portfolio.

The 1997 balance sheet revealed an increase in liquidity as cash and short-term investments increased by $.6 M to $5.0 M and account for 50% of current net assets. Long-term investments increased by $5.8 M. This increase was the result of $2.1 M of new gifts, market value increase of $4.9 M, and a withdrawal of $1.2 M to pay for scholarships and fellowships in accordance with the donors’ instructions.

Land, buildings, and equipment, net of accumulated depreciation, decreased by $.7 M as a result of the depreciation expense exceeding capital expenditures. This resulted in our inability to recover depreciation expense on federally funded capital projects.

The Laboratory continues to demonstrate the ability to attract funds from the federal government, from foundations, and from individuals. We are in the process of significantly upgrading the physical plant, making the Laboratory an even more attractive facility at which to do science. Our housing budget continues to generate surplus cash. With long-term investment growth and the strength of our capital campaign, the Marine Biological Laboratory will continue to provide a productive scientific experience for its community.

—Mary B. Conrad
REPORT OF INDEPENDENT ACCOUNTANTS

To the Board of Trustees of
Marine Biological Laboratory
Woods Hole, Massachusetts

We have audited the accompanying balance sheet of Marine Biological Laboratory (the “Laboratory”) as of December 31, 1997 and the related statements of activities and cash flows for the year then ended. These financial statements are the responsibility of the Laboratory’s management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of Marine Biological Laboratory as of December 31, 1997, and the changes in its net assets and its cash flows for the year then ended in conformity with generally accepted accounting principles.

Our audit was conducted for the purpose of forming an opinion on the basic financial statements taken as a whole. The supplemental schedule of functional expenses as of December 31, 1997 is presented for the purpose of additional analysis and is not a required part of the basic financial statements. Such information has been subjected to the auditing procedures applied in the audit of the basic financial statements and, in our opinion, is fairly stated, in all material respects, in relation to the basic financial statements taken as a whole.

Boston, Massachusetts
March 27, 1998

Coopers & Lybrand L.L.P.

Coopers & Lybrand L.L.P. is a member of Coopers & Lybrand International, a limited liability association incorporated in Switzerland.
### ASSETS

<table>
<thead>
<tr>
<th>Description</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash and cash equivalents</td>
<td>$560,801</td>
<td>$391,528</td>
</tr>
<tr>
<td>Short-term investments, at market (Note C)</td>
<td>4,408,046</td>
<td>3,918,194</td>
</tr>
<tr>
<td>Accounts receivable, net of allowance for doubtful accounts of $36,782 in 1997 and $15,000 in 1996</td>
<td>1,221,781</td>
<td>762,860</td>
</tr>
<tr>
<td>Current portion of pledges receivable (Note H)</td>
<td>2,219,056</td>
<td>1,826,494</td>
</tr>
<tr>
<td>Receivables due for costs incurred on grants and contracts</td>
<td>1,157,165</td>
<td>1,114,082</td>
</tr>
<tr>
<td>Other assets</td>
<td>560,269</td>
<td>482,992</td>
</tr>
<tr>
<td><strong>Total current assets</strong></td>
<td><strong>10,127,118</strong></td>
<td><strong>8,496,150</strong></td>
</tr>
<tr>
<td>Long-term investments, at market (Notes C and D)</td>
<td>35,614,151</td>
<td>29,763,495</td>
</tr>
<tr>
<td>Pledges receivable, net of current portion (Note H)</td>
<td>2,238,826</td>
<td>2,406,350</td>
</tr>
<tr>
<td>Plant assets, net (Notes E and F)</td>
<td>20,026,580</td>
<td>20,695,624</td>
</tr>
<tr>
<td><strong>Total long-term assets</strong></td>
<td><strong>57,879,557</strong></td>
<td><strong>52,865,469</strong></td>
</tr>
<tr>
<td><strong>Total assets</strong></td>
<td><strong>$68,006,675</strong></td>
<td><strong>$61,361,619</strong></td>
</tr>
</tbody>
</table>

### LIABILITIES AND NET ASSETS

<table>
<thead>
<tr>
<th>Description</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current portion of long-term debt and capital leases (Note E)</td>
<td>229,657</td>
<td>204,108</td>
</tr>
<tr>
<td>Accounts payable and accrued expenses</td>
<td>1,494,948</td>
<td>1,536,015</td>
</tr>
<tr>
<td>Deferred income and advances on contracts</td>
<td>384,258</td>
<td>321,998</td>
</tr>
<tr>
<td><strong>Total current liabilities</strong></td>
<td><strong>2,108,863</strong></td>
<td><strong>2,062,121</strong></td>
</tr>
<tr>
<td>Annuities and unitrusts payable</td>
<td>1,213,583</td>
<td>959,513</td>
</tr>
<tr>
<td>Long-term debt and capital leases, net of current portion (Note E)</td>
<td>2,567,370</td>
<td>2,591,973</td>
</tr>
<tr>
<td>Advances on contracts</td>
<td>1,433,208</td>
<td>1,230,950</td>
</tr>
<tr>
<td><strong>Total long-term liabilities</strong></td>
<td><strong>5,214,161</strong></td>
<td><strong>4,762,436</strong></td>
</tr>
<tr>
<td><strong>Total liabilities</strong></td>
<td><strong>7,323,024</strong></td>
<td><strong>6,824,557</strong></td>
</tr>
</tbody>
</table>

Net assets:

<table>
<thead>
<tr>
<th>Type of Net Assets</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrestricted</td>
<td>18,729,311</td>
<td>19,371,978</td>
</tr>
<tr>
<td>Temporarily restricted</td>
<td>25,596,656</td>
<td>21,484,748</td>
</tr>
<tr>
<td>Permanently restricted</td>
<td>16,357,684</td>
<td>13,680,336</td>
</tr>
<tr>
<td><strong>Total net assets</strong> (Note B)</td>
<td><strong>60,683,651</strong></td>
<td><strong>54,537,062</strong></td>
</tr>
</tbody>
</table>

**Total liabilities and net assets**

<table>
<thead>
<tr>
<th>Type of Financial Position</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total liabilities and net assets</strong></td>
<td><strong>$68,006,675</strong></td>
<td><strong>$61,361,619</strong></td>
</tr>
</tbody>
</table>

*The accompanying notes are an integral part of the financial statements.*
### MARINE BIOLOGICAL LABORATORY

**STATEMENT OF ACTIVITIES**

for the year ended December 31, 1997

<table>
<thead>
<tr>
<th>Operating support and revenues:</th>
<th>Unrestricted</th>
<th>Temporarily Restricted</th>
<th>Permanently Restricted</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government grants</td>
<td>$ 9,986,800</td>
<td>—</td>
<td>—</td>
<td>$ 9,986,800</td>
</tr>
<tr>
<td>Private contracts</td>
<td>1,178,192</td>
<td>—</td>
<td>—</td>
<td>1,178,192</td>
</tr>
<tr>
<td>Laboratory rental income</td>
<td>1,478,757</td>
<td>—</td>
<td>—</td>
<td>1,478,757</td>
</tr>
<tr>
<td>Tuition</td>
<td>399,703</td>
<td>—</td>
<td>—</td>
<td>399,703</td>
</tr>
<tr>
<td>Fees for conferences and services</td>
<td>3,085,616</td>
<td>—</td>
<td>—</td>
<td>3,085,616</td>
</tr>
<tr>
<td>Contributions</td>
<td>615,882</td>
<td>$4,434,938</td>
<td>$1,390,609</td>
<td>6,441,429</td>
</tr>
<tr>
<td>Investment income</td>
<td>471,832</td>
<td>1,238,151</td>
<td>—</td>
<td>1,709,983</td>
</tr>
<tr>
<td>Miscellaneous revenue</td>
<td>322,667</td>
<td>—</td>
<td>—</td>
<td>322,667</td>
</tr>
<tr>
<td>Present value adjustment to annuities</td>
<td>—</td>
<td>(165,504)</td>
<td>1,057</td>
<td>(164,447)</td>
</tr>
<tr>
<td>Net assets released from restrictions</td>
<td>3,811,922</td>
<td>(3,871,922)</td>
<td>60,000</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total operating support and revenues</strong></td>
<td>21,351,371</td>
<td>1,635,663</td>
<td>1,451,666</td>
<td>24,438,700</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expenses:</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>11,031,914</td>
<td>—</td>
<td>—</td>
<td>11,031,914</td>
</tr>
<tr>
<td>Instruction</td>
<td>4,144,508</td>
<td>—</td>
<td>—</td>
<td>4,144,508</td>
</tr>
<tr>
<td>Conferences and services</td>
<td>1,487,705</td>
<td>—</td>
<td>—</td>
<td>1,487,705</td>
</tr>
<tr>
<td>Other programs (Note B)</td>
<td>5,440,808</td>
<td>—</td>
<td>—</td>
<td>5,440,808</td>
</tr>
<tr>
<td><strong>Total expenses</strong></td>
<td>22,104,935</td>
<td>—</td>
<td>—</td>
<td>22,104,935</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change in net assets before nonoperating activity</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(753,564)</td>
<td>1,635,663</td>
<td>1,451,666</td>
<td>2,333,765</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nonoperating revenue:</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total investment income and earnings</td>
<td>152,543</td>
<td>3,490,810</td>
<td>1,225,682</td>
<td>4,869,035</td>
</tr>
<tr>
<td>Less: investment earnings used for operations</td>
<td>(414,646)</td>
<td>(1,014,565)</td>
<td>—</td>
<td>(1,056,211)</td>
</tr>
<tr>
<td>Reinvested investment earnings</td>
<td>110,897</td>
<td>2,476,245</td>
<td>1,225,682</td>
<td>3,812,824</td>
</tr>
<tr>
<td><strong>Total change in net assets</strong></td>
<td>(642,667)</td>
<td>4,111,908</td>
<td>2,677,348</td>
<td>6,146,589</td>
</tr>
</tbody>
</table>

| Net assets, beginning of year         | 19,371,978 | 21,484,748 | 13,680,336 | 54,537,062 |

| Net assets, end of year               | $18,729,311 | $25,596,656 | $16,357,684 | $60,683,651 |

*The accompanying notes are an integral part of the financial statements.*
MARINE BIOLOGICAL LABORATORY

STATEMENTS OF CASH FLOWS

for the year ended December 31, 1997

(with comparative totals for the year ended December 31, 1996)

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flows from operating activities:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in net assets</td>
<td>$6,146,589</td>
<td>$6,375,604</td>
</tr>
<tr>
<td>Adjustments to reconcile change in net assets to net cash (provided by) from operating activities:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>1,483,203</td>
<td>1,473,878</td>
</tr>
<tr>
<td>Unrealized (gain) loss on investments</td>
<td>(1,740,501)</td>
<td>(1,765,532)</td>
</tr>
<tr>
<td>Realized (gain) loss on investments</td>
<td>(1,726,792)</td>
<td>(932,530)</td>
</tr>
<tr>
<td>Present value adjustment to annuities payable</td>
<td>164,447</td>
<td>(118,076)</td>
</tr>
<tr>
<td>Contributions restricted for long-term investment and annuities</td>
<td>(1,390,609)</td>
<td>(1,042,945)</td>
</tr>
<tr>
<td>Provision for bad debt</td>
<td>21,781</td>
<td>5,000</td>
</tr>
<tr>
<td>Provision for uncollectible pledges</td>
<td>89,620</td>
<td>—</td>
</tr>
<tr>
<td>Change in certain balance sheet accounts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts receivable</td>
<td>(480,702)</td>
<td>(25,489)</td>
</tr>
<tr>
<td>Pledges receivable</td>
<td>(314,658)</td>
<td>(1,726,570)</td>
</tr>
<tr>
<td>Grants and contracts receivable</td>
<td>(43,083)</td>
<td>502,596</td>
</tr>
<tr>
<td>Other assets</td>
<td>(77,277)</td>
<td>(15,940)</td>
</tr>
<tr>
<td>Accounts payable and accrued expenses</td>
<td>(71,504)</td>
<td>(409,962)</td>
</tr>
<tr>
<td>Deferred income and advances on contracts</td>
<td>62,260</td>
<td>(59,539)</td>
</tr>
<tr>
<td>Annuities and unitruts payable</td>
<td>120,052</td>
<td>—</td>
</tr>
<tr>
<td>Advances on contracts</td>
<td>222,258</td>
<td>757,875</td>
</tr>
<tr>
<td><strong>Net cash provided by operating activities</strong></td>
<td><strong>2,463,024</strong></td>
<td><strong>3,018,370</strong></td>
</tr>
</tbody>
</table>

Cash flows from investing activities:

| Purchase of property and equipment | (814,159) | (730,966) |
| Proceeds from sale of investments | 23,450,218 | 7,293,473 |
| Purchase of investments            | (26,321,432) | (11,347,575) |
| **Net cash used in investing activities** | **(3,685,373)** | **(4,785,068)** |

Cash flows from financing activities:

| Payments on annuities and unitruts payable | (30,430) | (23,369) |
| Receipt of permanently restricted gifts  | 1,321,302 | 954,739 |
| Annuity and unitruts donations received  | 69,307   | 88,206 |
| Loan proceeds                           | 250,000  | 500,000 |
| Payments on long-term debt and capital leases | (218,557) | (205,878) |
| **Net cash provided by financing activities** | **1,391,622** | **1,313,698** |

Net increase (decrease) in cash and cash equivalents 169,273 (453,000)

Cash and cash equivalents at beginning of year 391,528 844,528

Cash and cash equivalents at end of year $560,801 $391,528

The accompanying notes are an integral part of the financial statements.
Marine Biological Laboratory

Notes to Financial Statements

A. Background:

The Marine Biological Laboratory (the “Laboratory”) is a private, independent not-for-profit research and educational institution dedicated to establishing and maintaining a laboratory or station for scientific study and investigation, and a school for instruction in biology and natural history. The Laboratory was founded in 1888 and is located in Woods Hole, Massachusetts.

B. Significant Accounting Policies:

Basis of Presentation

The accompanying financial statements have been prepared on the accrual basis of accounting and in accordance with the principles outlined in the American Institute of Certified Public Accountants’ Audit Guide, “Not-For-Profit Organizations.” The financial statements include certain prior-year summarized comparative information in total but not by net asset class. Such information does not include sufficient detail to constitute a presentation in conformity with generally accepted accounting principles. Accordingly, such information should be read in conjunction with the Laboratory’s financial statements for the year ended December 31, 1996, from which the summarized information was derived.

The Laboratory classifies net assets, revenues, and realized and unrealized gains and losses based on the existence or absence of donor-imposed restrictions and legal restrictions imposed under Massachusetts State law. Accordingly, net assets and changes therein are classified as follows:

Unrestricted

Unrestricted net assets are not subject to donor-imposed restrictions of a more specific nature than the furtherance of the Laboratory’s mission. Revenues from sources other than contributions are generally reported as increases in unrestricted net assets. Expenses are reported as decreases in unrestricted net assets. Gains and losses on investments and other assets or liabilities are reported as increases or decreases in unrestricted net assets unless their use is restricted by explicit donor stipulations or law. Expirations of temporary restrictions on net assets, that is, the donor-imposed stipulated purpose has been accomplished and/or the stipulated time period has elapsed, are reported as reclassifications between the applicable classes of net assets.

Temporarily Restricted

Temporarily restricted net assets are subject to legal or donor-imposed stipulations that will be satisfied either by the actions of the Laboratory, the passage of time, or both. These assets include gifts plus moneys for which the specific, donor-imposed restrictions have not been met and pledges, annuities, and unitrusts for which the ultimate purpose of the proceeds is not permanently restricted. As the restrictions are met, the assets are released to unrestricted net assets. Also, realized/unrealized gains/losses associated with permanently restricted gifts which are not required to be added to principal by the donor are classified as temporarily restricted but maintain the donor requirements for expenditure.

Permanently Restricted

Permanently restricted net assets are subject to donor-imposed stipulations that they be invested to provide a permanent source of income to the Laboratory. These assets include gifts, pledges and trusts which require that the corpus be invested in perpetuity and only the income be made available for program operations in accordance with donor restrictions.

Nonoperating revenues include realized and unrealized gains on investments during the year as well as investment income on the master pooled investments. Investment income from short-term investments and investments held in trust by others is included in operating support and revenues. To the extent that nonoperating investment income and gains are used for operations as determined by the Laboratory’s total return utilization policy (see below), they are reclassified from nonoperating to operating on the statement of activities as “Investment earnings used for operations.” All other activity is classified as operating revenue. The Laboratory recorded net realized gains of $1,728,792, net unrealized gains of $1,740,501 and dividend and interest income of $2,053,514 in 1997.

Cash and Cash Equivalents

Cash equivalents consist of resources invested in overnight repurchase agreements and other highly liquid investments with original maturities of three months or less.

Financial instruments which potentially subject the Laboratory to concentrations of risk consist primarily of cash and investments. The Laboratory maintains cash accounts with one banking institution. Investments are maintained primarily with two institutions.

Investments

Investments purchased by the Laboratory are carried at market value. Donated investments are recorded at fair market value at the date of the gift. For determination of gain or loss upon disposal of investments, cost is determined based on the first-in, first-out method. Investments with an original maturity of three months to one year are classified as short-term. All other investments are considered long-term.

In 1924, the Laboratory became the beneficiary of certain investments, included in permanently restricted net assets, which are held in trust by others. The Laboratory has the continuing rights to the income produced by these funds in perpetuity, subject to the contractual restrictions on the use of such funds. Accordingly, the trust has established a process to conduct a review every ten years by an independent committee to ensure the Laboratory continues to perform valuable services in biological research in accordance with the restrictions placed on the funds by the agreement. The committee met in 1994 and determined that the Laboratory has continued to meet the contractual requirements. The market
values of such investments are $7,440,158 and $6,214,477 at December 31, 1997 and 1996, respectively. The dividend and interest income on these investments totaled $254,898 and $224,324 in 1997 and 1996, respectively.

Investment Income and Distribution

For the master pooled investments, the Laboratory employs a total return utilization policy that establishes the amount of the investment return made available for spending each year. The Finance and Investment Committee has approved a standing policy that the withdrawal will be based on a percentage of the latest three-year average ending market values of funds. The market value includes the principal plus reinvested income, realized and unrealized gains and losses. Spending rates in excess of 5%, but not exceeding 7%, can be utilized if approved in advance by the Finance and Investment Committee of the Board of Trustees. For fiscal 1997, the Laboratory obtained approval to expend 6% of the latest three-year average ending market values of the investments. The 6% includes a 1½% administration fee for endowments. This fee was approved by the Laboratory’s Board of Trustees for the years 1996–2000.

The net appreciation on permanently and temporarily restricted net assets is reported together with temporarily restricted net assets until such time as all or a portion of the appreciation is distributed for spending in accordance with the total return utilization policy and applicable state law.

Investment income on the pooled investment account is allocated to the participating funds using the market value unit method (Note D).

Plant Assets

Buildings and equipment are recorded at cost. Donated facility assets are recorded at fair market value at the date of the gift. Depreciation is computed using the straight-line method, beginning the month after the asset is placed in service, over the asset’s estimated useful life. Estimated useful lives are generally three to ten years for equipment and 20 to 40 years for buildings and improvements. Depreciation expense for the year ended December 31, 1997 amounted to $1,453,203 and has been recorded in the statement of activities in the appropriate functionalized categories. When assets are sold or retired, the cost and accumulated depreciation are removed from the accounts and any resulting gain or loss is included in unrestricted income for the period.

Annuities and Unitrusts Payable

Amounts due to donors in connection with gift annuities and unitrusts are determined based on remainder value calculations, as of December 31, 1997, with varied assumptions of rates of return and payout terms.

Deferred Income and Advances on Contracts

Deferred income includes prepayments received on Laboratory publications and advances on contracts to be utilized within the next year. Advances on contracts include funding received for grants and contracts before it is earned. In certain circumstances, long-term advances are invested in the master pooled account until they are expended.

Revenue Recognition

Revenue is recognized at the time it is earned. The sources of revenue include grant payments from governmental agencies, contracts from private organizations, and income from the rental of laboratories and classrooms for research and educational programs. The tuition income is net of student financial aid of $536,097 and $479,000 in 1997 and 1996, respectively. Fees for conferences and other services include the following activities: housing, dining, library, scientific journals, aquatic resources and research services.

Contributions

Contribution revenue includes gifts and pledges. Gifts are recognized as revenue upon receipt. Pledges are recognized as temporarily or permanently restricted revenue in the year received and recorded at the present value of expected future cash flows, net of allowance for unfulfilled pledges. Gifts and pledges, other than cash, are recorded at fair market value at the date of contribution.

Expenses

Expenses are recognized when incurred and charged to the functions to which they are directly related. Expenses that relate to more than one function are allocated among functions using various methodologies.

Other programs expense consists primarily of fundraising, year-round labs, and library room rentals, costs associated with aquatic resource sales and scientific journals. Total fundraising expense for 1997 is $1,226,360.

Use of Estimates

The preparation of financial statements in conformity with generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of financial statements and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates.

Reclassification

Certain prior year amounts have been reclassified to conform with current year presentation. The reclassifications had no effect on net assets.

Tax-Exempt Status

The Laboratory is exempt from federal income tax under Section 501(c)(3) of the Internal Revenue Code.
C. Investments:

The following is a summary of the cost and market value of investments at December 31, 1997 and 1996:

<table>
<thead>
<tr>
<th></th>
<th>Market</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1997</td>
<td>1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificates of deposit</td>
<td>$ 40,000</td>
<td>$ 55,350</td>
</tr>
<tr>
<td>Money market securities</td>
<td>2,168,958</td>
<td>3,469,588</td>
</tr>
<tr>
<td>U.S. Government securities</td>
<td>1,292,600</td>
<td>1,233,690</td>
</tr>
<tr>
<td>Corporate fixed income</td>
<td>2,587,861</td>
<td>3,431,333</td>
</tr>
<tr>
<td>Common stocks</td>
<td>5,279,266</td>
<td>3,793,156</td>
</tr>
<tr>
<td>Mutual funds</td>
<td>23,223,812</td>
<td>17,371,972</td>
</tr>
<tr>
<td>Limited partnerships</td>
<td>5,429,700</td>
<td>4,326,600</td>
</tr>
<tr>
<td>Total investments</td>
<td>$40,022,197</td>
<td>$33,681,689</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>1996</td>
</tr>
<tr>
<td>Certificates of deposit</td>
<td>$ 40,000</td>
<td>$ 55,350</td>
</tr>
<tr>
<td>Money market securities</td>
<td>2,168,958</td>
<td>3,469,589</td>
</tr>
<tr>
<td>U.S. Government securities</td>
<td>1,098,526</td>
<td>998,829</td>
</tr>
<tr>
<td>Corporate fixed income</td>
<td>2,472,653</td>
<td>3,278,396</td>
</tr>
<tr>
<td>Common stocks</td>
<td>4,271,853</td>
<td>2,742,841</td>
</tr>
<tr>
<td>Mutual funds</td>
<td>19,317,499</td>
<td>14,555,958</td>
</tr>
<tr>
<td>Total investments</td>
<td>$32,679,483</td>
<td>$28,209,427</td>
</tr>
</tbody>
</table>

Investment portfolios for the years ended December 31, 1997 and 1996 are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Market</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1997</td>
<td>1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificates of deposit</td>
<td>$ 40,000</td>
<td>$ 55,350</td>
</tr>
<tr>
<td>Money market 1784 Fund</td>
<td>1,759,589</td>
<td>2,755,593</td>
</tr>
<tr>
<td>Common stocks</td>
<td>551,780</td>
<td>50,608</td>
</tr>
<tr>
<td>Mutual funds</td>
<td>2,056,677</td>
<td>1,056,643</td>
</tr>
<tr>
<td>Total (Short-Term Investments)</td>
<td>4,408,046</td>
<td>3,918,194</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>1996</td>
</tr>
<tr>
<td>Certificates of deposit</td>
<td>$ 40,000</td>
<td>$ 55,350</td>
</tr>
<tr>
<td>Money market 1784 Fund</td>
<td>1,759,589</td>
<td>2,755,593</td>
</tr>
<tr>
<td>Common stocks</td>
<td>530,936</td>
<td>50,608</td>
</tr>
<tr>
<td>Mutual funds</td>
<td>2,056,679</td>
<td>1,063,089</td>
</tr>
<tr>
<td>Total (Short-Term Investments)</td>
<td>4,387,204</td>
<td>3,924,640</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Market</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1997</td>
<td>1996</td>
</tr>
<tr>
<td>Pooled investments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master pooled investments</td>
<td>$26,163,702</td>
<td>$21,858,658</td>
</tr>
<tr>
<td>Separately invested:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Chase trust</td>
<td>5,846,916</td>
<td>4,898,630</td>
</tr>
<tr>
<td>Library Chase trust</td>
<td>1,593,242</td>
<td>1,315,847</td>
</tr>
<tr>
<td>Annuity and unitrust investments</td>
<td>2,010,291</td>
<td>1,690,360</td>
</tr>
<tr>
<td>Total (Long-Term Investments)</td>
<td>35,614,151</td>
<td>29,763,395</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total investments</td>
<td>$40,022,197</td>
<td>$33,681,689</td>
</tr>
<tr>
<td></td>
<td>Cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1997</td>
<td>1996</td>
</tr>
<tr>
<td>Total investments</td>
<td>$32,679,483</td>
<td>$28,209,427</td>
</tr>
</tbody>
</table>

D. Accounting for Pooled Investments:

Certain net assets are pooled for investment purposes. Investment income from the pooled investment account is allocated on the market value unit basis, and each fund subscribes to or disposes of units on the basis of the market value per unit at the beginning of the calendar quarter within which the transaction takes place. The unit participation of the funds at December 31, 1997 and 1996 is as follows:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrestricted</td>
<td>4,192</td>
<td>4,415</td>
</tr>
<tr>
<td>Temporarily restricted</td>
<td>42,693</td>
<td>41,426</td>
</tr>
<tr>
<td>Permanently restricted</td>
<td>65,411</td>
<td>66,442</td>
</tr>
<tr>
<td>Advances on contracts</td>
<td>6,506</td>
<td>6,493</td>
</tr>
<tr>
<td>Total</td>
<td>118,802</td>
<td>118,776</td>
</tr>
</tbody>
</table>
Pooled investment activity on a per-unit basis was as follows:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit value at beginning of year</td>
<td>$186.35</td>
<td>$159.37</td>
</tr>
<tr>
<td>Unit value at end of year</td>
<td>220.30</td>
<td>186.35</td>
</tr>
<tr>
<td>Total return on pooled investments</td>
<td>$33.95</td>
<td>$26.98</td>
</tr>
</tbody>
</table>

E. Long-Term Debt:

Long-term debt consisted of the following at December 31:

<table>
<thead>
<tr>
<th>Description</th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable rate (5.50% at December 31, 1997) Massachusetts Industrial Finance Authority Series 1992A Bonds payable in annual installments through 2012</td>
<td>$960,000</td>
<td>$990,000</td>
</tr>
<tr>
<td>6.63% Massachusetts Industrial Finance Authority Series 1992B Bonds, payable in annual installments through 2012</td>
<td>1,280,000</td>
<td>1,330,000</td>
</tr>
<tr>
<td>5.8% The University Financing Foundation, Inc., payable in monthly installments through 2000</td>
<td>325,210</td>
<td>418,821</td>
</tr>
<tr>
<td>5.8% The University Financing Foundation, Inc., payable in monthly installments through 2002</td>
<td>231,817</td>
<td>—</td>
</tr>
<tr>
<td>Capital leases with various rates and due dates</td>
<td>—</td>
<td>57,260</td>
</tr>
<tr>
<td></td>
<td>$2,797,027</td>
<td>$2,796,081</td>
</tr>
</tbody>
</table>

The aggregate amount of principal due on long-term debt for each of the next five fiscal years and thereafter is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>$229,657</td>
</tr>
<tr>
<td>1999</td>
<td>243,274</td>
</tr>
<tr>
<td>2000</td>
<td>267,404</td>
</tr>
<tr>
<td>2001</td>
<td>173,664</td>
</tr>
<tr>
<td>2002</td>
<td>148,028</td>
</tr>
<tr>
<td>Thereafter</td>
<td>1,735,000</td>
</tr>
<tr>
<td>Less current portion of long-term debt</td>
<td>(229,657)</td>
</tr>
<tr>
<td>Long-term debt net of current return</td>
<td>$2,567,370</td>
</tr>
</tbody>
</table>

In 1992, the Laboratory issued $1,100,000 Massachusetts Industrial Finance Authority (MIFA) Series 1992A Bonds and $1,500,000 MIFA Series 1992B. These bonds pay varying annual interest rates ranging from 3.48% to 6.63%. Interest expense on this debt totaled $141,899 for the year ended December 31, 1997. The Series 1992 A and B Bonds mature on December 1, 2012 and are collateralized by a first mortgage on certain Laboratory property.

The agreements related to these Bonds subject the Laboratory to certain covenants and restrictions. Under the most restrictive covenant of this debt, the Laboratory’s operating surplus (before transfers), interest, expense and transfers from the quasi-endowment for debt service must equal or exceed all debt service payments, as defined by the agreement. The Laboratory was in compliance with these covenants and restrictions at December 31, 1997.

In 1996, the Laboratory borrowed $500,000 with an interest rate of 5.8% from the University Financing Foundation, Inc. The interest expense for the year ended December 31, 1997 was $21,829. The loan matures in 2000 and is collateralized by 69,440 shares of a fixed income mutual fund with a fair value of $933,690 at December 31, 1997.

In 1997, the MBL borrowed $250,000 with an interest rate of 5.8% per annum from the University Financing Foundation, Inc. The interest expense for the year ended December 31, 1997 was $5,866. This loan matures 2002 and is collateralized by 69,440 shares of a fixed income mutual fund with a fair value of $933,690 at December 31, 1997.

The Laboratory has a line of credit agreement with BankBoston from which it may draw up to $1,000,000. No amounts were outstanding under this agreement as of December 31, 1997 and 1996.
F. Plant Assets:

Plant assets consist of the following at December 31:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>$ 702,908</td>
<td>$ 702,908</td>
</tr>
<tr>
<td>Buildings</td>
<td>32,419,072</td>
<td>31,730,830</td>
</tr>
<tr>
<td>Equipment</td>
<td>4,300,932</td>
<td>4,270,278</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>37,422,912</strong></td>
<td><strong>36,704,016</strong></td>
</tr>
<tr>
<td>Less: Accumulated depreciation</td>
<td>(17,396,332)</td>
<td>(16,008,392)</td>
</tr>
<tr>
<td><strong>Plant assets, net</strong></td>
<td><strong>$20,026,580</strong></td>
<td><strong>$20,695,624</strong></td>
</tr>
</tbody>
</table>

G. Retirement Plan:

The Laboratory participates in the defined contribution pension plan of TIAA-CREF (the "Plan"). The Plan is available to permanent employees who have completed two years of service. Under the Plan, the Laboratory contributes 10% of total compensation for each participant. Contributions amounted to $715,858 and $661,089 for the years ended December 31, 1997 and 1996, respectively.

H. Pledges:

Unconditional promises to give are included in the financial statements as pledges receivable and the related revenue is recorded in the appropriate net asset category. Unconditional promises to give are expected to be realized in the following periods:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>In one year or less</td>
<td>$2,219,056</td>
<td>$1,836,874</td>
</tr>
<tr>
<td>Between one year and five years</td>
<td>2,485,851</td>
<td>2,780,000</td>
</tr>
<tr>
<td>After five years</td>
<td>80,000</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,784,907</strong></td>
<td><strong>4,616,874</strong></td>
</tr>
<tr>
<td><strong>Pledges receivable at December 31</strong></td>
<td><strong>$4,457,882</strong></td>
<td><strong>$4,232,844</strong></td>
</tr>
</tbody>
</table>

I. Postretirement Benefits:

The Laboratory accounts for its postretirement benefits under Statement No. 106, "Employers’ Accounting for Postretirement Benefits Other than Pensions," which requires employers to accrue, during the years that the employee renders the necessary service, the expected cost of benefits to be provided during retirement. As permitted, the Laboratory has elected to amortize the transition obligation over 20 years commencing on January 1, 1994.

The Laboratory’s policy is that all current retirees and certain eligible employees who retired prior to June 1, 1994 will continue to receive postretirement health benefits. The remaining current employees will receive benefits; however, those benefits will be limited as defined by the Plan. Employees hired on or after January 1, 1995 will not be eligible to participate in the postretirement medical benefit plan.
Net postretirement benefits for 1997 and 1996 include:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service cost (benefits earned during period)</td>
<td>$29,095</td>
<td>$61,712</td>
</tr>
<tr>
<td>Interest cost (on projected benefit obligation)</td>
<td>135,892</td>
<td>149,149</td>
</tr>
<tr>
<td>Actual return on plan assets</td>
<td>(31,976)</td>
<td>(20,700)</td>
</tr>
<tr>
<td>Net amortization and deferral</td>
<td>59,071</td>
<td>92,176</td>
</tr>
<tr>
<td><strong>Net postretirement benefits cost</strong></td>
<td><strong>$192,082</strong></td>
<td><strong>$282,337</strong></td>
</tr>
</tbody>
</table>

Below is a reconciliation of the funded status of the Plan at December 31, 1997 and 1996:

Accumulated postretirement benefit obligation:

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retirees and dependents</td>
<td>$1,439,899</td>
<td>$1,369,787</td>
</tr>
<tr>
<td>Fully eligible active participants</td>
<td>163,188</td>
<td>230,290</td>
</tr>
<tr>
<td>Other active participants</td>
<td>316,778</td>
<td>608,796</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,919,865</td>
<td>2,208,873</td>
</tr>
</tbody>
</table>

Market value of plan assets

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>701,140</td>
<td>588,337</td>
</tr>
</tbody>
</table>

Unfunded obligations

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,218,725</td>
<td>1,620,536</td>
</tr>
</tbody>
</table>

Unrecognized prior service cost (credit)

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unrecognized net (gain) loss

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(191,078)</td>
<td>136,158</td>
</tr>
</tbody>
</table>

Unrecognized transition obligation

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1,389,159</td>
<td>1,475,981</td>
</tr>
</tbody>
</table>

Accrued postretirement benefit cost

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$20,644</td>
<td>$(8,397)</td>
</tr>
</tbody>
</table>

The health care cost trend rate assumptions used in determining the projected benefit obligation begin at 9.5% in 1997 and gradually decrease to 5.0% in the year 2000 and thereafter. The effect of raising the assumed health care cost trend rate by one percentage point in each year would be to increase the accumulated postretirement benefit obligation as of December 31, 1997 by $173,001 and to increase the aggregate of the service and interest cost components of net periodic postretirement benefit cost for the year then ended by $14,528. The discount rate used in determining the accumulated postretirement benefit obligation is 7.5%, and the expected return on plan assets was 8.0%. During 1997, the Laboratory contributed $192,082 to fund the Trust for these postretirement benefits.
# Marine Biological Laboratory

## Supplemental Schedule of Functional Expenses

for the year ended December 31, 1997

<table>
<thead>
<tr>
<th></th>
<th>Research</th>
<th>Instruction</th>
<th>Conferences</th>
<th>Other</th>
<th>Facilities Maintenance</th>
<th>Administration</th>
<th>Library Services</th>
<th>Research Services</th>
<th>Aquatic Research Services</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>$3,188,396</td>
<td>$368,776</td>
<td>$346,380</td>
<td>$636,238</td>
<td>$1,045,652</td>
<td>$1,722,940</td>
<td>$346,574</td>
<td>$344,199</td>
<td>$239,100</td>
<td>$8,238,255</td>
</tr>
<tr>
<td>Fringe benefits</td>
<td>852,100</td>
<td>99,599</td>
<td>93,522</td>
<td>171,739</td>
<td>282,421</td>
<td>468,136</td>
<td>93,575</td>
<td>92,934</td>
<td>64,557</td>
<td>2,218,583</td>
</tr>
<tr>
<td>Professional services</td>
<td>63,077</td>
<td>252,301</td>
<td>—</td>
<td>29,915</td>
<td>73,695</td>
<td>196,044</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>618,960</td>
</tr>
<tr>
<td>Subcontracts</td>
<td>981,132</td>
<td>—</td>
<td>957,949</td>
<td>3,127</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1,942,208</td>
</tr>
<tr>
<td>Equipment</td>
<td>522,592</td>
<td>334,164</td>
<td>2,470</td>
<td>1,466</td>
<td>135,947</td>
<td>26,875</td>
<td>—</td>
<td>4,050</td>
<td>2,598</td>
<td>1,030,162</td>
</tr>
<tr>
<td>Supplies</td>
<td>537,402</td>
<td>391,223</td>
<td>40,850</td>
<td>110,557</td>
<td>217,796</td>
<td>138,744</td>
<td>15,073</td>
<td>353,334</td>
<td>42,422</td>
<td>1,847,401</td>
</tr>
<tr>
<td>Travel</td>
<td>501,316</td>
<td>193,138</td>
<td>(2,834)</td>
<td>151,35</td>
<td>3,133</td>
<td>39,363</td>
<td>10,707</td>
<td>915</td>
<td>95</td>
<td>782,854</td>
</tr>
<tr>
<td>Serials</td>
<td>627</td>
<td>1,466</td>
<td>—</td>
<td>15,846</td>
<td>628</td>
<td>1,305</td>
<td>476,119</td>
<td>346</td>
<td>—</td>
<td>496,337</td>
</tr>
<tr>
<td>Utilities</td>
<td>292</td>
<td>439</td>
<td>185,488</td>
<td>1,901</td>
<td>730,360</td>
<td>99,609</td>
<td>367</td>
<td>304</td>
<td>1,599</td>
<td>1,020,359</td>
</tr>
<tr>
<td>Depreciation</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1,483,203</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1,483,203</td>
<td>—</td>
</tr>
<tr>
<td>Other</td>
<td>223,503</td>
<td>300,789</td>
<td>216,477</td>
<td>331,173</td>
<td>493,2367</td>
<td>472,017</td>
<td>111,450</td>
<td>195,312</td>
<td>82,656</td>
<td>2,426,613</td>
</tr>
<tr>
<td>Internal direct changes</td>
<td>359,010</td>
<td>801,051</td>
<td>(665,077)</td>
<td>98,639</td>
<td>(147,503)</td>
<td>28,593</td>
<td>49,906</td>
<td>(498,532)</td>
<td>(26,087)</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7,229,447</td>
<td>2,743,631</td>
<td>1,175,225</td>
<td>1,431,736</td>
<td>4,323,769</td>
<td>3,193,626</td>
<td>1,107,674</td>
<td>492,887</td>
<td>406,940</td>
<td>22,104,935</td>
</tr>
<tr>
<td><strong>Indirect expense allocations</strong></td>
<td>3,802,467</td>
<td>1,400,877</td>
<td>312,480</td>
<td>4,009,072</td>
<td>(4,323,769)</td>
<td>(3,193,626)</td>
<td>(1,107,674)</td>
<td>(492,887)</td>
<td>(406,940)</td>
<td>—</td>
</tr>
<tr>
<td><strong>Total expenses</strong></td>
<td><strong>$11,031,914</strong></td>
<td><strong>$4,144,508</strong></td>
<td><strong>$1,487,705</strong></td>
<td><strong>$5,440,808</strong></td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td><strong>$22,104,935</strong></td>
</tr>
</tbody>
</table>
One of the goals of the MBL's recently announced Discovery Campaign is to raise $1 million in support of the MBL/WHOI Library. This is excellent news indeed for the library. Funding at this level will be a good start towards protecting for future generations of scientists one of the world's most comprehensive—and valuable—collections of books and journals in the biological, oceanographic, and ecological sciences. This support will also help in the development of information technology, which promises to play a vital role in the future of the library.

The way the library will serve scientists in the next decade will be very different from the way it serves them today. More and more the library is becoming a conduit rather than a repository of information, providing on-line access to the burgeoning electronic literature. But even as electronic delivery alters the library and the way it is used, the MBL's irreplaceable book and journal collection continues to be a national treasure that must be conserved.

The Library Committee has spent considerable time over the past year evaluating our collection as a whole, the library's physical plant, and the future of both the paper and electronic library. The committee found that even with the advent of more electronic resources in the library, still more room will soon be needed to house all the early monographic series now available in the stacks and the hardware required to serve the growing electronic resources.

With fellow members of the Boston Library Consortium, we are looking into the feasibility of having an off-site storage facility. If this plan is realized, we can look forward to a cooperatively run depository that will offer electronic retrieval and courier service as well as warehousing for some of our lesser used volumes, making room for other, ever expanding information resources.

Special collections

A new Special Collections area has been created in the third floor book section of the library through a generous gift made in memory of Ivor Cormann. In this area, the expeditions, bound collected reprints, and books from the open shelves published before 1900 are being protected. Earlier works, currently on the open shelves in the stacks, are being cataloged and placed in the Rare Books Room.

Digital library

As we preserve the older collection, we are expanding the electronic collection. The library currently supports more than 300 full-text electronic journals on its web site (www.mbl.edu). We provide access to more than 35 commercial databases and provide public access to databases created here at the MBL on marine animals, E. coli, women-in-science, the Leuckart charts, and other educational material of interest to both scientists and students. From the Community of Science we have purchased funding and patent databases including the Expertise Database, which contains information on individual scientists and their projects. Woods Hole scientists who enter information about their work in the data bank are rewarded with timely information on available funding sources in their field.

The library continues to update to the latest versions of Internet Grateful Med and PubMed and InfoBank Search. The latter service includes newspaper, magazine, academic, and general reference searching targeted to our student and visitor populations. Bibliographies of relevant resources for the many summer courses held at the MBL have been created and can be accessed via the web. The Don Flescher photo collection of fish is a new database available from the library home page. It is comprised of 1500 pictures searchable by species, common name, catch area, or taxonomy.

Journal issues

One of the newest issues facing libraries, along with the continued rise in subscription prices, is the new
phenomena of publishers collecting electronic information at the "article level" when library users log into their sites. Vendors and publishers can now gather specific user data right down to the exact article, phrase, and words that someone pulls up or orders. What happens to this information? If this user information should be sold to the right company, it could become important for determining who else in the world is interested in, or perhaps working on, the same research problem. Will investigators hesitate to look at publishers' electronic sites for fear of competitors getting a hint of what they are working on? What protections can the library provide? A cloak of anonymity, possibly; but right now information on article use is transmitted almost exclusively to the publishers and not provided to the library.

Like other libraries, the MBL/WHOI Library is now managing licenses covering information content as opposed to purchasing the contents. At the same time, we are trying to negotiate protections for our users. Our newly appointed Technical Services Coordinator carries the responsibility of "watchdog" for these licenses. From the arena of fair use, we now are venturing into the arena of ethical use of information.

Ensuring access to today's electronic resources tomorrow is another major concern. Since 1991 the library has canceled more than 500 journal subscriptions. In 1991 we borrowed 1858 articles for our patrons. In 1997 we borrowed 3259, representing a 42% increase over six years. This practice will continue to increase as it becomes necessary to cancel titles in order to meet publishers' price increases for "must have" journals. As a result, electronic document delivery, whether providing documents for other libraries or retrieving materials for our own scientists, is becoming an ever-increasing component of the library's services.

Instruction

The new Science Reference Librarian has quickly expanded and improved the library's instructional programs on all four campuses (MBL, WHOI, Fisheries, and USGS). Training and course instruction is now provided for researchers and students, and new on-line bibliographies and reserve lists have been created for MBL summer courses. There continues to be high demand for new courses in how to search scientific databases. JAVA, Web page design, Windows 95, Powerpoint, etc.

Branch libraries

Jacqueline Riley, the Science Reference Librarian at the Fisheries, has implemented many new services including launching a NEFSC library web page. The contract that provides library services for the National Marine Fisheries, while bringing a collegial interchange at the local level, presents some technological problems at the national level that resulted in different automated library systems. The marriage of two different library systems seemed to be impossible until a method was devised by Laurel Duda (MBL) and Maggie Rioux (WHOI) that allows both libraries to share bibliographic records without redundant effort (Duda, L.E. and M.A. Rioux, One Library, One Bib Record—Two OPACs, Two Systems. Information Outlook Vol. 2, No 3: 31–36).

A new library was incorporated into the design of the new WHOI Research Vessel Atlantis. Spaced designed for a computer workstation with Internet access for the researchers and staff to fulfill their information needs while at sea. A reference collection, popular works, and a wonderful collection of World War II monographs donated by Ken Parda are also available aboard ship.

The Data Library, using the Library's integrated computer systems, has installed a new image server, providing photographic images of the WHOI scientific instrument collection. The new ALVIN archive catalog provides retrieval of individual ALVIN dive records through our local on-line catalog, MARINER, including all related media the data archive holds and hot links to images from the dives. More than 700 of the photographs in the MBL archives, including the late 1800 and early 1900 collection of MBL's Baldwin Coolidge photos, have also been cataloged and are available through MARINER and the Web.

A growing debate focusing on numerical data in the Earth and Environmental sciences and the issues relevant to the management of all non-text information was the focus of the Scientific Data Advisory Committee which met this past year at WHOI. The major problem identified was access to the data and how the library must make it easier for users of data sets to find, select, and retrieve that data. In order to do this the Data Library needs to encourage submission of data sets in a useable standard metadata format, with appropriate documentation. Because getting scientists to do the latter is referred to as "herding cats," the community needs to provide assistance and incentives.

The future

The National Library of Medicine awarded the library $1,033,278 in support of the project titled, "Professional Services in Support of NLM's Outreach Efforts to Encourage the Use of Computers and Information Science in Medicine." With this support,
the library is able to plan for "change" over the next five years and to offer services that will fit evolving needs. However, all of the members of the scientific community must promote the value of academic access to information for research and teaching. They will also need to use innovative technology to improve scholarly communications without operating in an economic model tied to increasing costs from large commercial publishers. Libraries and administrators have realized that spiraling costs cannot be solved by strategies that merely include canceling titles and collective purchasing. Change must be effected through partnerships in new technologies, and the development of new models of publication and distribution.

While the new electronic environments offer opportunities to provide new services, we also need to think about the sustainability of the information ecosystem: managing the life cycle of information for preservation and access. This year the Florence Gould Foundation awarded $30,000 to the library for the preservation and conservation of the French scientific rare books in our collection. The library will make these books available electronically and will use some of the high-end translation dictionaries now available on our Web page that allows French to English translation.

As noted, one of the goals of the Discovery Campaign is to help preserve the library facility and the book and journal collections for future scholars. Managing this traditional collection will be much easier than managing the new electronic collection, which presents a number of new issues, not the least being the lack of planning for digital archival storage and migration to new technologies by the publishers. As we approach the 21st Century, "change" will be the MBL/WHOI Library's primary challenge.

—Catherine Norton
Educational Programs

Summer Courses

Biology of Parasitism: Modern Approaches
(June 12–August 15)

Directors
Steven Hajduk, University of Alabama, Birmingham
Edward Pearce, Cornell University

Faculty
Robert Bullis, Marine Biological Laboratory
Harry Dickerson, University of Georgia
Steve Ealick, Cornell University
Christopher Hunter, University of Pennsylvania School of Veterinary Medicine
Susan Little, University of Georgia
Phil LoVerde, State University of New York, Buffalo
David Russell, Washington University School of Medicine
Phillip Scott, University of Pennsylvania
David Sibley, Washington University School of Medicine
Christian Tschudi, Yale University School of Medicine
Buddy Ullman, Oregon Health Sciences University
Elisabeta Ullu, Yale University School of Medicine

Teaching Assistants
Laura Rosa Brunet, Cornell University
Nino Campobasso, Cornell University
Darrick Carter, Oregon Health Sciences University
Jaime Dant, Washington University Medical School
Jerome Drain, University of Alabama, Birmingham
Merle Elloso, University of Pennsylvania
Wendy Freebfern, State University of New York, Buffalo
Maren Lingnau, Washington University School of Medicine
Carol Lopez-Estrano, Yale University

Joao Pedras-Vasconcelo, Cornell University Veterinary School
Elizabeth Sabin, Cornell University

Lecturers
Norma Andrews, Yale University School of Medicine
James Bangs, University of Wisconsin, Madison
Stephen Beverley, Harvard University School of Medicine
John Boothroyd, Stanford University
Karen Day, Oxford University, United Kingdom
John Donelson, University of Iowa College of Medicine
Paul Englund, Johns Hopkins University School of Medicine
Daniel Goldberg, Washington University
Richard K. Griscis, University of Manchester, United Kingdom
Kasturi Haladar, Stanford University School of Medicine
John Heuser, Washington University School of Medicine
Stephen Hoffman, Naval Medical Research Institute
Peter Hotez, Yale University School of Medicine
William Jeffery, Pennsylvania State University
Patricia Johnston, University of California, Los Angeles
Richard Komuniecki, University of Toledo
Manfred Kopf, Basel Institute for Immunology, Switzerland
Jean Langhorne, Imperial College of Science and Technology, United Kingdom
Timothy Nilsen, Case Western Reserve University
Marilyn Parsons, Seattle Biomedical Research Institute
William Petri, University of Virginia Health Sciences Center
Meg Phillips, University of Texas Southwest
Steven Reed, Infectious Disease Research Institute
Steve Reiner, University of Chicago
David Sacks, National Institutes of Health
Alan Sher, National Institutes of Health
Mitchell Sogin, Marine Biological Laboratory
Kenneth Stuart, Seattle Biomedical Research Institute
Sam Turco, University of Kentucky College of Medicine
C. C. Wang, University of California, San Francisco
Gary Ward, University of Vermont
Tom Wellens, National Institutes of Health
Directors

Marianne Bronner-Fraser, California Institute of Technology
Scott Fraser, California Institute of Technology

Faculty

Andre Adoutte, Université Paris-Sud, France
Rosa Beddington, National Institute for Medical Research, United Kingdom
R. Andrew Cameron, California Institute of Technology
Andrea Collazo, California Institute of Technology
Eric H. Davidson, California Institute of Technology
Richard Harland, University of California, Berkeley
Lee Nisswander, Memorial Sloan-Kettering Cancer Center
James Posakony, University of California, San Diego
Nadia Rosenthal, Massachusetts General Hospital
Joel Rothman, University of California, Santa Barbara
Joshua Sanes, Washington University School of Medicine
John Saunders, Jr., Marine Biological Laboratory
Martin Shankland, University of Texas
Judith Venuti, Columbia University

Teaching Assistants

Maria Ina Amone, California Institute of Technology
Guillaume Balavoine, Wellcome/CRC Institute, United Kingdom
Rebecca Beach, Hollins College
Steve Gendreau, University of California, Santa Barbara

Course Coordinator

Robert Sabatini, University of Alabama, Birmingham

Course Assistant

Susan Pardo, University of Pennsylvania

Laboratory Assistant

Joseph Paton, Tufts University

Students

Kimberly Brouwer, Johns Hopkins School of Public Health
Maristela Camargo, Federal University of Minas Gerais, Brazil
Soren Ganti, New York University School of Medicine
Michelle Gleson, University of Technology, Australia
Meike Hensmann, Yale University
David Jiang, Johns Hopkins University School of Medicine
Andreas Lingnau, Washington University Medical School
Gunnar Mair, Queen's University of Belfast, United Kingdom
Antoinette Marsh, University of California, Davis
Lillian Ouko, University of Pennsylvania
Lisa Shoda, Washington State University
Kevin Tan, National University, Singapore
Carl Johan Treutiger, Karolinska Institute, Sweden
Elisabeth Tripllett, Cornell University
Eric Villegas, University of Pennsylvania
Ulrike Wille, University of Tübingen, Germany

Embryology: Concepts and Techniques in Modern Developmental Biology
(June 15–July 26)

Directors

Marianne Bronner-Fraser, California Institute of Technology
Scott Fraser, California Institute of Technology

Faculty

Andre Adoutte, Université Paris-Sud, France
Rosa Beddington, National Institute for Medical Research, United Kingdom
R. Andrew Cameron, California Institute of Technology
Andrea Collazo, California Institute of Technology
Eric H. Davidson, California Institute of Technology
Richard Harland, University of California, Berkeley
Lee Nisswander, Memorial Sloan-Kettering Cancer Center
James Posakony, University of California, San Diego
Nadia Rosenthal, Massachusetts General Hospital
Joel Rothman, University of California, Santa Barbara
Joshua Sanes, Washington University School of Medicine
John Saunders, Jr., Marine Biological Laboratory
Martin Shankland, University of Texas
Judith Venuti, Columbia University

Teaching Assistants

Maria Ina Amone, California Institute of Technology
Guillaume Balavoine, Wellcome/CRC Institute, United Kingdom
Rebecca Beach, Hollins College
Steve Gendreau, University of California, Santa Barbara

Course Coordinator

Robert Sabatini, University of Alabama, Birmingham

Course Assistant

Brian Hondowicz, University of Pennsylvania

Laboratory Assistant

Joseph Paton, Tufts University

Students

Kimberly Brouwer, Johns Hopkins School of Public Health
Maristela Camargo, Federal University of Minas Gerais, Brazil
Soren Ganti, New York University School of Medicine
Michelle Gleson, University of Technology, Australia
Meike Hensmann, Yale University
David Jiang, Johns Hopkins University School of Medicine
Andreas Lingnau, Washington University Medical School
Gunnar Mair, Queen's University of Belfast, United Kingdom
Antoinette Marsh, University of California, Davis
Lillian Ouko, University of Pennsylvania
Lisa Shoda, Washington State University
Kevin Tan, National University, Singapore
Carl Johan Treutiger, Karolinska Institute, Sweden
Elisabeth Tripllett, Cornell University
Eric Villegas, University of Pennsylvania
Ulrike Wille, University of Tübingen, Germany

Microbial Diversity (June 15–July 31)

Directors

Edward Leadbetter, University of Connecticut
Abigail Salyers, University of Illinois
Faculty
Kurt Hanselmann, University of Zurich, Switzerland
Bruce Paster, Forsyth Dental Center
Rolf Schauder, University of Frankfurt, Germany

Teaching Assistants
Elena Barbieri, University of Urbino, Italy
Daniel Gisi, Swiss Federal Institute of Technology, Switzerland
David Graham, University of Illinois
Irena Levin, Forsyth Dental Center
Caroline Plinge, Wageningen Agricultural University, The Netherlands

Lecturers
Bianca Brahamsa, University of California, San Diego
Colleen Cavanagh, Harvard University
Yehuda Cohen, Hebrew University of Jerusalem, Israel
Sharon Danielson, Rensselaer Polytechnic Institute
Daniel Distel, University of Maine
Stephen Farrand, University of Illinois, Urbana-Champaign
James Fleming, University of Tennessee
Tillman Gergross, Metabolix, Inc., Cambridge
Robert Haselkorn, University of Chicago
Holger Jannasch, Woods Hole Oceanographic Institution
Jared Leedbetter, Michigan State University
Mark McBride, University of Wisconsin, Milwaukee
Terry Miller, New York State Department of Health
Duane Moser, Center for Great Lakes Studies, Milwaukee
Sandra Nierzwicki-Bauer, Rensselaer Polytechnic Institute
Thomas Pitta, Rowland Institute for Science
James Russell, Cornell University
Daad Saffarini, University of Massachusetts
Anglica Seitz, Harvard University
Nadja Shoemaker, University of Illinois
Alfred Spormann, Stanford University
David Stahl, Northwestern University
Anne Summers, University of Georgia
Andreas Teske, Woods Hole Oceanographic Institution
Pieter Visscher, University of Connecticut, Avery Point
John Waterbury, Woods Hole Oceanographic Institution
Lily Young, Rutgers University

Course Coordinator
Madeline Vargas, College of the Holy Cross

Course Assistant
Noah Horst, Tufts University

Students
Ehud Banin, Tel Aviv University, Israel
Fikry Barghuthy, Hebrew University, Israel
Brendan Bohannan, Michigan State University
Alfred Boyle, Rutgers University
Scott Dawson, University of California, Berkeley
Jeffrey Dugas, University of Connecticut
Kelly Evans, Queen’s University, Canada
Deborah Hughes, Scripps Institution of Oceanography
Elke Jaspers, Universitat Oldenburg, Germany
Hope Johnson, Stanford University
Sabine Krause, Max-Planck-Institut, Germany
Thomas Lie, University of Connecticut

David Long, Montana State University
Junko Munakata Marr, Colorado School of Mines
William Sobczak, Cornell University
Alexandra Stone, Ohio State University
Acharawan Thongnue, University of North Texas
Crisogono Vasconcelos, Universidade Federal Fluminense, Brazil
S. Wenuganen, Bogor Agricultural University, Indonesia
Ludek Zurek, University of Alberta, Canada

Neural Systems & Behavior (June 15–August 8)

Directors
Janis Weeks, University of Oregon
Harold Zakon, University of Texas, Austin

Faculty
Ronald L. Calabrese, Emory University
Catherine Carr, University of Maryland
Kathleen French, University of California, San Diego
David Glanzman, University of California, Los Angeles
Scott Hooper, Ohio University
Richard Hyson, Florida State University
Masashi Kawasaki, University of Virginia
William Kristan, University of California, San Diego
Richard Levine, University of Arizona
Pierre Meyrand, Université de Bordeaux, France
Michael Nusbaum, University of Pennsylvania School of Medicine
Glen Prusky, University of Lethbridge, Canada
William Roberts, University of Oregon
Gary Rose, University of Utah
Angela Wenning, Universität Konstanz, Germany

Teaching Assistants
Cecilia Armstrong, University of Oregon
Dawn Marie Blitz, University of Pennsylvania School of Medicine
Shaoping Chen, University of California, Los Angeles
Richard Dyck, University of Lethbridge, Canada
Michael Ferrari, University of California, San Diego
Evelyn Field, University of Lethbridge, Canada
Matthew Friedman, Cornell University
Jorge Golowasch, Brandeis University
Andrew Hill, Emory University
Maria Kubke, University of Maryland
David Lenzi, University of Oregon
Lynne McAnelly, University of Texas
Tasha McMahon, University of California, Los Angeles
Geoffrey Murphy, University of California, Los Angeles
David Sandstrom, University of Arizona
Daphne Soares, University of Maryland
Laura Wolszczak, Columbia University

Lecturers
George Augustine, Duke University Medical Center
Rita Balice-Gordon, University of Pennsylvania School of Medicine
David Clayton, University of Illinois
Roger Hanlon, Marine Biological Laboratory
Ron Hoy, Cornell University
Edward Kravitz, Harvard Medical School
Eduardo Macagno, Columbia University
Gina Turrigiano, Brandeis University

Scholars-in-Residence
Sascha du Lac, Salk Institute
Alan Gelperin, Bell Labs
Rebecca Johnston, Colby College
Simon Laughlin, University of Cambridge, United Kingdom

Course Assistants
Sarah Doernberg, Emory University
Sarah Gaines, Princeton University

Students
Emre Aksay, Bell Labs
Eric Bauer, University of Texas, Austin
Ben Bonham, University of California, San Francisco
Holly Campbell, University of Arizona
Randy Chitwood, University of Texas, San Antonio
Virginia de Sa, University of California, San Francisco
Teresa Esch, University of Virginia
Joe Fass, Michigan Tech University
Paul Gasser, Arizona State University
Timothy Holy, Princeton University
William Kargo, Allegheny University
Christopher Kilroy, University of North Carolina, Wilmington
Susan Laessig, University of Maryland, Baltimore
Lynne Merchant, University of California, San Diego
Leslie Osborne, University of California, Berkeley
Dort Polna, Northeastern University
Rex Robison, Stanford University
Sen Song, Brandeis University
Ayako Yamaguchi, Columbia University
Shih-Rung Yeh, Georgia State University

Neurobiology (June 15–August 16)

Directors
Gary Banker, University of Virginia Medical School
Daniel Madison, Stanford University Medical Center

Section Directors
Michael Greenberg, Childrens’ Hospital
Stephen Smith, Stanford University Medical Center

Faculty
Susan Birren, Brandeis University
Mark Bowlby, Wyeth-Ayerst Research
Gabriel Corfas, Childrens’ Hospital
Kerry Delaney, Simon Fraser University, Canada
Donald Faber, Allegheny University of the Health Sciences
Steven Finkbeiner, Childrens’ Hospital
Philip Haydon, Iowa State University
Stephen Jones, Case Western Reserve University
Maurice Kernan, State University of New York, Stony Brook
Stephen Lin, Wyeth-Ayerst Research
Ed McCleskey, Oregon Health Sciences University
Adam Rory McQuiston, Stanford University School of Medicine
Thomas Reese, National Institutes of Health
Morgan Sheng, Howard Hughes Medical Institute
Carolyn Smith, National Institutes of Health
Stuart Thompson, Stanford University
Li-Huei Tsai, Harvard Medical School
Susan Wray, National Institutes of Health
Joshua Zimmerberg, National Institutes of Health

Teaching Assistants
F. Woodward Hopf, Stanford University Medical Center
Alane Murdock, Stanford University Medical Center
Paul Pavlidis, Stanford University Medical Center
Alberto Pereda, Allegheny University
Martine Usdin, Stanford University Medical Center

Lecturers
Yadin Dudai, Weizmann Institute of Science, Israel
Justin Fallon, Brown University
Julie Ann Kauer, Duke University Medical Center
Maurine Linder, Washington University Medical School
Diane Lipscombe, Brown University
Luis Parada, University of Texas
Robert Rosenberg, University of North Carolina, Chapel Hill
Gary Ruvkun, Massachusetts General Hospital
Thomas Sudhof, University of Texas
Karel Svoboda, Cold Spring Harbor Laboratory
Roger Tsien, University of California, San Diego

Course Assistants
Tara Bennett, Dartmouth College
Eleanore Edson, Stanford University

Students
Alberto Bacci, University of Milano, Italy
Elizabeth Brown, Medical College of Virginia
Benjamin Cravatt, Scripps Research Institute
Samuel Hess, Cornell University
Warren Kim, Yale University School of Medicine
Stuart Licht, Massachusetts Institute of Technology
Johanna Montgomery, Otago University, New Zealand
Craig Nelson, Harvard University
Eric Norman, University of Pittsburgh
Rita Sattler, University of Toronto, Canada
Marilee Shelton, University of North Carolina, Chapel Hill
Stephan Sigrist, Max-Planck-Institut, Germany

Physiology: Cellular and Molecular Biology (June 16–July 27)

Directors
Kerry Bloom, University of North Carolina, Chapel Hill
Mark Mooseker, Yale University

Faculty
William Bement, University of Wisconsin
Richard Cheney, University of North Carolina, Chapel Hill
Jonathan Chernoff, Fox Chase Cancer Center
Ruth Empson, University of Oxford, United Kingdom
Antony Galione, University of Oxford, United Kingdom
Tom Hays, University of Minnesota, St. Paul
Daniel Kiehart, Duke University Medical Center
Daniel Lew, Duke University Medical Center
Mary Ann Sells, Fox Chase Cancer Center
Edwin Taylor, University of Chicago
Joseph S. Wolencki, Yale University
Elaine Yeh, University of North Carolina, Chapel Hill

Teaching Assistants
Elaine Barde, Duke University Medical Center
Lisa Evans, Yale University
Tama Hasson, Yale University
Amanda Hayward-Lester, Yale University
Gary Michael Idelchik, University of Wisconsin
Min-gang Li, University of Minnesota, St. Paul
Feng Liu, Fox Chase Cancer Center
Craig Mandato, University of Waterloo, Canada
Ruth Montague, Duke University Medical College
Samara Reck-Peterson, Yale University
Melissa Reeder, Fox Chase Cancer Center
Rey Antonio Sia, Duke University Medical Center
Jenny Sider, University of Wisconsin
Andre Silvanovich, University of Minnesota, St. Paul

Lecturers
Sid Ahnman, Yale University
Angelika Amon, Massachusetts Institute of Technology
Van Bennett, Duke University
John Chant, Harvard University
Paul Forscher, Yale University
Martin Hemler, Dana Farber Cancer Institute
Laurinda Jaffe, University of Connecticut Health Center
Jennifer Lippincott-Schwartz, National Institutes of Health
Bruce Mayer, Harvard University
Ben Neel, Beth Israel Hospital
Terry Orr-Weaver, Massachusetts Institute of Technology
Michael Snyder, Yale University
Karl Swann, University of Connecticut Health Center
Mark Terasaki, University of Connecticut Health Center
Lew Tilney, University of Pennsylvania
Pat Wadsworth, University of Massachusetts, Amherst
Sandra Wolen, Yale University
Tian Xu, Yale University Medical School
Bruce Zetter, Harvard University

Course Coordinator
Dawn Grant, Louisiana State University Medical Center

Course Assistant
Rebekah Harrison, Stanford University

Students
Richard Bayliss, University of Cambridge, United Kingdom
Dale Beach, University of North Carolina, Chapel Hill
George Bell, University of Arizona
Jill Broome, University of North Carolina, Chapel Hill
Julie Canman, University of North Carolina, Chapel Hill
Anthony DePass, University of Massachusetts, Amherst
John Diggins, Providence College
Jean-Emmanuel Faure, Centre National de la Recherche Scientifique, France
Rip Finst, Emory University
Gundula Gries, University of Pennsylvania
Edward Guo, Columbia University
William Heinz, Johns Hopkins University
Maria Holzmann, University of Geneva, Switzerland
G. Karthikeyan, Tata Institute of Fundamental Research, India
Kooru Katoh, Marine Biological Laboratory
Reed Kelso, Yale University
Tijj Ketelaar, Wageningen Agricultural University, The Netherlands
Rosy Lee, Stanford University
Laura Linz, Louisiana State University Medical Center
Jonathan Lyon, Scripps Institute of Oceanography
Paul Maddox, University of North Carolina, Chapel Hill
Gregory McGillem, University of Alabama, Birmingham
Spontaneous McKnight, University of Arizona
Brian Nibbelink, University of Vermont
Helen Nilsson, University of Göteborg, Sweden
Nesrin Ozoren, University of Pennsylvania
Omar Quintero, Duke University Medical Center
Rachael Ream, Hopkins Marine Station
Eric Reese, University of California, Riverside
Yasuhiro Sato, University of Tokyo, Japan
Matthew Simmons, University of Florida
Justin Skoble, University of California, Berkeley
Aline Valster, University of Massachusetts, Amherst
Gang Wang, University of Iowa
Yihong Wang, Ohio University
Kathryn White, Scripps Institute of Oceanography

Short Courses

Analytical & Quantitative Light Microscopy
(May 8–May 16)

Directors
Greenfield Sluder, University of Massachusetts Medical Center, Worcester Foundation Campus
David Wolf, University of Massachusetts Medical Center, Worcester Foundation Campus

Faculty
William B. Amos, Medical Research Council, United Kingdom
Richard Cardello, University of California, Riverside
Walter Carrington, University of Massachusetts Medical School
Jeff Gelles, Brandeis University
Shinya Inoue, Marine Biological Laboratory
Rudolf Oldenbourg, Marine Biological Laboratory
Edward Salmon, University of North Carolina, Chapel Hill
Randi Silver, Cornell University Medical College
Kenneth Spring, National Institutes of Health
Yali Wang, University of Massachusetts Medical Center, 
Worcester Foundation Campus
Warren Zipsel, Cornell University

Teaching Assistants
Christine Thompson, University of Massachusetts Medical Center, 
Worcester Foundation Campus
Elizabeth Thompson, University of Massachusetts Medical Center, 
Worcester Foundation Campus
Clare Waterman-Storer, University of North Carolina, Chapel Hill

Course Coordinator
Frederick Miller, University of Massachusetts Medical Center, 
Worcester Foundation Campus

Students
Julia Avery, Yale University
Margaret Clarke, Oklahoma Medical Research Foundation
Carol Cogswell, University of Sydney, Australia
David Collings, North Carolina State University
Rossella Conti, Brandeis University
Carol Gregorio, University of Arizona, Tucson
Alexey Khodjakov, Wadsworth Center for Labs and Research
Helmut Knapp, Swiss Federal Institute of Technology, Switzerland
Stephen Lambert, University of Massachusetts Medical Center, 
Worcester Foundation Campus
Jeannie Lee, Whitehead Institute
Edwin Levitan, University of Pittsburgh
Ilona Linnola, National Cancer Institute
Frank Macaluso, Albert Einstein College of Medicine
Richard MacDonald, Massachusetts General Hospital
Ivona Novak, August Krogh Institute, Denmark
Joan Packenham, National Institute of Environmental Health 
Sciences
Brigitta Peteri-Brunbæk, Astra Hässle AB, Sweden
Jonathan Pines, The Wellcome Trust/Cancer Research Campaign, 
United Kingdom
Guillermo Romero, University of Pittsburgh
Ichiro Sase, Laboratory of Molecular Biophotonics, Japan
Shuji Toyonaga, Laboratory of Molecular Biophotonics, Japan
Shlomo Trachtenberg, National Institutes of Health
Steven Treisman, University of Massachusetts Medical Center
Stefan Wilhelm, Carl Zeiss, Inc., Germany
Ginger Withers, University of Virginia
Steven Wooding, Medical Research Council, United Kingdom
Ji-Hong Zang, Stanford University
Julianna Zimmerman, Payload Systems, Inc.

Methods in Computational Neuroscience 
(August 3–August 30)

Directors
David Kleinfeld, University of California, San Diego
David Tank, Bell Laboratories/Alcatel Technologies

Faculty
Lawrence Abbott, Brandeis University
Moshe Abeles, Hebrew University of Jerusalem, Israel
Richard Andersen, California Institute of Technology
Robert Barlow, State University of New York Health Science Center
William Bialek, NEC Research Institute
Thomas Collett, University of Sussex, United Kingdom
Rob de Ruyter van Steveninck, NEC Research Institute
Kerry Delaney, Simon Fraser University, Canada
Bard Ermentrout, University of Pittsburgh
David Hansel, Ecole Polytechnique, France
John Hopfield, Princeton University
Daniel Johnston, Baylor College of Medicine
Nancy Kopell, Boston University
Kevan Martin, Swiss Federal Institute of Technology, Switzerland
Kevin Martin, University of North Carolina, Chapel Hill
David McCormick, Yale University School of Medicine
Wolfram Schulte, Université de Fribourg, Switzerland
Terrance Sejnowski, Salk Institute

Medical Informatics (June 1–June 8)

Director
Daniel Masys, University of California, San Diego

Faculty
Paul Clayton, Columbia University
James Grigsby, University of Colorado Health Sciences Center
George Hirpcsak, Columbia-Presbyterian Medical Center
Stephen Johnson, Columbia-Presbyterian Medical Center
Lawrence Kingsland, National Library of Medicine
David Landsman, National Library of Medicine
Donald D.A.B. Lindberg, National Library of Medicine
Richard Rodgers, National Library of Medicine
Jay Sanders, Global Telemedicine Group
H. Sebastian Seung, Bell Laboratories
Arthur Sherman, National Institutes of Health
Karen Sigvardt, University of California, Davis
Frederick Sigworth, Yale University School of Medicine
Haim Sompolinsky, Hebrew University of Jerusalem, Israel
Mircea Steriade, Université Laval, Canada
David Terman, Ohio State University
Naftali Tishby, Hebrew University of Jerusalem, Israel
Misha Tsodyks, The Weizmann Institute, Israel
Steven Zucker, Yale University

Lab Instructors
Roderick Jensen, Wesleyan University
Terrance Kovacs, Bell Laboratories
John White, Boston University

Course Assistant
Joseph Paton, Tufts University

Students
Thomas Adelman, Cornell University
Yoram Ben Shaul, Hebrew University Hadassah School of Medicine, Israel
Karl Deisseroth, Stanford University
Reiko Maki Fitzsimonds, University of California, San Diego
Galit Fuhrmann, Hebrew University of Jerusalem, Israel
Mark Goldman, Harvard University
Audrey Guzik, Allegheny University
Richard Hahnloser, Swiss Federal Institute of Technology, Switzerland
Robert Harris, University of Cambridge, United Kingdom
Katrina MacLeod, California Institute of Technology
William Miller, Brandeis University
Jonathan Murnick, Harvard University Medical School
Louis Neltner, Ecole Polytechnique, France
Duane Nykamp, New York University
Anitha Pasapathy, Johns Hopkins University
Sharon Peled, Massachusetts Institute of Technology
Daniel Reich, Rockefeller University
Mark Schnitzer, Princeton University
Oren Shriki, Hebrew University of Jerusalem, Israel
Jonathan Simon, University of Maryland
William Vinge, University of California, Berkeley
Martin Wainwright, Harvard University
James Zackheim, Rutgers University

Course Assistant
Lisa Mehlmann, University of Connecticut Health Center

Students
Anne Borgne, CNRS, France
Tao Cheng, Massachusetts General Hospital
Goffredo Cognetti, University of Palermo, Italy
Maxim Dorovkov, University of Medicine and Dentistry of New Jersey/Robert Wood Johnson Medical School
William Faught, Medical University of South Carolina
Jennifer Hartt, University of Pennsylvania
Lorayne Jenkins, Wyeth Ayerst Research
Kathleen Jensen, U.S. Environmental Protection Agency
Shuxian Jiang, Harvard Institutes of Medicine
David Lagunoff, St. Louis University
Yoshiki Omura, Heart Disease Research Foundation
Stelios Papaioannou, United Medical and Dental School of Guy’s and St. Thomas’ Hospitals, United Kingdom
May Peñarroyo, De La Salle University, Philippines
Gloria Perez, Massachusetts General Hospital
Margherita Randazzo, University of Palermo, Italy
Vasantha Reddi, University of Virginia
Carol Reimisch, Tufts University School of Veterinary Medicine
Nancy Searby, NASA Ames Research Center/Stanford University
Jennifer Stephens, University of Oklahoma
Nirmala SundarRaj, University of Pittsburgh

Molecular Mycology: Current Approaches to Fungal Pathogenesis (August 10–August 30)

Directors
John Edwards, Jr., Harbor-UCLA Medical Center
Paul T. Magee, University of Minnesota
Aaron P. Mitchell, Columbia University

Lecturers
Arturo Casadevall, Albert Einstein College of Medicine
Gary T. Cole, Medical College of Ohio
Brendan Cormack, Stanford University School of Medicine
Jim Cutler, Montana State University
Judith Domer, Tulane Medical School
Scott Filler, Harbor-UCLA Medical Center
Gerald Fink, Whitehead Institute of Biomedical Research
Carol A. Kumamoto, Tufts University School of Medicine
Myra Kurtz, Merck Research Laboratories
June Kwon-Chung, National Institutes of Health
John McCusker, Duke University Medical Center
John Perfect, Duke University School of Medicine
Michael A. Pfaffer, University of Iowa College of Medicine
Judith Rhodes, University of Cincinnati
Stewart Scherer, University of Minnesota School of Medicine
Brian Wong, Veterans Administration Connecticut Healthcare System

Teaching Assistants
Janna Beckerman, University of Minnesota
Maria Soudek, Columbia University
Yang Xiao, Columbia University

Microinjection Techniques in Cell Biology
(May 20–May 27)

Director
Robert B. Silver, Marine Biological Laboratory

Faculty
Suzanne Klaessig, Cornell University
Douglas Khine, Kent State University
Gernot Presting, Institute of Plant Breeding, Germany
Eric Shelden, University of Michigan
Course Assistant
Joseph Paton, Tufts University

Students
James Alspaugh, Duke University
Kent Buchanan, University of Oklahoma Health Sciences Center
Ena Clarke, Royal Postgraduate Medical School, United Kingdom
Marianne De Backer, Janssen Research Foundation, Belgium
Maurizio Del Poeta, Duke University Medical Center
Tamara Doering, Cornell University Medical School
Roy Hopfer, University of North Carolina, Chapel Hill
Margaret Hostetter, University of Minnesota
Linda Janusck, Loyola University of Chicago
Herbert Mathews, Loyola University of Chicago
Frank-Michael Muller, National Cancer Institute
Norbert Schnell, Zeneca Pharmaceuticals, United Kingdom
Craig Thompson, Scriptgen Pharmaceuticals
Jan van Biezen, Fred Hutchinson Cancer Research Center
Paul Verweij, University Hospital Nymegen, The Netherlands
Mason Zhang, University of Nevada School of Medicine

Neurobiology & Development of the Leech
(August 9–August 30)

Directors
Pierre Drapeau, McGill University, Canada
Martin Shankland, University of Texas, Austin

Faculty
Andreas Baader, University of Zurich, Switzerland
Irmgard Dietzel-Meyer, Ruhr-Universität Bochum, Germany
Francisco Fernandez de Miguel, Universidad Nacional Autonoma, Mexico
John Jellies, Western Michigan University
Jorgen Johansen, Iowa State University
Anna Kleinhaus, New York Medical College
Eduardo Macagno, Columbia University
Mark Martindale, University of Chicago
Barbara Modney, Cleveland State University
Kenneth Muller, University of Miami School of Medicine
John Nicholls, University of Basel, Switzerland
Christine Sahley, Purdue University
Catherine Wedeen, New York Medical College
David Weisblat, University of California

Course Assistant
Gabrielle Tomasky, Marine Biological Laboratory

Students
Istvan Albert, University of Notre Dame
Dianne Allen, Louisiana State University Medical Center
Maria Casanueva, Catholic University, Chile
James Eunum, Marquette University
Chunfa Jie, Iowa State University
Lynette Nguyen, Smith-Kettlewell Eye Research Institute
Elizabeth Perrucio, New York Medical College
Aloysius Phillips, Columbia University
Giulietta Pinato, International School for Advanced Studies, Italy
Subhabrata Sanyal, Tata Institute of Fundamental Research, India
Daniel Shain, University of California, Berkeley
Patrick Wigge, Medical Research Council, United Kingdom

Optical Microscopy and Imaging in the Biomedical Sciences (October 8–October 16)

Director
Colin Izzard, State University of New York, Albany

Faculty
Joseph DePasquale, New York State Department of Health
Robert Hard, State University of New York, Buffalo
Brian Herman, University of North Carolina, Chapel Hill
Shahid Khan, Albert Einstein College of Medicine
Frederick Maxfield, Cornell University Medical College
John Murray, University of Pennsylvania
David M. Piston, Vanderbilt University
Kenneth Spring, National Institutes of Health
Jason Swedlow, Harvard University Medical School

Teaching Assistants
Ken Dunn, Indiana University Medical Center
Lynda Pierini, Cornell University Medical College
Wade Sigurdson, State University of New York, Buffalo
Elizabeth Weihofner, State University of New York, Buffalo

Lecturers
Jan Hinsch, Leica, Inc.
Shinya Inoue, Marine Biological Laboratory
H. Ernst Keller, Carl Zeiss, Inc.
Rudolf Oldenburg, Marine Biological Laboratory
Martin Scott, Consultant in Scientific Imaging

Course Assistant
Kari Lavalli, Marine Biological Laboratory

Students
Diana Bartelt, St. John’s University
Michelle Burack, University of Virginia
Dorte Christensen, Biologic Denmark
Conan Cooper, University of Calgary, Canada
John Crocker, University of Pennsylvania
Leanne Delbridge, University of Melbourne, Australia
Mark Drew, Johns Hopkins University
Tracey du Lancy, University of North Carolina, Chapel Hill
Lars Hansen, Hagedorn Research Institute, Denmark
Brian Helmke, University of Pennsylvania
Robert Hughes, University of Washington
Eleanor Kable, Sydney University, Australia
Peter Kaplan, University of Pennsylvania
Timothy King, University of Texas
Thomas Kinraide, United States Department of Agriculture
David Marcey, Kenyon College
Susanne Pedersen, University of Copenhagen, Denmark
Marli Robertson, University of Calgary, Canada
Pascal Stein, Harvard Medical School
David Swift, University of Pennsylvania
James Thomson, University of Wisconsin
Sebastian Tille, Carl Zeiss Jena, Germany
Mariko Tokito, University of Pennsylvania
Frances Wang, National Institute of Standards & Technology
Karen Zito, University of California, Berkeley
Pathogenesis of Neuroimmunologic Diseases
(August 17–August 29)

Directors
Celia F. Brosnan, Albert Einstein College of Medicine
Jack Rosenbluth, New York University School of Medicine

Faculty
Barbara Barres, Stanford University School of Medicine
Etty Benveniste, University of Alabama, Birmingham
Joan Berman, Albert Einstein College of Medicine
Peter Charles, Albert Einstein College of Medicine
Patricia Coyle, State University of New York, Stony Brook
Robert Darnell, Rockefeller University
Judah Denburg, McMaster University, Canada
David Felten, University of Rochester
Robert M. Gould, New York State Institute of Basic Research
Diane Griffin, Johns Hopkins University
John Griffin, Johns Hopkins School of Medicine
William Hickey, Dartmouth-Hitchcock Medical Center
Gilla Kaplan, Rockefeller University
Paul Knopf, Brown University
Vijay Kuchroo, Brigham and Women’s Hospital

Jon Lindstrom, University of Pennsylvania School of Medicine
James Martiney, Picower Institute for Medical Research
Steven Pfeiffer, University of Connecticut Health Center
Richard Ransohoff, Cleveland Clinic Foundation
Bruce Ransom, University of Washington School of Medicine
Anthony Reder, University of Chicago
J. M. Ritchie, Yale University School of Medicine
James Salzer, New York University Medical Center
Clifford Saper, Beth Israel Hospital
Moon Shin, University of Maryland, Baltimore
Michele Solimena, Yale University
Esther Sternberg, National Institutes of Health
J. Wayne Streilein, Schepens Eye Research Institute
Byron Waksman, Foundation for Microbiology

Students
Amit Bar-Or, Massachusetts General Hospital
Rita Baron-Faust, WCBS NewsRadio 88
Alexei Boiko, Russian State Medical University, Russia
Emanuela Bonfoco, La Jolla Institute of Immunology
Laurent Coscoy, Pasteur Institute, France
Benedicte Dubois, Rega Institute, Belgium
Urszula Fiszer, Institute of Psychiatry & Neurology, Poland
Glen Greenough, Dartmouth-Hitchcock Medical Center
Carolyn Hoban, Cambridge Neuroscience Inc.
Liwei Hua, Albert Einstein College of Medicine
Kee-Ching Jeng, Taichung Veterans General Hospital, Taiwan
Pitagoras Justino, Universidade Federal de Uberlandia, Brasil
Bernd Kieser, University of Würzburg, Germany
Pia Kivisikk, Karolinska Institute, Sweden
Dmitriy Labunsky, Institute of Neurology, Russia
Igor Leykin, Weizmann Institute of Science, Israel
Carrie McManus, Albert Einstein College of Medicine
Mary McMenamin, Oxford University, United Kingdom
Neeluwar Mozaffarian, Albert Einstein College of Medicine
Marcin Mycko, Medical Academy of Lodz, Poland
Jitendra Patel, Zeneca Pharmaceuticals
Barry Singer, New York Hospital-Cornell Medical Center
Nevil Singh, Tata Institute of Fundamental Research, India
Sulpicio Soriano, Children’s Hospital/Harvard Medical School

Workshop on Molecular Evolution
(August 3–August 15)

Directors
Daniel B. Davison, Bristol-Myers Squibb PRI
Mitchell Sogin, Marine Biological Laboratory

Faculty
W. Ford Doolittle, Dalhousie University, Canada
Douglas Eernisse, California State University
Joseph Felsenstein, University of Washington
Michael Gray, Dalhousie University, Canada
Robert Haselkorn, University of Chicago
David Hillis, University of Texas
Mike Holder, University of Houston
Richard Hudson, University of California, Irvine
Thomas Kaufman, Indiana University
David Maddison, University of Arizona, Tucson
Geoffrey McFadden, University of Melbourne, Australia
Lynn Miller, Genetics Computer Group, Inc.
Michael Miyamoto, University of Florida
Rasmus Nielsen, University of California, Berkeley
Gary Olsen, University of Illinois
William Pearson, University of Virginia
Kevin Peterson, California Institute of Technology
David Roos, University of Pennsylvania
Pamela Solts, Washington State University
David Swoffer, Smithsonian Institution
John Wakeley, Nelson Biological Labs
Bruce Wash, University of Arizona, Tucson
Sam Ward, University of Arizona, Tucson
Carl Woose, University of Illinois, Urbana-Champaign

Teaching Assistant
Steven Thompson, Washington State University

Course Assistant
Udeni Amit, Marine Biological Laboratory

Students
Michael Alfaro, University of Chicago Field Museum of National History
John Archibald, Dalhousie University, Canada
Pamela Armosky, Woods Hole Oceanographic Institution
Vijay Aswani, Smithsonian Tropical Research Institute
Andrew Baker, University of Miami
Anne Bansemir, Rutgers University
Elizabeth Barratt, Zoological Society of London, United Kingdom
Mary Bateson, Montana State University
Christiane Biermann, State University of New York, Stony Brook
Carrine Blank, University of California, Berkeley
Lisa Borghesi, Oklahoma Medical Research Foundation
Adriana Briscoe, Harvard University
Daniel Brumbaugh, University of Texas, Austin
Nina Brunner, University of Essen, Germany
Carmen Cadilla, University of Puerto Rico
Susan Chien, University of Florida
Manuela Coelho, University of Lisbon, Portugal
Chris Conroy, University of Alaska Museum
Colombar de Vargas, University of Geneva, Switzerland
Joel Doré, Institut National de la Recherche Agronomique, France
Mark Dorss, University of Edinburgh, Scotland
Amy Driskell, University of Chicago Field Museum of National History
Lindsey Dubb, University of Washington
Mary Eubanks, Duke University
Jeffry Fasick, University of Maryland Baltimore County
Osin Feeley, Dalhousie University, Canada
Victor Fet, Marshall University
Eric Gaidos, California Institute of Technology Jet Propulsion Laboratory/Woods Hole Oceanographic Institution
Regine Großkopf, Max-Planck-Institut, Germany
Gabriel Gutierrez, University of Seville, Spain
Malin Heldtander, National Veterinary Institute, Sweden
Hiromi Imamichi, SAIC Frederic
Alex Jeffries, National Research Council, Canada
Dana Jones, Centers for Disease Control and Prevention
Marie-Josée LaForest, University of Montreal, Canada
Kirsten Lindstrom, University of California, Berkeley
Jaw-Ching Liu, University of Texas, Houston
Lei Liu, University of Connecticut
Frieder Mayer, University of Erlangen, Germany
Damhnait McHugh, Harvard University
Kirsten Nicholson, University of Miami

Link Olson, University of Chicago Field Museum of National History
Berit Pettersson, Royal Institute of Technology, Sweden
Mary Poss, University of Washington
Linda Prince, University of North Carolina, Chapel Hill
Anne Marie Quinn, Yale University
Patrick Reynolds, Hamilton College
Frank Rosenzweig, University of Idaho
Marco Salemi, Rega Institute, Belgium
Andrew Salywon, Arizona State University
Nikolaos Schizas, University of South Carolina
Alastair Simpson, University of Sydney, Australia
James Robert Stevens, University of Bristol, United Kingdom
Suzanne Sukhdon, Rutgers University
Jing Tong, Chinese University, Hong Kong
Catherine Walton, University of Leeds, United Kingdom
Hai Wang, University of Houston
Jacqueline Wecker, University of Alaska, Fairbanks
Connie Westhoff, University of Nebraska
Adrian Whatmore, University of Warwick, United Kingdom
Kenneth Wurdack, University of North Carolina, Chapel Hill

Other Programs

Semester in Environmental Science
(September 8–December 19)

Directors
Jerry M. Melillo, Director
Kenneth H. Foreman, Associate Director

Faculty
Charles Hopkinson, Aquatic Course Director
Knute Nadelhoffer, Terrestrial Course Director
John Hobbie, Microbial Ecology
Edward Rastetter, Mathematical Modeling
Anne Giblin
Linda Deegan
Bruce Peterson
Christopher Neill
Joe Vallino
Mathew Williams
Paul Stedler
Peter Siver, Faculty Fellow, Connecticut College

Research Assistants
Jeffrey Hughes
James Laundre
Jane Tucker
Lori Soucy
Kristin Tholke
Kathleen Regan
Beth Hooker
John Helfrich
Martha Downs
Amy Nolin
Kathleen Newkirk
Neil Bettez

Teaching Assistants
Martha Peterson
Michele Bahr
Patricia Micks
Bonnie Kwiatkowski
Robert Garratt
Nat Weston

Students
Toby Ahrens, Connecticut College
Hyacinth Armstrong, Mt. Holyoke College
Noah Bleich, Brandeis University
Abbey DeRocker, Bates College
Lynn Diener, Bard College
Janice Glass, Lafayette College
Sarah Jackson, Connecticut College
Samuel Kelsey, Dickinson College
Christy Meredith, Allegheny College
Sophie Parker, Wellesley College
Stephanie Parker, Middletown College
Rachel Poretsky, Brandeis University
Shana Rapoport, Brandeis University
Amy Townsend-Small, Skidmore College
Marlene Tsie, Brandeis University
Rebecca Weidman, Carleton College

Teachers' Workshop: Living in the Microbial World (August 17–August 23)

Course Director
Lorraine Olendzenski, University of Connecticut

Course Assistant
Andy Heaford, University of Connecticut

Presenters
Lynn Margulis, University of Massachusetts
Ricardo Guerrero, University of Barcelona, Spain
Steve Goodwin, University of Massachusetts, Amherst
Robert Bullis, Marine Biological Laboratory
Holger Jannasch, Woods Hole Oceanographic Institute
Greg Hinkle, University of Massachusetts, Dartmouth
Art Girard, Pfizer Central Research, Groton, CT
Norman Wainwright, Marine Biological Laboratory
Adrian Smith, Marine Biological Laboratory

Participants
Charles Anastasia, Mashpee High School
Diane E. Arnold, Bennie Dover Jackson Middle School
Catherine Baker, East Junior High School
Marcia A. Benvenuti, Bennie Dover Jackson Middle School
Florence Berdan, Parsippany Hills High School
Wesley Blauss, Indian Head Middle School
William Cerino, Lyme-Old Lyme High School
Paul J. Chamberlin, Nauset Regional High School
Elizabeth Check, Attleboro High School
Howard C. Estes, East Junior High School
Maryrose L. Flynn, Indian Head Middle School
Marsha R. Folger, Lyme-Old Lyme High School
Mary Johnson, Parsippany Hills High School, Brooklawn Middle School
Lucy Lupinacci, Griswold Intermediate School
Joreen Mattas, Griswold Intermediate School
Sheila E. McTigue, Lyme-Old Lyme High School
M. Susan O'Donnell, Indian Head Middle School
Jane Shute, Indian Head Middle School
Judith J. Trotta, Nauset Regional High School
James Watson, East Junior High School
Summer Research Programs

Principal Investigators

Armstrong, Clay, University of Pennsylvania
Armstrong, Peter B., University of California, Davis
Augustine, George J., Duke University Medical Center

Barbieri, Elena, Marine Biological Laboratory
Barlow, Jr., Robert B., State University of New York Health Science Center
Beauch, Luis, Instituto M. y M. Ferreyra, Argentina
Bennett, Michael V. L., Albert Einstein College of Medicine
Berlin, Joshua, Bockus Research Institute
Bloom, George, University of Texas Southwestern Medical Center
Bodzuck, David, Wesleyan University
Borou, Walter F., Yale University Medical School
Borst, David, Illinois State University
Boyter, Barbara, Union College
Bruce, Scott T., The University of Texas Southwestern Medical Center, Dallas
Brown, Joel E., Albert Einstein College of Medicine
Browne, Carole, Wake Forest University
Burger, Max M., Friedrich Miescher Institute, Switzerland
Burgos, Mario, Universidad Nacional de Cuyo-Conicet, Argentina

Cardell, Robert R., University of Cincinnati
Casagrand, Janet, University of Colorado
Chappell, Richard L., Hunter College, City University of New York
Cohen, Lawrence B., Yale University School of Medicine
Cohen, William D., Hunter College, City University of New York
Corwin, Jeffrey, University of Virginia

De Weer, Paul, University of Pennsylvania School of Medicine
DeMont, Edwin, St. Francis Xavier University, Canada
Devlin, Leah, Penn State University
Dipolo, Reinaldo, IVIC, Venezuela

Eckberg, William, Howard University
Edwards, Donald, Georgia State University
Ehrlich, Barbara, University of Connecticut Health Center

Fay, Richard, Loyola University of Chicago
Fishman, Harvey M., The University of Texas Medical Branch, Galveston

Godsby, David, The Rockefeller University
Garcia-Blanco, Mariano, Duke University Medical Center
Garrick, Rita Anne, Fordham University College, Lincoln Center

Giuditta, Antonio, University of Naples, Italy
Goldman, Robert D., Northwestern University Medical School
Gould, Robert, New York State Institute for Basic Research in Developmental Disabilities
Gray, John, Queen's University, Canada
Groden, Joanna, University of Cincinnati
Gundersen, Gregg, Columbia University

Haimo, Leah, University of California, Riverside
Habstead, Matthew, University of Auckland, New Zealand
Henry, Jonathan J., University of Chicago
Hershko, Avram, Technion, Israel
Highstein, Steven M., Washington University School of Medicine
Hines, Michael, Yale University School of Medicine
Holz, George, Massachusetts General Hospital
Hoskin, Francis, US Army Natick RD&E Center
Hoszko, Gwendolyn, Texas Southern University

Ip, Wallace, University of Cincinnati

Johnston, Daniel, Baylor College of Medicine
Joye, Samantha, Texas A&M University

Kaczmarek, Leonard, Yale University School of Medicine
Kaplan, Ilene M., Union College
Khan, Shahid, Albert Einstein College of Medicine
Khodakhah, Kamran, University of Pennsylvania
Klerks, J.H.E.M., Utrecht University, The Netherlands
Kravitz, Edward, Harvard Medical School
Kuhns, William, The Hospital for Sick Children, Canada

Laff, Eileen M., University of Texas Health Science Center
Landowne, David, University of Miami School of Medicine
Langford, George, Dartmouth College
Laskin, Jeffrey, University of Medicine and Dentistry of New Jersey
Layne, John, Duke University Marine Laboratory
Levandoski, Mark, Brown University
Lipicky, Raymond J., Food and Drug Administration
Uhnás, Rodolfo R., New York University Medical Center
Lovett, Donald, The College of New Jersey

Martindale, Mark, University of Chicago
McNeil, Paul, Medical College of Georgia
Mensing, Allen, Washington University School of Medicine
Metzals, Janis, University of Ottawa Faculty of Medicine, Canada
Minkoff, Charles, Duke University Medical Center
Miyakawa, Hiroyoshi, Tokyo University of Pharmacy and Life Science, Japan
R34 Annual Report

Moore, John, Duke University Medical Center
Nasi, Enrico, Boston University School of Medicine
Nguyen, Quoc Thang, University of California, Irvine

Palazzo, Robert, University of Kansas
Palma, Eleanora, Regina Elina Center Research Institute, Italy
Pant, Harish, National Institutes of Health
Parysek, Linda, University of Cincinnati
Pixley, Sarah, University of Cincinnati
Puga, Alvaro, University of Cincinnati

Quigley, James P., State University of New York, Stony Brook

Rakowski, Robert F., Finch University of Health Sciences/The Chicago Medical School
Rasmussen, Howard, Medical College of Georgia
Ratner, Nancy, University of Cincinnati
Reese, Thomas S., National Institutes of Health
Rieder, Conly, Wadsworth Center
Ripps, Harris, University of Illinois College of Medicine
Rome, Larry, University of Pennsylvania
Rosenbluth, Jack, New York University Medical Center
Ross, William, New York Medical College
Ruderman, Joan V., Harvard Medical School
Russell, John M., Medical College of Pennsylvania

Saito, Takehito, University of Tsukuba, Japan
Schweitzer, Felix, Duke University Medical Center
Shashar, Nadav, Marine Biological Laboratory
Shetz, Michael, Duke University Medical Center
Simpson, Alastair, University of Sydney, Australia
Siver, Peter, Connecticut College
Sloboda, Roger D., Dartmouth College
Spann, Timothy, Northwestern University Medical School
Spiegler, Evelyn, Dartmouth College
Spiegel, Melvin, Dartmouth College
Standart, Nancy, University of Cambridge, United Kingdom
Steffen, Walter, Institute of Biochemistry and Molecular Cell Biology, Austria
Stuart, Ann E., University of North Carolina, Chapel Hill
Sugimori, Mutuyuki, New York University Medical Center
Suszkiew, Janusz, University of Cincinnati

Takahashi, Megumi, Kanagawa Psychiatric Center, Japan
Telzer, Bruce, Pomona College
Tokumara, Hiroshi, Duke University Medical Center
Tran, Phong, University of North Carolina, Chapel Hill
Troll, Walter, New York University Medical Center
Tytell, Michael, Bowman Gray School of Medicine, Wake Forest University

Wachowiak, Matt, University of California, Berkeley
Weil, E. Jennifer, Marine Biological Laboratory
Whittaker, J. Richard, University of New Brunswick, Canada
Wicklein, Martina, University of Arizona

Zigman, Seymour, University of Rochester Medical School
Zottoli, Steven, Williams College
Zukin, R. Suzanne, Albert Einstein College of Medicine

Other Research Personnel

Abe, Terno, Niigata University, Japan
Altamirano, Anibal, University of Buenos Aires, Argentina

Anderson, Erik, St. Francis Xavier University, Canada
Antic, Srdjan, Yale University School of Medicine
Aranaeda, Ricardo, Albert Einstein College of Medicine
Armstrong, Clara, University of Pennsylvania

Baikie, Iain, Robert Gordon University, United Kingdom
Barrera, Jose, New York University Medical Center
Bears, Elaine, Brown University
Becker, Julie, Temple University
Bezanilla, Francisco, University of California, Los Angeles
Bobb, David, Huston-Tillotson College
Boyle, Kim-Laura, Colby-Sawyer College
Brackenbury, Robert, University of Cincinnati
Breitwieser, Gerda E., Johns Hopkins School of Medicine
Brown, Euan, Marine Biological Association, United Kingdom
Burris, Jennifer, Carleton College

Carroll, Nicola, University of Cambridge, United Kingdom
Cavanagh, Michael, University of Cincinnati
Christman, Emily, Goucher College
Cimini, Ashley, Yale University
Claessens, Luc, Marine Biological Laboratory
Clay, John, National Institutes of Health
Clifford, Patrick, College of New Jersey
Connaughton, Martin, University of Pennsylvania
Cooper, Gordon, Yale University School of Medicine
Couch, Ernest, Texas Christian University
Cserjesi, Peter, Columbia University

Dadacay, Alma-Villa, Hunter College
Davis, Bruce A., Yale University
DePina, Ana, Dartmouth College
Dodge, Frederick, State University of New York Health Science Center

Eddleman, Chris, University of Texas Medical Branch, Austin
Edwards-Walton, Peggy, University of California, Riverside
Eyman, Maria, University of Naples, Italy

Fang, Jing, Yale University School of Medicine
Feinstein, Douglas, Cornell University
Fernandez-Busquets, Xavier, Friedrich Miescher Institut, Switzerland
Filamare, Inigo, University of Victoria, Canada
Fukuda, Mitsunori, Tsukuba Life Science Center, Japan
Fukui, Yoshio, Northwestern Medical School
Zakevicius, Jane M., University of Illinois, Chicago
Zavilowitz, Joseph, Albert Einstein College of Medicine
Zecchini, Dejan, Yale University School of Medicine
Zeki, Semir, University College London, United Kingdom
Zhao, Jinhua, Yale University
Zigman, Bunnie R., University of Rochester Medical Center

Library Readers

Abbott, Jayne, Marine Research Inc.
Adelberg, Edward A., Yale University
Ahmadjian, Vernon, Clark University
Alkon, Daniel, National Institutes of Health
Allen, Garland E., Washington University
Alliegro, Mark, Louisiana State University Medical Center
Anderson, Everett, Harvard Medical School
Baccetti, Baccio, University of Siena, Italy
Barry, Susan R., Mount Holyoke College
Benjamin, Thomas L., Harvard Medical School
Benthem, Dolores A., SPC Associates, New York
Berne, Rosalyn W., University of Virginia
Bernhard, Jeffrey D., University of Massachusetts Medical Center
Birnbaumer, Alan W., New York University
Borgese, Thomas A., Lehman College
Boyce, John, Union College
Burgess, David, Pittsburgh, PA
Campbell, Robert K., Ares Advanced Technology
Candelas, Graciela C., University of Puerto Rico
Cariello, Lucio, Stazione-Zoologica, Italy
Chaet, A. B., University of West Florida
Child, Frank M., Trinity College
Clark, Arnold M., University of Delaware
Clark, Denise, University of New Brunswick
Clark, Eloise E., Bowling Green State University
Clarkson, Kenneth L., Bell Labs, Lucent Technologies
Cogswell, Carol, University of Sydney, Australia
Cohen, Seymour S., American Cancer Society
Cohen, Leonard A., American Health Foundation
Cohen, Yehuda, Hebrew University of Jerusalem, Israel
Coller, Marjorie M., St. Peters College
Comoglio, Paolo, Institute for Cancer Research, Turino, Italy
Cooperstein, Sherwin J., University of Connecticut Health Center
Copeland, Eugene C., Woods Hole, MA
Cowling, Vincent F., SUNY, Albany
D'Allescio, Giuseppe, University of Naples
deToledo-Morrell, Leyla, Rush Medical College
Duncan, Thomas K., Nichols College
Epstein, Herman T., Brandeis University
Feldman, Susan C., New Jersey Medical School
Finch, Caleb E., University of Southern California
Frenkel, Krystyna, NYU Medical Center
Gehrke, Lee, Massachusetts Institute of Technology
German, James L., New York Blood Center
Goldman, Robert, Northwestern University Medical School
Goldstein, Mose H., Johns Hopkins University
Groden, Joanna, University of Cincinnati
Gross, Paul, University of Virginia

Grossman, Albert, NYU Medical School
Gruner, John, Cephalon, Inc.

Haye, Leah, University of California
Halvorson, Harlyn, University of Massachusetts, Dartmouth
Herskovits, Theodore T., Fordham University
Hunter, Robert, Gartnaul Royal Hospital

Ilan, Judith, Case Western Reserve University
Inoue, Sadayuki, McGill University, Canada
Issodorides, Marrietta, University of Athens, Greece

Jacobson, Allan S., University of Massachusetts Medical Center
Josephson, Beth, Ocean Arks International

Kaltenbach, Jane C., Mount Holyoke College
Kaminer, Benjamin, Boston University School of Medicine
Kamino, Kohtaro, Tokyo Medical & Dental University, Japan
Kaplan, Arnold, University of Illinois at Chicago
Karlin, Arthur, Columbia University
Kelly, Robert E., University of Illinois
Keynan, Alex, Israel Academy of Sciences and Humanities
King, Kenneth, Falmouth, MA
Klein, Donald, Colorado State University
Kramer, Fred R., Public Health Research Institute
1997 Library Room Readers

Daniel Alkon
National Institutes of Health

Lucio Cariello
Stazione-Zoolociga A. Dohrn

A. Chaet
University of Connecticut

Paolo Comoglio
Institute of Cancer Research, Turino, Italy

Giuseppe D’Alessio
University of Naples

Robert Goldman
Northwestern Univ. Medical School

Harlyn Halvorson
Marine Biological Laboratory

Alex Keynan
Israel Academy of Science

Hans Laufer
University of Connecticut

Joe L. Martinez
University of Texas, San Antonio

Michael Rabinowitz
Marine Biological Laboratory

George Reynolds
Princeton University

Gerald Weissman
NYU School of Medicine
Laderman, Aimlee D., Yale School of Forestry & Environmental Studies
Laster, Leonard, University of Massachusetts Medical Center
Lauffer, Hans, University of Connecticut
Lee, John J., City College of CUNY
Leighton, Joseph, Aerion Biotechnology, Inc.
Levy, Arthur L., St. Vincents Hospital of New York
Lisman, John, Brandeis University
Long, Carol, Allegheny University
Lorand, Laszlo, Northwestern University Medical School
Luckenbill-Eds, Louise, Ohio University

MacNichol, Edward F., Boston University School of Medicine
Major, Guy, Oxford University
Masland, Richard, Massachusetts General Hospital
Martinez, Joe L., University of Texas, San Antonio
Mauterall, David, Rockefeller University
Michaelson, James, MGH Cancer Center
Miller, Daniel, Rockefeller University
Mills, Eric L., Dalhousie University, Canada
Minkoff, Charles G., Duke University Medical Center
Mitchell, Ralph, Harvard University
Mizell, Merle, Tulane University

Nagel, Ronald L., Albert Einstein Institute
Narahashi, Toshiro, Northwestern University Medical School
Nathans, Jeremy, Johns Hopkins University
Nangle, John, NASA
Nicaise, Mari-Luz, Université de Nice, France
Nicaise, Ghislain, Université de Nice, France
Nickerson, Peter A., SUNY, Buffalo

Pappas, George D., University of Illinois
Pollan, Daniel A., University Massachusetts Medical Center
Porter, Mary E., University of Minnesota
Pruschi, Robert D., Gonzaga University
Przybyszewski, Andrew W., University of Massachusetts Medical Center

Rabinowitz, Michael, Marine Biological Laboratory
Rafferty, Nancy S., Northwestern University
Rafferty, Keen, Northwestern University
Reynolds, George, Princeton University
Rosenbluth, Raja, Simon Fraser University
Rosenkranz, Herbert S., University of Pittsburgh
Ryan, Terence E., Regeneron Pharmaceuticals

Sanger, Joseph W., University of Pennsylvania Medical School
Sanger, Jean M., University of Pennsylvania Medical School
Schauer, Rolf, University of Frankfurt, Germany
Segal, Rosalind, Harvard Institute of Medicine
Shepro, David, Boston University Microvascular Research
Siwicki, Kathleen K., Swarthmore College
Spector, Abraham, Columbia University
Spotte, Stephen, University of Connecticut
Sundquist, Eric, US Geological Survey
Sweet, Frederick, Washington University School of Medicine

Tilney, Lewis, University of Pennsylvania
Trager, William, The Rockefeller University
Tweedell, Kenyon S., University of Notre Dame
Tykociński, Mark L., Case Western Reserve University
Van Holde, Kensal E., Oregon State University

Walton, Alan J., Cavendish Lab, Cambridge University, UK
Warren, Leonard, Wistar Institute
Weidner, Earl, Louisiana State University
Weissman, Gerald, NYU Medical Center
Whittaker, Victor P., Max-Planck-Institute for Biophysical Chemistry

Yevick, George, Stevens Institute of Technology

**Domestic Institutions Represented**

AgBiotech Center
Alabama, University of, Birmingham
Alaska, University of, University of Alaska, University of
Albert Einstein College of Medicine
Allegheny University
Allegheny University of the Health Sciences
Allina Information Services
American College of Allergy
Arizona State University
Arizona, University of

Bancroft School
Baylor College of Medicine
Bell Labs
Beth Israel Medical Center
Bockus Research Institute
Boston University
Boston University School of Education
Boston University School of Medicine
Bowdoin College
Brandeis University
Brigham and Women’s Hospital
Forsyth Dental Center
Foundation of Microbiology
Fox Chase Cancer Center
Fred Hutchinson Cancer Research Center

Genetics Computer Group, Inc.
George Washington University
Georgia State University
Georgia, University of
Global Telemedicine Group
Goucher College

Hampton College
Hampshire College
Harbor-UCLA Medical Center
Hartford, University of
Harvard Institutes of Medicine
Harvard Medical School
Harvard University
Harvard University School of Public Health
Heart Disease Research Foundation
Hollins College
Hopkins Marine Station
Houston, University of
Howard Hughes Medical Institute
Howard University
Hunter College
Huston-Tillotson College

Idaho, University of
Illinois State University
Illinois Wesleyan University
Illinois, University of
Indiana University
Indiana University School of Medicine
Infectious Disease Research Institute
Institute for Basic Research in
Developmental Disabilities
Iowa College of Medicine, University of
Iowa State University
Iowa, University of

Jester Center
Jet Propulsion Laboratory
Johns Hopkins University
Johns Hopkins University School of
Medicine
Johns Hopkins University School of Public
Health

Kansas, University of
Kent State University
Kentucky College of Medicine, University of

Laboratory of Kidney & Electrolyte
Metabolism
Leica, Inc.
Louisiana State University Medical Center
Loyola University of Chicago

Maine, University of
Marine Biological Laboratory
Marquette University
Marshall University
Maryland, University of
Massachusetts General AIDS Research Center
Massachusetts General Hospital
Massachusetts Institute of Technology
Massachusetts Medical School, University of Massachusetts, University of
Medical College of Georgia
Medical College of Ohio
Medical College of Pennsylvania
Medical University of South Carolina
Meharry Medical College
Memorial Sloan-Kettering Cancer Center
Metcalf Research Laboratories
Metabolix, Inc., Cambridge
Miami, University of
Michigan State University
Michigan Technological University
Michigan, University of
Millbrook School
Minnesota Medical School, University of Minnesota, University of
Mission Neighborhood Health Center
Montana State University
Museum of Comparative Zoology Labs

NASA Ames Research Center
National Cancer Institute
National Institute of Environmental Health Science
National Institute of Standards & Technology
National Institutes of Health
National Library of Medicine
Naval Medical Research Institute
Nebraska, University of
NEC Research Institute
Nelson Biological Labs
Nevada, University of
New Jersey, College of
New Jersey, University of Medicine and Dentistry
New York Academy of Medicine
New York Eye & Ear Infirmary
New York Medical College
New York State Department of Health
New York State Institute for Basic Research
New York State Psychiatric Institute
New York University Medical Center
New York University School of Medicine
North Carolina State University
North Carolina, University of
North Carolina, University of, Chapel Hill
North Texas, University of
Northeastern University
Northwestern University
Northwestern University Medical School
Notre Dame, University of
NW Portland Area Indian Health Board

Ochsner Medical Library
Ohio State University
Ohio University
Oklahoma Health Sciences, University of Oklahoma Medical Research Foundation
Oregon Health Science University
Oregon, University of
Payload Systems, Inc.
Pennsylvania School of Medicine, University of
Pennsylvania School of Veterinary Medicine, University of
Pennsylvania State University
Pennsylvania, University of
Picower Institute for Medical Research
Pittsburgh School of Medicine, University of Pittsburgh, University of
Pomona College
Princeton University
Providence College
Puerto Rico, University of
Purdue University

Reading Hospital & Medical Center
Rensselaer Polytechnic Institute
Rochester Medical School, University of Rochester, University of
Rocketeeller University
Rowland Institute for Science
Rutgers University
Salk Institute
San Francisco State University
Schepps Eye Research Institute
Scripps Institution of Oceanography
Scripps Research Institute
Scriptgen Pharmaceuticals
Seattle Biomedical Research Institute
Sloan Center for Theoretical Neurobiology
Smith-Kettlewell Eye Research Institute
Smithsonian Institution
Smithsonian Tropical Research Institute
South Carolina, University of
Southwestern University Medical Center
St. John’s University
St. Louis University School of Medicine
St. Peters College
Stanford University
Stanford University Medical Center
State University of New York Health Science Center
State University of New York, Albany
State University of New York, Buffalo
State University of New York, Stony Brook
Temple University
Tennessee, University of
Texas A&M University
Texas A&M University College of Medicine
Texas Christian University
Texas Health Science Center, University of
Texas M.D. Anderson Cancer Center, University of
Texas Medical Branch, University of
Texas Southern University
Texas Southwestern Medical Center, University of
Texas Tech University
Texas, University of  
Toledo, University of  
Tufts University  
Tufts University School of Medicine  
Tufts University School of Veterinary Medicine  
Tulane University Medical School  
U.S. Army Natick RD&E Center  
U.S. Department of Agriculture  
U.S. Environmental Protection Agency  
Union College  
Utah, University of  

Vanderbilt University  
Vermont, University of  
Veterans Administration Connecticut Healthcare System  
Virginia Commonwealth University  
Virginia Health Sciences Center, University of  
Virginia School of Medicine, University of Virginia, University of  
Vollum Institute  

Wadsworth Center for Labs and Research  
Wake Forest University  
Wake Forest University, Bowman Gray School of Medicine  
Washington School of Medicine, University of  
Washington State University  
Washington, University of  
Wayne State University  
Wellesley College  
Wesleyan University  
West Virginia University  
Western Michigan University  
Wheaton College  
Whitehead Institute for Biomedical Research  
Williams College  
Wisconsin Regional Primate Research  
Wisconsin, University of  
Women & Infants Hospital  
Woods Hole Oceanographic Institution  
Worcester Foundation for Biomedical Research  
Wyeth-Ayerst Research  

Yale University  
Yale University School of Medicine  

Zanvyl Krieger Mind Brain Institute  
Zeneca Pharmaceuticals  

**Foreign Institutions Represented**

Alberta, University of, Canada  
Astra Hässle, Sweden  
Auckland, University of, Australia  
August Krogh Institute, Denmark  
Basel, University of, Switzerland  
Bogor Agricultural University, Indonesia  
Bordeaux, University of, France  
Brazil, University of, Brazil  
Bristol, University of, United Kingdom  
Buenos Aires, University of, Argentina  
Calgary, University of, Canada  
Cambridge, University of, United Kingdom  
Carl Zeiss, Inc., Germany  
Catholic University of Chile, Chile  
CENA-USP, Brazil  
Centre National de la Recherche Scientifique, France  
Chinese University of Hong Kong, Hong Kong  
Dalhousie University, Canada  
De La Salle University, Philippines  
Ecole Polytechnique, France  
Edinburgh, University of, Scotland  
Erlangen, University of, Germany  
Federal University of Minas Gerais, Brazil  
Frankfurt, University of, Germany  
Fribourg, University of, Switzerland  
Friedrich Miescher Institute, Switzerland  
Geneva, University of, Switzerland  
Göteborg, University of, Sweden  
Göttingen, University of, Germany  
Hagedorn Research Institute, Denmark  
Hebrew University of Jerusalem, Israel  
Hospital for Sick Children, Canada  
Huddinge University Hospital, Sweden  
I.V I.C., Venezuela  
Imperial College of Science, Technology and Medicine, United Kingdom  
Innsbruck, University of, Austria  
International School of Advanced Studies, Italy  
Institut Nationale de la Recherche Agronomique, France  
Institut Pasteur de Lille, France  
Institute for Marine Biosciences, Canada  
Institute of Biochemistry and Molecular Cell Biology, Austria  
Institute of Neurology of Moscow, Russia  
Institute of Plant Breeding, Germany  
Instituto M. y M. Ferreyra, Argentina  
J.W. Goethe-Universität, Germany  
Janssen Research Foundation, Belgium  
Julius-Maximilians-University, Germany  
Kangawa Psychiatric Center, Japan  
Karolinska Institute, Sweden  
Laboratory of Molecular Biophotonics, Japan  
Laval University School of Medicine, Canada
Leeds, University of, United Kingdom
Leiden, University of, The Netherlands
Lethbridge, University of, Canada
Lisbon, University of, Portugal
Lund University, Sweden
Manchester, University of, United Kingdom
Marine Biological Association, United Kingdom
Max-Planck-Institut, Germany
McGill University, Canada
McMaster University, Canada
Medical Academy of Lodz, Poland
Medical Research Council, United Kingdom
Melbourne, University of, Australia
Milano, University of, Italy
Montreal, University of, Canada
Munich, University of, Germany
Naples, University of, Italy
National Institute for Medical Research, United Kingdom
National University of Singapore, Singapore
National Veterinary Institute, Sweden
New Brunswick, University of, Canada
Niigata University, Japan
Oldenburg, University of, Germany
Otago, University of, New Zealand
Ottawa, University of, Canada
Oxford, University of, United Kingdom
Palermo, University of, Italy
Poland Institute of Psychiatry & Neurology, Poland
Queen’s University, Canada
Queen’s University of Belfast, United Kingdom
Rega Institute, Belgium
Regina Elina Center Research Institute, Italy
Robert Gordon University, United Kingdom
Rostock, University of, Germany
Royal Institute of Technology, Sweden
Royal Postgraduate Medical School, United Kingdom
Ruhr-Universität Bochum, Germany
Russian State Medical University, Russia
School of Biological Sciences, United Kingdom
Seville, University of, Spain
Simon Fraser University, Canada
St. Francis Xavier University, Canada
Stazione Zoologica A. Dohrn, Italy
Sussex, University of, United Kingdom
Swiss Federal Institute of Technology, Switzerland
Sydney, University of, Australia
Taichung Veterans General Hospital, Taiwan
Technion, Faculty of Medicine, Israel
Tel Aviv University, Israel
Tokyo Medical & Dental University, Japan
Tokyo, University of, Japan
Toronto, University of, Canada
Tsukuba Life Science Center, Japan
Tübingen, University of, Germany
Universidad Nacional Autonoma, Mexico
Universidad Nacional de Cuyo-Conicet, Argentina
Universidade Federal Fluminense, Brazil
Universität GH Essen, Germany
Universität zu Köln, Germany
Université Paris-Sud, France
University College London, United Kingdom
University Hospital Nijmegen, The Netherlands
University Laboratory of Physiology, United Kingdom
University Newcastle upon Tyne, United Kingdom
University of Technology, Australia
Urbino, University of, Italy
Utrecht University, The Netherlands
Victoria, University of, Canada
Wageningen Agricultural University, The Netherlands
Waterloo, University of, Canada
Weizmann Institute of Science, Israel
Wellcome/CRC Institute, United Kingdom
York University, Canada
Zeneca Pharmaceuticals, United Kingdom
Zoological Society of London, United Kingdom
Zurich, University of, Switzerland
Year-Round Research Programs

Architectural Dynamics in Living Cells Program

Established in 1992, this program focuses on architectural dynamics in living cells—the timely and coordinated assembly and disassembly of macromolecular structures essential for the proper functioning, division, mobility, 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 and manipulation devices that permit such studies directly in living cells and functional cell-free extracts. The Architectural Dynamics in Living Cells Program promotes interdisciplinary research and consists of resident core investigators and a cadre of adjunct members.

Resident Core Investigators
Danuser, Gaudenz, Postdoctoral Fellow
Inoué, Shinya, Distinguished Scientist
Katoh, Kaoru, Postdoctoral Research Associate
Oldenbourg, Rudolf, Associate Scientist

Staff
Geer, Thomas, Research Assistant
Knudson, Robert, Instrumental Development Engineer
Macario, Jackie, Laboratory Assistant
MacNeil, Jane, Executive Assistant

Visiting Investigators
Burgos, Mario H., Universidad Nacional de Cuyo, Conicet, Mendoza, Argentina
Fukui, Yoshio, Northwestern University Medical School
Inoué, Theodore D., Universal Imaging Corporation, West Chester, PA
Okada, Naobumi, Olympus Corporation, Hachioji, Japan
Suzuki, Keisuke, Olympus Corporation, Hachioji, Japan
Takahashi, Hajime, Olympus Corporation, Hachioji, Japan
Tran, Phong, University of North Carolina, Chapel Hill

The Josephine Bay Paul Center for Comparative Molecular Biology and Evolution

Major emphasis in The Josephine Bay Paul Center for Comparative Molecular Biology and Evolution is placed upon comparative/phylogenetic studies of genes and genomes, molecular microbial ecology/biodiversity, evolution of pathogenesis and evolution of host defense mechanisms in marine invertebrates. The center encourages studies of genotypic diversity across all phyla and promotes the use of modern molecular genetics and phylogeny to gain insights into the evolution of genes and genomes. The Marine Biology Laboratory has considerable strength in Comparative Molecular Biology and Evolution including Mitchell Sogin’s studies of genome evolution and diversity of Eukaryotes, Monica Riley’s Metabolic Database and evolutionary studies of protein sequences, Neal Cornell’s comparative molecular studies of genes critical to heme biosynthesis, Norman Wainwright’s studies of the molecular basis of host defense mechanisms in marine invertebrates, and Michael Cumming’s work on evolution of pathogenesis in prokaryotes. Other collaborative projects include studies of P450 evolution between M. Sogin and John Stegeman’s laboratory at Woods Hole Oceanographic Institution (WHOI), a molecular ecology component of the Long-Term Ecological Research project between M. Sogin’s laboratory and J. Hobbie of the Ecosystems Center, and collaborative studies of molecular diversity among marine protists and bacteria with several eukaryotic microbiologists at WHOI.

Excellent resources for studies of molecular evolution exist in the form of automated DNA sequencing, well-equipped research laboratories, and powerful computational facilities. The Josephine Bay Paul Center for Comparative Molecular Biology and Evolution plays an active role in educational activities at the MBL. In addition to participating in the Parasitology and Microbial Diversity courses, it sponsors the Workshop in Molecular Evolution at the MBL which has gained an international reputation for excellence. This Workshop serves 60 students by offering a series of lectures and mini-symposia, which are complemented by a state-of-the-art computational facility.

The Josephine Bay Paul Center for Comparative Molecular Biology and Evolution includes the laboratories of Neal Cornell, Michael Cummins, Monica Riley, Mitchell Sogin, and Norman Wainwright.

Resident Core Investigators
Sogin, Mitchell, Director and Senior Scientist
Cornell, Neal, Senior Scientist
Riley, Monica, Senior Scientist
Wainwright, Norman, Senior Scientist

Laboratory of Neal Cornell

Research in this laboratory is concerned with the comparative molecular biology of genes that encode the enzymes for heme biosynthesis, with particular emphasis on 5-aminolevulinate synthase, the first enzyme in the pathway. Because the ability to produce heme from common metabolic materials is a near universal requirement for living organisms, these genes provide useful indicators of molecular
aspects of evolution. For example, 5-aminolevulinate synthase in vertebrate animals and simple eukaryotes such as yeast and *Plasmodium falciparum* have high sequence similarity to the enzyme from the alpha-purple subgroup of eubacteria. This supports the suggestion that alpha-purple bacteria are the closest contemporary relatives of the ancestor of eukaryotic mitochondria. The analysis also raises the possibility that plant and animal mitochondria had different origins. Aminolevulinate synthase genes in mitochondria-containing protists are currently being analyzed to obtain additional insight into endosymbiotic events. Also, genes of primitive chordates are being sequenced to gain information about the large scale gene duplication that played a very important role in the evolution of higher vertebrates. Other studies in the laboratory have been concerned with the effects of environmental pollutants on heme biosynthesis in marine fish, and it has been shown that polychlorinated biphenyls (PCBs) enhance the expression of the gene for aminolevulinate synthase.

**Staff**
Cornell, Neal W., Senior Scientist  
Dunlap, Rachel, Research Associate  
Faggart, Maura A., Research Assistant  
Kreiling, Jill, Research Assistant  
Macarro, Jackie, Laboratory Assistant  
O’Neil, Brendan, Laboratory Assistant

**Visiting Scientist**
Fox, T. O., Harvard Medical School

**Laboratory of Norman Wainwright**

The mission of the laboratory is to understand the molecular defense mechanisms exhibited by marine invertebrates in response to invasion by bacteria, fungi, and viruses. The 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 which results in blood coagulation. Several proteins found in the hemocyte and hemolymph display microbial binding proteins that contribute to antimicrobial defense. Commensal or symbiotic microorganisms may also augment the antimicrobial mechanisms of macroscopic marine species. Secondary metabolites are being isolated from diverse marine microbial strains in an attempt to understand their role. Microbial participation in oxidation of the toxic gas hydrogen sulfide is also being studied.

**Staff**
Wainwright, Norman, Senior Scientist  
Child, Alice, Research Assistant

**Visiting Investigator**
Anderson, Porter. University of Rochester

**Molecular Evolution of Genomes**

The genome of the bacterium *Escherichia coli* contains all of the information required for a free-living chemoheterotrophic organism to live, adapt, and multiply. The information content of the genome can be dissected from the point of view of understanding the role of each gene and gene product in achieving these ends. The many functions of *E. coli* have been organized in a hierarchical system representing the complex physiology and structure of the cell. In collaboration with Dr. Peter Karp of SRI International, an electronic encyclopedia of information is being constructed on the genes, enzymes, metabolism, transport processes, regulation, and cell structure of *E. coli*. The interactive EcoCyc program is now publicly available and has graphical hypertext displays, including literature citations, on nearly all of *E. coli* metabolism, all genes and their locations, a hierarchical system of cell functions and some regulation processes. This work is continuing.

In addition, the *E. coli* genome contains valuable information on molecular evolution. We are analyzing the sequences of proteins of *E. coli* in terms of their evolutionary origins. By grouping like sequences and tracing back to their common ancestors, one learns not only about the paths of evolution for all contemporary *E. coli* proteins, but one extends even farther back before *E. coli*, traversing millennia to the earliest evolutionary times when a relatively few ancestral proteins served as ancestors to all contemporary proteins of all living organisms. The complete genome sequence of *E. coli* and sophisticated sequence analysis programs permit us to identify evolutionary related protein families, determining ultimately what kinds of unique ancestral sequences generated all of present-day proteins. The data developed in the work has proved to be valuable to the community of scientists sequencing microbial genomes. *E. coli* data serve as needed reference points.

**Staff**
Riley, Monica, Senior Scientist  
Pelligrini-Toole, Alida, Research Assistant II  
Kerr, Alastair, Postdoctoral Research Associate

**Program in Comparative Molecular Biology and Evolution:**  
**Laboratory of Mitchell L. Sogin**

The Program in Molecular Evolution employs comparative phylogenetic studies of genes and genomes to define patterns of evolution that gave rise to contemporary biodiversity on the planet Earth. We are especially interested in discerning how the eukaryotic cell was invented as well as the identity of microbial groups that were ancestral to animals, plants, and fungi. We take advantage of the extraordinary conservation of ribosomal RNAs to define phylogenetic relationships that span the largest of evolutionary distances. These studies have overhauled traditional eukaryotic microbial classifications systems. We have discovered new evolutionary assemblages that are as genetically diverse and complex
as plants, fungi, and animals. The nearly simultaneous separation of these eukaryotic groups (described as the eukaryotic "Crown") occurred approximately one billion years ago and was preceded by a succession of earlier diverging protist lineages, some as ancient as the separation of the prokaryotic domains. At the same time this database provides a powerful tool for the newly emerging discipline of molecular ecology. Using the ribosomal RNA data-base and nucleic acid based probe technology, it is possible to detect and monitor microorganisms including those that cannot be cultivated in the laboratory. This strategy has revealed new habitats and major revelations about geographical distribution of microorganisms.

This past year we initiated a new project designed to unlock the secrets of genome evolution in the parasite Giardia lamblia. We selected G. lamblia as a model organism for genome analysis because of its well-recognized impact on human health, its relatively modest-sized genome containing 12 million base pairs distributed onto five chromosomes, and the insights it will provide about the origins of nuclear genome organization. Comparisons of several different gene families demonstrate Giardia's basal position in molecular phylogenies, which is consistent with the absence of several prominent organelles like mitochondria, peroxisomes, and mitotic spindles that characterize most eukaryotic cells. This genome project will complement an ongoing survey of genomic diversity from eukaryotic microorganisms that do not have mitochondria. We previously demonstrated that these taxa represent some of the earliest diverging lineages in the evolutionary history of eukaryotes. The objective is to develop a set of additional molecular markers for studying molecular evolution. These will be invaluable in unraveling sudden evolutionary radiations that cannot be resolved by RNA comparisons and will provide insights into the presence or absence of important biochemical properties in the earliest ancestors common to all eukaryotic species.

**Staff**

Sogin, Mitchell L., Director and Senior Scientist
Amaral, Linda, Post Doctoral Research Associate
Edgcomb, Virginia, Post Doctoral Research Associate
Hinkle, Greg, Post Doctoral Research Associate
Morrison, Hilary G., Research Associate
Roger, Andrew, Post Doctoral Research Associate
Silberman, Jeff. Post Doctoral Research Associate

**Visiting Investigators**

Bahr, Michele, Ecosystems Center
Podar, Mirea, WHOI
Weil, Jennifer, Joslin Diabetes Center

**BioCurrents Research Center**

The BioCurrents Research Center (BRC), one of the NIH National Centers for Research Resources, has for many years been pioneering methods in the study of transmembrane currents and has hosted a variety of research pursuits. The Center provides visiting investigators access to a variety of unique technologies as well as new approaches to experimentation in the biomedical sciences.

Since the early 1980s, when this Biomedical Research Technology Program (BRTP) was established at the MBL, a number of probes have been introduced. Four systems are available or being developed at the BRC. All these probe technologies are based on the principles of a self-referencing electrode, maximizing sensitivity by noise and drift reduction. All the probes are non-invasive and generally placed in close proximity to the membrane of cells or tissues, in some cases at sub-micron distances. The two older techniques are designed to measure the movement of ions across the membranes of living tissues or cells with the minimum of disturbance. The current probe, developed in 1974, is still available for the study of external current densities resulting from the general net balance of ion transport. Most use is made of the ion-selective probes (Seris), which measure and follow the transmembrane transport of specific ions such as calcium, potassium and protons. This system also can detect non-electrogenic transporters. Two newer techniques, which are finding their first successful applications on biological material, are the BioKelvin Probe and the non-invasive Oxygen Probe (Serp). The BioKelvin Probe measures voltages around living tissues in air. Recently, successful measurements were made of fields derived from growing corn seedlings responding to gravity and light. Experiments will apply this new instrument to the study of skin physiology. A radically different approach is being taken to the measurements of biocurrents using the Oxygen Probe. Presently applied to molecular oxygen, such a technique offers opportunity for the study of molecular transport using redox potentials. The prototype has made measurements of the oxygen consumption of a single neuron in culture with a spatial resolution of several μm². We are currently developing further improvements to all our systems by incorporating super-resolution algorithms based on machine vision.

A state-of-the-art system offers non-invasive ion probes coupled with current and voltage clamp (both single, two electrode, and patch) along with ratio imaging using a recently purchased Zeiss Axiofluar system, all of which are finding uses in the hosted biomedical studies, as well as BRC research and development.

Research by O. Shirihai, an MD/PhD student from Israel, who was at MBL as a Grass Fellow, is an example that brings together many aspects of a BRTP Center, resulting in discoveries that otherwise would not take place. While at the MBL he joined us to use the imaging capability of BRC. During that study he also applied the specialized Seris-electrodes to growing mammalian microglia, demonstrating, for the first time, a new member of the potassium/proton ATPase family in the central nervous system. The physiological demonstration was supported by immuno-histochemical work with antibodies made available to us through another Center visiting investigator, Dr. D. Brown of Harvard and Massachusetts General Hospital. The antibodies were raised by Adam Smolka in the Carolinas. As the microglia form a principal brain reactive cell, and are implicated in neurodegenerative diseases of the CNS, we believe these discoveries will be of fundamental biomedical importance.

MBL year-round laboratories with which BRC is in active collaboration are the Laboratory of Rudolf Oldenbourg and the Laboratory of Reproductive Medicine, headed by David Keefe. Dr. Keefe and Dr. Peter Smith, BRC Director, are Co-Investigators on a grant to support the development of new technology to assess the developmental potential of preimplantation embryos and to study the pathophysiology of oocyte dysfunction.

**Staff**

Smith, Peter J. S., Director and Associate Scientist
Baikie, Iain D., Associate Scientist
Danuser, Gaudenz M., Visiting Scientist
Hanmar, Katherine, Research Assistant
Jaffe, Lionel F., Senior Scientist
McLaughlin, Jane A., Research Assistant
Porterfield, D. Marshall, Research Associate
Sanger, Richard H., Senior Electronics Technician
Tamse, Catherine T., Graduate Student, University of Rhode Island

**Visiting Scientist and Publications**

This past year the Research Center hosted 25 visitors, 19 from the United States with the remaining from Canada, Israel, United
Kingdom and New Zealand. Scientific publications during the year numbered 21.

**Boston University Marine Program**

**Faculty**

Atema, Jelle, Professor of Biology, Director  
Dionne, Vincent, Professor of Biology, Acting Director  
Humes, Arthur, Professor of Biology Emeritus  
Kaufman, Lex, Associate Professor of Biology  
Lobel, Phil, Associate Professor of Biology  
Valiela, Ivan, Professor of Biology  
Voigt, Rainer, Research Associate Professor  
Ward, Nathalie, Lecturer

**Staff**

Burns, Jennifer, Course Coordinator  
DiNunno, Paul, Research Assistant, Dionne Laboratory  
Hahn, Dorothy, Sr. Administrative Secretary  
Hall, Sheri, Program Manager  
Magee, Jennifer, Administrative Secretary  
Olson, Nancy, Program Assistant/Department’s Secretary  
Prof. Heinz, Research Assistant, Lobel Laboratory  
Roberts, Brian, Research Technician, Valiela Laboratory  
Soucy, Lori, Research Assistant, Valiela Laboratory  
Tomasky, Gabby, Research Assistant, Valiela Laboratory  
Wheatley, MaryJo, Information and Development Officer  
Zackrison, Rebecca, Course Coordinator

**Postdoctoral Investigators**

Basil, Jenny, Atema Laboratory  
Cebran, Just, Valiela Laboratory  
Cohen, Anne, Lobel Laboratory  
Delay, Rona, Dionne Laboratory  
Eisthen, Heather, Dionne Laboratory  
Grasso, Frank, Atema Laboratory  
Lavalli, Kari, Atema Laboratory  
Trott, Thomas, Atema Laboratory

**Visiting Faculty and Investigators**

Epstein, Slava, Northeastern University  
Hanlon, Roger, Marine Biological Laboratory

Hecker, Barbara, Rutgers University  
Hinkle, Gregory, Marine Biological Laboratory  
Margulis, Lynn, University of Massachusetts, Amherst  
Moore, Michael, Woods Hole Oceanographic Institution  
Silver, Robert, Marine Biological Laboratory  
Simmons, Bill, Sandia National Laboratory  
Wainwright, Norman, Marine Biological Laboratory

**Other**

Dolan, Mike, Visiting Teaching Assistant  
Drucker, Sam, Visiting Teaching Assistant  
Witting, Jan, Visiting Teaching Assistant

**Graduate Students**

**PhD Students**

Existing  
Baptakas, Ioannis  
Behr, Peter  
Dale, Jonathon  
Economakis, Alistair  
Farley, Lynda  
Hauxwell, Jennifer  
Herold, Ruth  
Lindholm, James  
Ma, Diana  
McClelland, James  
Oliver, Steven  
Tamse, Armando  
Zhou, Qiao

New  
Cole, Marci  
Kroeger, Kevin  
Piccillo, Bianca  
Sloan, Kevin  
Thiene, Erica  
Thoren, Erika  
Zhao, Jing

**Masters Students**

Existing  
Ashcraft, Susan  
Barry, Kevin  
Bell, Kimberly  
Demary, Kristian  
Ewell, Cara  
Filson, Jean  
Heiskell, Marybeth  
Jefferson, Shawn  
Keith, Lucy  
Kerr, Lisa  
Paganssi, Laura  
Ryan, Pamela  
Searcy, Brian  
Thompson, Sarah  
Timmer, Edward  
Valentini, Stefanie  
Watson, Elise  
Wittenberg, Kim

New  
Atkinson, Kim  
Baizer, Abby

Visiting Faculty and Investigators

Epstein, Slava, Northeastern University  
Hanlon, Roger, Marine Biological Laboratory
Barlow, Margaret
Bowen, Jennifer
Cavanaugh, Joseph
DeConinck, Domenique
Ferland, Amy
Griffin, Martin
Homkow, Laura
Lawrence, David
Smith, Spence
Tober, Joanna
Wright, Dana

Undergraduate Students

Spring 97
Balays, Roman
Bentis, Christopher
Drucker, Sam
Schlimmer, Lisa
Siager, Emily
Strongin, Daniel
Wilkman, Jason

Fall 97
Adams, Elizabeth
Banik, Amy
Bell, Richard
Benjamin, Natasha
Berasi, Brenda
Brines, Zachary
Brown, Nicole
Camp, Sara
Dohogne, Michelle
Efros, Michelle
Frenz, Christopher
Furlong, Chris
Harrington, April
Hubert, Jessica
Jacks, Jennifer
Joyce, Kelly
Kam, Adrienne
Krawczyk, Jaime
Levy, Ian
Lolli, Amanda
Miller, Laura
Paradise, Kristen
Rodriguez, Jennifer
Weaver, Matthew

Summer 1997 Interns

Duffy, Elisabeth
Elkins, Kim
Heberlig, Laura
Hoeppner, Susanne
Javonillo, Robert
Kilkan, Brian
Lee, Rosalynn
Markley, Jessamyn
Morlock, Summer
Taylor, David
Voss, Daniel
Whitman, Allison

Laboratory of Jelle Atema

Many organisms and cellular processes use chemical signals as their main channel of information about the environment. All environments are noisy and require some form of filtering to detect important signals. Chemical signals are transported by turbulent currents, viscous flow, and molecular diffusion. Receptor cells extract chemical signals from the environment through various filtering processes. In our laboratory, fish, marine snails, and crustaceans have been investigated for their ability to use chemical signals under water. Currently, we use the lobster and its exquisite senses of smell and taste as our major model to study the signal-filtering abilities of the whole animal and its narrowly tuned chemoreceptor cells.

Research in our laboratory focuses on amino acids, which represent important food signals for the lobster, and on the function and chemistry of pheromones used in lobster courtship. We examine animal behavior in the sea and in the lab. This includes social interactions and chemotaxis. To understand the role of chemical signals in the sea we use real lobsters and small untethered robots. Besides measurement and computer modeling of odor plumes and of the water currents, lobsters generate to send and receive chemical signals, our research includes neurophysiology of receptor cells and anatomical studies of receptor organs and pheromone glands.

Laboratory of Vincent Dionne

Odors are powerful stimuli. They can focus the attention, elicit behaviors (or misbehaviors), and even resurrect forgotten memories. These actions are directed by the central nervous system, but they depend upon the initial transduction of chemical signals by olfactory receptor neurons in the nasal passages. More than just a single process appears to underlie odor transduction, and the intracellular pathways that are used are far more diverse than once thought. Hundreds of putative odor receptor molecules have been identified that work through several different second messengers to modulate the activity of various types of membrane ion channels. Our studies are being conducted with aquatic salamanders using amino acids and other soluble chemical stimuli which these animals perceive as odors. Using electrophysiological and molecular approaches, the research examines how these cellular components produce odor detection, and how odors are identified and discriminated.

Laboratory of Arthur G. Humes

Research interests include systematics, development, host specificity, and geographical distribution of copepods associated with marine invertebrates. Current research is on taxonomic studies of copepods from invertebrates in the tropical Indo-Pacific area, and poecilostomatoid and siphonostomatoid copepods from deep-sea hydrothermal vents and cold seeps.

The Laboratory of Les Kaufman

Current research projects in the laboratory deal with speciation and extinction dynamics of haplochromine fishes in Lake Victoria. We are studying the systematics, evolution, and conservation genetics of a species flock encompassing approximately 700 very recently evolved taxa, in the dynamic and heavily impacted landscape of northern East Africa. In the lab, we are studying evolutionary morphology, behavior, and systematics of these small, brightly colored cichlid fishes. Another area of study is developmental and skeletal plasticity in fishes; we are studying the diversity of bone tissue types in fishes, differential response to mineral and mechanical challenge, and matrophenic versus environmental effects in the development of coral reef fishes. We also study the biological basis for marine reserves in
the New England fisheries. We are involved in collaborative research with NURC, NMFS, and others on the relative impact on groundfish stocks of juvenile habitat destruction versus fishing pressure.

**Laboratory of Phillip Lobel**

Fish are the most diverse vertebrate group and provide opportunities to study many aspects of behavior, ecology, and evolution. We primarily study how fish are adapted to different habitats and the behavioral ecology of species interactions. Current research focuses on fish acoustic communication. We are also conducting a long-term study of the marine biology of Johnston Atoll, Central Pacific Ocean. Johnston Atoll has been occupied continuously by the military since the 1930s and proved a unique opportunity for assessing the biological impacts of island industrialization and effects on reefs. Johnston Atoll is the site of the US Army’s chemical weapons demilitarization facility. JACADS.

**Laboratory of Ivan Valiela**

A focus of our work is the link between land use on watersheds and consequences in the receiving estuarine ecosystems. The work examines how landscape use and urbanization increase nutrient loading to groundwater and streams. Nutrients in groundwater are transported to the sea, and, after biogeochemical transformation, enter coastal waters. There, increased nutrients bring about a series of changes on the ecological components. To understand the coupling of land use and consequences to receiving waters, we study the processes involved, assess ecological consequences, and define opportunities for coastal management.

A second long-term research topic is the structure and function of salt marsh ecosystems, including the processes of predation, herbivory, decomposition, and nutrient cycles.

**Calcium Imaging Laboratory**

This laboratory investigates the roles of calcium patterns in development. Our main tool uses the aequorins, a family of luminescent proteins ultimately obtained from a jellyfish and long studied by Dr. Osamu Shimomura at the MBL. Aequorins can either be microinjected into cells or transgenically expressed without disturbing function or development. The patterns of luminescence that are emitted by aequorinated cells reveals changing patterns and levels of free calcium with the cell or its progeny. Much of what we know about the role of calcium in development has been obtained with the aequorins.

The four systems under present or planned investigation are the *Drosophila* egg (in collaboration with Carl Hashimoto at Yale), the zebrafish egg, the fucoid egg (in collaboration with Dr. Ken Robinson at Purdue), and the cellular slime mold, *Dictyostelium*.

**Staff**

Jaffe, Lionel, Senior Scientist
Créton, Robert, Research Associate

**Center for Advanced Studies in the Space Life Sciences at the MBL**

(supported by the National Aeronautics and Space Administration)

The Marine Biological Laboratory and the National Aeronautics and Space Administration have established a cooperative arrangement with the formation of the Center for Advanced Studies in the Space Life Sciences at the MBL. This Center serves as an interface between NASA and the basic science community, addressing issues of mutual interest. A series of symposia, workshops, and seminars are held at the MBL to advise NASA on a wide variety of topics in the life sciences, including cellular, molecular, developmental, plant, neuro-, and evolutionary biology. Special attention is directed at examining how gravity and its control impact on biological processes, and how variations in gravity can be used as a probe to better understand such processes. This center provides a forum for scientists to think and discuss, often for the first time, the role that gravity and other aspects of space flight may play in fundamental cellular and physiological processes. These interactions also serve to inform the community of research opportunities in the life sciences that are of interest to NASA. In addition, a newsletter will be published to disseminate this information to a wider audience.

During the past year the Center sponsored two workshops at the MBL: “Genetic Regulatory Networks in Embryogenesis and Evolution” held on June 11–14, 1997, chaired by Eric Davidson and David McClay; and “Evolution: A Molecular Point of View” held on October 24–26, 1997, chaired by Mitchell Sogin.

**Staff**

Dawidowicz. Lenny, Administrator
Amit, Udeni. Administrative Assistant
Nixon, Jennifer, Administrative Assistant

**The Ecosystems Center**

The Center carries out research and education in ecosystems ecology. Terrestrial and aquatic scientists work in a wide variety of ecosystems ranging from the streams, lakes and tundra of the Alaskan Arctic (limits on plant primary production) to sediments of Massachusetts Bay (controls of nitrogen cycling), to forests in New England (effects of soil warming on carbon and nitrogen cycling), and South America (effects of greenhouse gas fluxes of conversion of rain forest to pasture) and to large estuaries in the Gulf of Maine (effects of plankton and benthos of nutrients and organic matter in stream runoff). Many projects, such as those dealing with carbon and nitrogen cycling in forests, streams, and estuaries, use the stable isotopes $^{13}$C and $^{15}$N to investigate natural processes. A mass spectrometer facility is available. Data from field and laboratory research are used to construct mathematical models of whole-system responses to change. Some of these models are combined with geographically referenced data to produce estimates of how environmental changes affect key ecosystem indexes such as net primary productivity and carbon storage throughout the world’s terrestrial biophere.
The results of the Center’s research are applied, wherever possible, to the questions of the successful management of the natural resources of the earth. In addition, the ecological expertise of the staff is made available to public affairs groups and governmental agencies who deal with problems such as acid rain, coastal eutrophication, and possible carbon dioxide-caused climate change. The Semester in Environmental Science, a fall offering, was held for the first time in 1997. Sixteen students from 11 colleges participated in the program. There are opportunities for postdoctoral fellows.

Administrative Staff
Hbbie, John E., Co-Director
Melillo, Jerry M., Co-Director
Berthel, Dorothy J., Administrative Assistant
Chandler, Marsha, Administrative Assistant, Semester in Environmental Science
Donovan, Suzanne J., Executive Assistant
Foreman, Kenneth H., Associate Director of Environmental Studies Program
Nuñez, Guillermo, Research Administrator
Seifert, Mary Ann, Administrative Assistant
Scanlon, Deborah G., Executive Assistant, LMER Coordination Office

Scientific Staff
Hbbie, John E., Senior Scientist
Melillo, Jerry M., Senior Scientist
Peterson, Bruce J., Senior Scientist
Shaver, Gary R., Senior Scientist
Giblin, Anne E., Associate Scientist
Hopkinson, Charles S., Senior Scientist
Nadelhoffer, Knute J., Associate Scientist
Deegan, Linda A., Associate Scientist
Rastetter, Edward B., Associate Scientist
Steudler, Paul A., Senior Research Specialist
Neil, Christopher, Assistant Scientist
Pan, Yude, Research Associate
Vallino, Joseph J., Assistant Scientist
Williams, Mathew, Assistant Scientist
Xiao, Xiangming, Research Associate

Educational Staff Appointments
Currie, William, Visiting Postdoctoral Scholar, U.S. Department of Agriculture
Garcia, Diana, Postdoctoral Research Associate
Gough, Laura, Postdoctoral Research Associate
Hartley, Anne, Postdoctoral Research Associate
Herbert, Darrell A., Postdoctoral Research Associate
Holmes, Robert M., Postdoctoral Research Associate
Hughes, Jeffrey E., Postdoctoral Research Associate
Jakobsen, Leanne, Postdoctoral Research Associate
Stieglitz, Marc, NOAA Global Climate Change Postdoctoral Fellow
Tian, Hanqin, Postdoctoral Research Associate

Technical Staff
Bahr, Michele P., Research Assistant
Bettez, Neil D., Research Assistant
Bryant, David M., Research Assistant
Canary, Jana D., Research Assistant
Catria, Christina E., Research Assistant
Clark, Tamara, Research Assistant
Claessens, Luc, Research Assistant

Dornblaser, Mark M., Research Assistant
Downs, Martha R., Research Assistant
Garritt, Robert H., Senior Research Assistant
Helfrich, John V. K., III, Senior Research Assistant
Holland, Keri, Research Assistant
Hooker, Bethanie, Research Assistant
Kicklighter, David W., Senior Research Assistant
Kwiatkowski, Bonnie L., Research Assistant
Laundre, James A., Senior Research Assistant
Micks, Patricia, Research Assistant
Newkirk, Kathleen M., Research Assistant
Nolin, Amy L., Research Assistant
Pratt, Sara, Research Assistant
Regan, Kathleen M., Research Assistant
Ricca, Andrea, Research Assistant
Schwamb, Carol, Laboratory Assistant
Slavik, Karie A., Research Assistant
Soucy, Lori, Research Assistant
Thieler, Kama, Research Assistant
Thomas, Suzanne, Research Assistant
Tholke, Kristin S., Research Assistant
Tucker, Jane, Senior Research Assistant
Weston, Nat, Research Assistant
Wolheim, Wilfred M., Research Assistant

Consultants
Bowles, Frances P., Research Systems Consultant Principal, Research Designs
Bowles, Margaret C., Administrative Consultant
Golden, Heidi E., Research Consultant

Visiting Scientists and Scholars
Kling, George, Visiting Scientist, University of Michigan, Ann Arbor
Loya, Wendy, Visiting Scholar, Kansas State University
Seifert, Gabriel, CIEE Intern, Technical University of Wismar, Germany
Siver, Peter, Semester in Environmental Science Faculty Fellow, Connecticut College

Laboratory of Aquatic Animal Medicine and Pathology

The laboratory provides diagnostic, consultative research, and educational services to the institutions and scientists of the Woods Hole community concerned with marine animal health. Diseases of wild, captive, and cultured animals are investigated.

Staff
Abt, Donald A., Director and The Robert R. Marshak Term Professor of Aquatic Animal Medicine and Pathology, School of Veterinary Medicine, University of Pennsylvania
Bullis, Robert A., Research Associate in Microbiology, University of Pennsylvania
Lecibovitz, Louis, Director Emeritus
McCafterty, Michelle, Histology Technician, University of Pennsylvania
Moniz, Priscilla C., Administrative Assistant
Smolowitz, Roxanna M., Research Associate in Pathology, University of Pennsylvania
Wadman, Elizabeth A., Microbiology Technician, University of Pennsylvania
**Laboratory of Aquatic Biomedicine**

Work in this laboratory centers on comparative immunopathology and molecular biology using marine invertebrates as experimental models. Examples of current research include determining the prevalence of leukemia in *Mya arenaria* (the soft shell clam) in Massachusetts. Monoclonal antibodies developed by this laboratory are being used to diagnose clam leukemia, identify and characterize a tumor-specific protein, and differentiate other leukemias in bivalve molluscs. Developmental and chemically-induced changes in gene expression and neuronal growth are also being studied in the surf clam, *Spisula solidissima*. Work in molecular biology is creating a clearer understanding of the comparative etiology and pathogenesis of tumors, particularly in environmentally impacted aquatic animals.

**Staff**

Reinisch, Carol L., Associate Scientist, MBL, and Chairperson, Department of Environmental and Population Health, Tufts University School of Veterinary Medicine

Jessen-Eller, Kathryn, Postdoctoral Fellow

Steinle, Marjorie, Research Assistant

Barker, Colleen, Laboratory Technician

**Visiting Scientist**

Barker, Lewellys, Senior Associate Department of International Health, Johns Hopkins University School of Public Health

**Student**

Smith, Cynthia, Tufts University School of Veterinary Medicine

**Laboratory of Cell Communication**

Established in 1994, this laboratory is devoted to the study of intercellular communication. The research focuses on the cell-to-cell channel, a membrane channel built into the junctions between cells. This channel provides one of the most basic forms of intercellular communication in organs and tissues. The work is aimed at the molecular physiology of this channel, in particular, at the mechanisms that regulate the communication. Electrophysiological-, fluorescent-tracer-, and molecular biological techniques are used to this end. As was recently discovered in this laboratory, the channel is the conduit of growth-regulating signals. It is instrumental in a basic feedback loop whereby cells in organs and tissues control their number; in a variety of cancer forms it is crippled. Work is aimed now at the mechanisms of growth control and at correcting cancer growth by transferring the gene for the cell-to-cell channel protein from normal cells into the cancer cells. Molecular genetic techniques are used in this endeavor.

**Staff**

Loewenstein, Werner, Senior Scientist

Rose, Birgit, Senior Scientist

Jillson, Tracy, Research Assistant

**Laboratory of Barbara and Bruce Furie**

γ-Carboxyglutamic acid is a calcium-binding amino acid that is found in the conopeptides of the predatory marine cone snail, *Conus*. This laboratory has been investigating the biosynthesis of this amino acid in *Conus* and the structural role of γ-carboxyglutamic acid in the conopeptides. This satellite laboratory relates closely to the main laboratory on the Harvard Medical School campus in Boston; the main focus of the primary laboratory is the synthesis and function of γ-carboxyglutamic acid in blood clotting proteins and the role of vitamin K.

Large numbers of cone snails from Fiji have been obtained and are being maintained in the Marine Resources Center. The marine cone snail is the sole invertebrate known to synthesize γ-carboxyglutamic acid (Gla). The venous cone snail produces neurotoxic conopeptides, some rich in Gla, which it injects into its prey. To examine the biosynthetic pathway for Gla, we have studied the *Conus* carboxylase which converts glutamic acid to γ-carboxyglutamic acid. Of the *Conus* species tested, *C. bandanus*, *C. marmoreus*, *C. textile*, and *C. leopardus* had high specific γ-carboxylase activity. This activity has an absolute requirement for vitamin K. The *Conus* carboxylase has been extensively purified and its gene is being cloned. The *Conus* carboxylase substrates appear to contain a carboxylation recognition site on the conotoxin precursor. The *Conus* vitamin K-dependent carboxylase should be an excellent model for determining the mechanism of action of vitamin K in the synthesis of γ-carboxyglutamic acid.

Fifteen novel γ-carboxyglutamic acid-containing conopeptides have been isolated from the venom of *Conus textile*. The amino acid sequence, amino acid composition and molecular weights of these peptides have been determined. For several peptides, the cDNA encoding the precursor conotoxin has been cloned.

The three-dimensional structure of some of these Gla-containing conopeptides as well as conantokin G have been determined by 2D NMR spectroscopy. Complete resonance assignments were made from 2D 1H NMR spectra via identification of intrasidue spin systems using 1H-1H through-bond connectivities. NOESY spectra provided d<sub>αα</sub>, d<sub>αN</sub> and d<sub>NS</sub> NOE connectivities and vicinal spin-spin coupling constants J<sub>αNS</sub> were used to calculate φ torsion angles. Structure generation based on interproton distance restraints and torsion angle measurements yield convergent structures generated using distance geometry and simulated annealing methods. The goal of this project is to determine the structural role of γ-carboxyglutamic acid in the Gla-containing conotoxins.

**Staff**

Barbara C. Furie, Scientist

Bruce Furie, Scientist

Johan Stenflo, Visiting Scientist

Eva Czerep, Postdoctoral Fellow

Gail Begley, Postdoctoral Fellow

Alan Rigby, Postdoctoral Fellow
Laboratory of Roger Hanlon

This laboratory investigates the behavior and neurobiology of cephalopods. Studies of various learning capabilities are currently being conducted, as are studies on reproductive strategies that include agonistic behavior, female mate choice, and sperm competition. The latter studies involve DNA fingerprinting to determine paternity and help assess alternative mating tactics. Currently we are studying sensory mechanisms and function of polarization vision in cephalopods. Complimentary field studies are conducted locally and on coral reefs. The functional morphology and neurobiology of the chromatophore system of cephalopods are also studied on a variety of cephalopod species, and image analysis techniques are being developed to study crypts and the mechanisms that enable cryptic body patterns to be neurally regulated by visual input.

Staff
Hanlon, Roger, Senior Scientist
Boal, Jean, Postdoctoral Fellow
Shashar, Nadav, Postdoctoral Fellow

Visiting Investigators
Gabr, Howaida, Graduate Student, Suez Canal University, Panama
Wittenberg, Kim, Graduate Student, Boston University Marine Program

Laboratory of Shinya Inoué

Scientists in this laboratory study the molecular mechanism and control of mitosis, cell division, cell motility, and cell morphogenesis, with emphasis on biophysical studies made directly on single living cells, especially developing eggs in marine invertebrates. Development of biophysical instrumentation and methodology, such as polarization optical and video microscopy and digital image processing techniques, and exploration of their underlying theory are an integral part of the laboratory’s effort.

Staff
Inoué, Shinya, Distinguished Scientist
Knudson, Robert, Instrument Development Engineer
Maccaro, Jackie, Laboratory Assistant
MacNeil, Jane, Executive Assistant

Laboratory of Alan M. Kuzirian

Research in the laboratory explores the functional morphology and ultrastructure of various organ systems in molluscs. The program includes culture of the nudibranch, Hennissenda crassicornis, with emphasis on developing reliable culture methods for rearing and maintaining the animal as a research resource. The process of metamorphic induction by natural and artificial inducers is being explored in an effort to understand the processes involved and as a means to increase the yield of cultured animals. Morphologic studies stress the ontogeny of neural and sensory structures associated with the photic and vestibular systems which have been used in learning and memory studies as well as the spatial and temporal occurrence of regulatory and transmitter neurochemicals. Concurrent with these morphologic studies is the development of new histologic techniques designed to facilitate the acquisition of morphologic and structural information supporting proposed physiologic processes.

Collaborative research includes histochemical investigations on strontium’s role in initiating calcification in molluscan embryos (shell and statoliths), as well as immunocytochemical labelling of cell-surface antigens, neurosecretory products, second messenger proteins involved with learning and memory, and intracellular transport organelles using mono- and polyclonal antibodies on squid (Loligo pealei) giant axons and Hennissenda sensory and neurosecretory neurons, both in situ and in cell culture. Toxicity studies detailing the effects of lead on Hennissenda learning and memory, feeding, and the physiology of cultured neurons are also being conducted.

Additional collaborative research includes DNA fingerprinting using RAPD-PCR techniques in preparation for isogenic strain development of laboratory-reared Hennissenda and hatchery produced bay scallops (Argopecten irradians) with distinct phenotypic markers for the rapid field identification. Systematic and taxonomic studies of nudibranch molluscs, to include molecular phylogenetics, are also of interest.

Staff
Kuzirian, Alan M., Associate Scientist

Visiting Scientists
Chikarmane, Hemant, Research Scientist, Aphios Corporation, Woburn MA: Assistant Scientist, MBL
Clay, John R., NINDS/NIH

Laboratory of Rudolf Oldenbourg

The laboratory investigates the molecular architecture of living cells and of biological model systems using optical methods for imaging and manipulating these structures. For imaging non-invasively and non-destructively cell architecture dynamically and at high resolution, we have developed a new polarized light microscope (Pol- Scope). The Pol-Scope combines microscope optics with new electro-optical components, video, and digital image processing for fast analysis of specimen birefringence over the entire viewing field. Examples of biological systems currently investigated with the Pol-Scope are: microtubule-based structures (asters, mitotic spindles, single microtubules); actin-based structures (acrosomal process, stress fibers, nerve growth cones); zona pellucida of vertebrate oocytes; and biopolymer liquid crystals.

Staff
Oldenbourg, Rudolf, Associate Scientist
Katoh, Kaoru, Postdoctoral Research Associate
Geer, Thomas, Research Assistant
Knudson, Robert, Instrument Development Engineer
Maccaro, Jackie, Laboratory Assistant

Laboratory for Reproductive Medicine, Brown University and Woman and Infants Hospital, Providence

Work in this laboratory centers on the investigation of the underlying mechanisms behind female infertility. Particular emphasis is placed on the physiology of the oocyte or early embryo, with the aim of assessing developmental potential and mitochondrial dysfunction arising from mtDNA deletions. The studies taking place at the MBL branch of the Brown Laboratory use some of the unique instrumentation available through the resident programs directed by Rudolf Oldenbourg and Peter J. S. Smith. Most particularly, non-invasive methods for oocyte and embryo study are being sought. Of several specific aims, one is to use the new Pol-Scope to analyze the
birefringence of the preimplantation mammalian zona pellucida—a structure most predictive of successful implantation. We also have used this instrument to examine meiotic spindles. An additional aim is to continue the studies on transmembrane ion transport using the non-invasive electro-physiological techniques available at the BioCurrents Research Center. Preliminary studies indicate that the calcium transport may form an accurate predictor of oocyte and embryo health. The newly developed oxygen probe also offers the possibility of looking directly at abnormalities in the mitochondria arising from accumulated mtDNA damage. Ultimately, in addition to investigating the mechanisms behind cellular aging underlying infertility, this laboratory aims to produce clinical methods for assessing preimplantation embryo viability, a development that will make a significant contribution to the health of women and children.

Staff
Keefe, David, Director
Liu, Lin, Research Associate
Pepperell, John, Visiting Investigator
Sokhal, Emily, Research Assistant
Trimarchi, James, Post-doc Fellow

Laboratory of Sensory Physiology
Members of this laboratory have conducted research on various facets of vision since 1973. Current investigations use UV/VIS light microspectrophotometry on vertebrate retinal photoreceptors for the determination of visual pigment absorbance characteristics. One aim is to arrive at a better understanding of the method of spectral tuning that forms the chemical basis of color vision. Polarized light microscopic techniques are used to measure linear dichroism and linear birefringence aimed at revealing structure-function relationships and biophysical mechanisms. An area of interest is polarization discrimination, the mechanisms that could account for the ability of some fish species to detect the direction of polarization of light collected by their eyes. As a recent development, investigations are carried out on sickling in fish red blood cells due to hemoglobin polymerization, once again making extensive use of polarized light microscopic techniques.

Staff
Hárosi, Ferenc I., Senior Scientist, MBL, and Boston University School of Medicine
Novales Flamarique, I., Postdoctoral Fellow

Visiting Scientists
Van Keuren, Jeffrey R., Postdoctoral Fellow, Woods Hole Oceanographic Institution
Hunt von Herbing, I., Assistant Professor, University of Maine

Laboratory of Osamu Shimomura
Biochemical mechanisms involved in the bioluminescence of various luminescent organisms are investigated. Based on the results obtained, various improved forms of bioluminescent and chemiluminescent probes are designed and produced for the measurements of intracellular free calcium and superoxide anion.

Staff
Shimomura, Osamu, Senior Scientist, MBL, and Boston University School of Medicine
Shimomura, Akemi, Research Assistant

Laboratory of Robert B. Silver
The members of this laboratory study how living cells make decisions. The focus of the research, typically using marine models, is on two major areas: the role of calcium in the regulation of mitotic cell division (sea urchins, sand dollars, etc.) and structure and function relationships of hair cell stereociliary movements in vestibular physiology (oyster, toadfish). Other related areas of study, e.g., synaptic transmission (squid), are also, at times, pursued. Tools include video light microscopy, multispectral, subwavelength, and very high speed (sub-millisecond frame rate) photon counting video light microscopy, telementalpulation of living cells and tissues, and modeling of decision processes. A cornerstone of the laboratory's analytical efforts is high performance computational processing and analysis of video light microscopy images and modeling. With luminescent, fluorescent, and absorptive probes, both empirical observation and computational modeling of cellular, biochemical, and biophysical processes permit interpretation and mapping of space-time patterns of intracellular chemical reactions and calcium signaling in living cells. A variety of in vitro biochemical, biological, and immunological methods are used. In addition to fundamental biological studies, the staff designs and fabricates optical hardware, and designs software for large video image data processing, analysis, and modeling.

Staff
Silver, Robert, Associate Scientist
Luders, Bruce, Research Assistant

Interns
Hirwitz, Layne R., REU Intern, Adelphi University
Sheikh, Sarah I., REU Intern, University of Edinburgh & Oxford University
Strongin, Daniel E., REU Intern, Boston University
Visiting Scientists

Alt, Maxim, MikroPhotonische Universität von CZI, Germany
Reeves, Anthony, Cornell University
Scarby, Nancy, NASA Ames Research Center
Stromboli, Emilio, Stazione de Napoli, Italy

The Marine Resources Center

The Marine Resources Center (MRC) is one of the world’s most advanced facilities for maintaining and culturing aquatic organisms essential to advanced biological, biomedical, and ecological research. Service and education also play an important and complimentary role in the modern, 32,000-square-foot facility.

The MRC and its life support systems have already increased the ability of MBL scientists to conduct research and have inspired new concepts in scientific experiments. Vigorous research programs focusing on basic biological and biomedical aquatic models are currently being developed at the Center. These programs will enhance and build upon the MRC’s existing research activities by the University of Pennsylvania’s Laboratory of Aquatic Animal Medicine and Pathology (LAAMP) and in the Laboratory of Roger Hanlon.

In addition to research, the MRC provides a variety of services to the MBL community through its Aquatic Resources Division, the Water Quality and System Engineering Division, the Administrative Division, and the Laboratory for Aquatic Animal Medicine and Pathology.

Research and educational opportunities are available at the facility to established investigators, postdoctoral fellows, graduate, and undergraduate students. Investigators and students will find that the MRC’s unique life support and seawater engineering systems make this a favorable environment in which to conduct independent research and masters and doctoral theses using a variety of aquatic organisms and flexible tank space for customized experimentation on live animals. Prospective investigators and students should contact the Director of the MRC for further information.

The MRC also hosts several courses: the annual AQUAVETS® courses sponsored by LAAMP, and an aquaculture course, the theme of which changes according to regional and national interests.

Staff

Hanlon, Roger, Director and Senior Scientist
Kazirian, Alan, Associate Scientist
Boal, Jean, Postdoctoral Fellow
Shashar, Nadav, Postdoctoral Fellow

Visiting Investigators

Baker, Robert, New York University
Gilland, Edwin, Postdoctoral Fellow
Adamo, Shelly, Dalhousie University, Canada
Spotte, Stephen, University of Connecticut
Wittenberg, Kim, Graduate Student, Boston University Marine Program
Gabr, Howaida, Graduate Student, Suez Canal University, Panama
Honors

Friday Evening Lectures

June 20
Roger Y. Tsien, Howard Hughes Medical Institute, University of California, San Diego
"Molecular Spies Reveal Cell Signals in Living Color"

June 27
Charles F. Stevens, The Salk Institute for Biological Studies
"Synapses and Memory" (Lang Lecture)

July 4
Marianne Bronner-Fraser, California Institute of Technology
"Development of the Neural Crest"

July 11
Clara Franzini-Armstrong, University of Pennsylvania
"How Muscle Contraction is Turned On"

July 18
Jerry M. Melillo, Marine Biological Laboratory
"Ecological Research and Global Environmental Policy: New Challenges for an Essential Partnership"

July 24, 25
Semir Zeki, University College London
"The Functions of the Visual Brain" and "The Autonomy of the Visual Areas" (Forbes Lectures)

August 1
Eric Wieschaus, Princeton University
"Zygotic Transcription and the Control of Embryonic Development in Drosophila" (Glassman Lecture)

August 8
Daniel Barry, NASA/Johnson Space Center
"Space Flight from a Physician-Scientist's Perspective"

August 15
Rudolf A. Raff, Indiana University
"Development, Genes, and the Evolution of Animal Body Plans"

Fellowships and Scholarships

Robert Day Allen Fellowship
Drs. Joseph W. and Jean M. Sanger

ASCB Summer Research Award
American Society for Cell Biology

Frederik B. Bang Fellowship
Mrs. Betsy G. Bang

Frank A. Brown, Jr. Memorial Readership
Dr. and Mrs. Francis D. Carlson

The Jean and Katsuma Dan Fellowship Fund
Dr. Howard Holtzer
Dr. and Mrs. Shinya Inoué
Drs. Joseph W. and Jean M. Sanger
Mrs. H. Burr Steinbach

Bernard Davis Fund
Mrs. Elizabeth M. Davis

Aline D. Gross Scholarship Fund
Mrs. Mona Gross
Drs. Joan and Gerald Ruderman
Mr. and Mrs. Alfred M. Weisberg

Kefler Hartline Fellowship Fund
Dr. Edward F. MacNichol, Jr.

William Randolph Hearst Educational Endowment
William R. Hearst Foundation

Fred Karush Endowed Library Readership
Dr. and Mrs. Laszlo Lorand
Dr. and Mrs. Arthur M. Silverstein

MBL Summer Fellowships
Dr. and Mrs. Shinya Inoué
### Charles Baker Metz and Charles William Metz Scholarship Fund
Mr. Ronald H. Abel  
Mrs. Grace S. Metz

### Mountain Memorial Fund
Ms. Brenda J. Bodian  
Dr. and Mrs. Benjamin Kaminer  
Dr. and Mrs. R. Walter Schlessinger

### James A. and Faith Miller Fellowship Fund
Mr. and Mrs. David A. Miller  
Mr. Robert K. Schlessinger

### Frank Morrell Fund
Dr. Jack C. Berger  
Ms. Elena N. Cohen  
Ms. Kathleen A. Dunn  
Dr. Leyla de Toledo Morrell  
Dr. Serge J.C. Pierre-Louis  
Rush Presbyterian-St. Luke’s  
Dr. Susan Stefoski

### Nikon Fellowship
Nikon, Inc.

### Pfizer Scholarship Fund
Pfizer, Inc.

### William Townsend Porter Scholarship
William Townsend Porter Foundation

### Ruth Sager Scholarship Fund
Dr. and Mrs. Harlyn O. Halvorson  
Dr. and Mrs. Laszlo Lorand  
Dr. Arthur B. Pardee  
Dr. and Mrs. David Shepro

### The Ann Osterhout Edison/
Theodore Miller Edison and Olga Osterhout Sears/Harold Bright Sears Endowed Scholarship Fund
Ms. Elizabeth F. Brewster  
Mr. and Mrs. John W. Child  
Ms. Jane T. Claffey  
Mr. and Mrs. Putnam P. Flint  
Dr. and Mrs. Paul L. Goodrich  
Mr. and Mrs. Allan C. Henry  
Ms. and Mrs. Robert L. Loud  
Ms. Elaine M. Medeiros  
Mr. Maren Miles and Ms. Nancy Douglas  
Ms. Nancy L. Olsen  
Dr. and Mrs. Miles H. Robinson  
Mr. and Mrs. Christopher A. Sims  
Mr. and Mrs. Peter E. Sloane  
Dr. and Mrs. Thomas R. Stetson  
Ms. Marsden Williams

### Science Writing Fellowships Program
American Society for Biochemistry & Molecular Biology  
American Society for Neurochemistry, Inc.  
American Society for Photobiology Association for Research in Vision and Ophthalmology  
Biophysical Society  
Charles A. Dana Foundation  
Federation of American Society for Experimental Biology  
Foundation for Microbiology  
Friendship Fund  
New York Times Foundation  
Nicholas B. Ottaway Foundation

### The Moshe Shilo Memorial Scholarship Fund
Dr. and Mrs. John J. Lee  
Dr. and Mrs. Richard I. Mateles

### The Evelyn and Melvin Spiegel Fellowship Fund
Drs. Joseph W. and Jean M. Sanger  
Drs. Melvin and Evelyn Spiegel and the Sprague Foundation

### H. B. Steinbach Fellowship
Mrs. H. Burr Steinbach

### Horace W. Stunkard Fellowship
Mrs. Eunice Latham  
Dr. Albert J. Stunkard and Dr. Margaret Maurin

### The Walter L. Wilson Endowed Scholarship Fund
Mrs. Irmgard Alexander (deceased)  
Dr. Paul N. Chervin  
Mrs. Marian Rigaumont  
Dr. Jean R. Wilson

### Young Scholars/Fellows Program
Merck Research Laboratories

---

### Fellowships Awarded

**MBL Summer Research Fellows**

- Elena Barbieri, M.Sc., the **Bernard Davis Fellow**, is a researcher in the Bay Paul Center for Comparative Molecular Biology and Evolution at the MBL. She is also a fellow at the University of Urbino, Urbino Italy. She worked with Dr. Norman Wainwright on the role of symbiotic bacteria in the accessory nidamental gland (ANG) of the squid, *Loligo pealei*. She measured secondary metabolites derived from these symbiotic bacteria. These metabolites may have antimicrobial activity in the capsule-like membranes of the squid eggs. This study may lead to the development of new antibiotics or potential treatments in clinical chemotherapy.

- Barbara C. Boyer, Ph.D., was an **Erik B. Fries** and an **MBL Associates Fellow**. She is a professor in the Department of Biology at Union College, Schenectady, New York. Dr. Boyer studied the evolution of development using the turbellarian flatworms *Haploplana*, *Stylochus* and *Neochildia*.

- Mario H. Burgos, M.D., was supported by the **Frank R. Lillie Fellowship** while working with Dr. Shinya Inoue during the summer of 1997. Dr. Burgos is Founder and Director of the Institute of Histology and Embryology in Mendoza, Argentina. He used video
microscopy and confocal fluorescence microscopy in his research on gossypol, a male anti-fertility agent produced from cottonseed. Dr. Burgos used the male gamete of the sea urchin as a model system in which to test the effects of the agent. Research on gossypol may eventually result in a birth control drug for men.

• Edwin DeMont, Ph.D., is an associate professor in the Biology Department at St. Francis Xavier University, Antigonish, Nova Scotia, Canada. Dr. DeMont was supported by the Esther A. and Joseph Klingenstein Fund during the summer of 1997 while he studied the biomechanics of jet-propelled swimming in the squid Loligo pealei.

• Leah Devin, Ph.D., was supported by the NASA Life Sciences Program Fellowship, the M.G.F. Fuortes Fellowship, and the Lucy B. Lemann Fellowship. She is an assistant professor of Biology at Penn State University in Abington, Pennsylvania. Dr. Devin used a vibrating calcium-selective electrode to explore the movement of calcium in cardiac and smooth muscle. Her primary research organisms were the channelled whelk,Busycon canaliculatum, and the sea cucumber, Sclerodactyla briareus. Dr. Devin’s research is significant in assessing the effects of anti-arrhythmic and anti-hypertensive drugs, such as calcium blockers, on calcium channel activity in cardiac and smooth muscle.

• Gregg G. Gunderson, Ph.D., is an associate professor in the Department of Cell Biology and Anatomy at Columbia University in New York, New York. As the 1997 Nikon Fellow, Dr. Gunderson studied the dynamics and assembly of adhesion complexes during cell migration. Dr. Gunderson’s research on the basic mechanism of cell motility may eventually aid clinicians’ abilities to combat cancer and infectious diseases.

• Gwendolyn B. Howe, Ph.D., is an associate professor in the Biology Department of Texas Southern University. Dr. Howe’s research at the MBL last summer was supported by the William Townsend Porter Fellowship for Minority Investigators, as well as an MBL Associates Fellowship. Dr. Howe did on-line research of DNA sequence databases. She characterized proteins that play a role in the condensation of chromatin. Chromatin is the mass of material that condenses into individual distinguishable chromosomes just before a cell nucleus divides. Dr. Howe’s research may lead to a better understanding of certain pathologies that are due to abnormal gene expression.

• Samantha B. Joyce, Ph.D., is an assistant professor in the Department of Oceanography at Texas A&M University. She was supported by an MBL Associates Fellowship and worked with Dr. Ivan Vielstra during the summer of 1997. Dr. Joyce studied the reduction of nitrogen loading to estuaries by denitrification in fringing salt marshes.

• Kamran Khodakhah, Ph.D., is a post-doctoral researcher in the Department of Physiology at the University of Pennsylvania School of Medicine. His research last summer was supported by the H.B. Steinbach Fellowship, the Frederik B. Bang Fellowship Fund, and an MBL Associates Fellowship. Dr. Khodakhah used the American eel and catfish to study the regulation of liver metabolism. His research may have applications in the treatment of diabetes.

• J.H.E.M. (Anka) Klerkx, M.Sc., is a graduate student in the Department of Experimental Zoology at Utrecht University, Utrecht, The Netherlands. Her research last summer was sponsored by the Evelyn and Melvin Speigel Fellowship Fund, the James A. and Faith Miller Memorial Fund, and the Charles R. Crane Fellowship. She studied the mechanisms that evolved to control development in the spirulins, Chaetopterus and Nereis.

• Donald L. Lovett, Ph.D., is an associate professor in the Department of Biology at The College of New Jersey in Trenton, New Jersey. His research was supported by the John O. Crane Fellowship Fund, the Esther A. and Joseph Klingenstein Fund, and an MBL Associates Fellowship. Dr. Lovett studied the effects of methyl farnesoate on the cellular mechanisms of the green crab, Carcinus maenas. This research has potential economic applications in crustacean aquaculture and biomedical applications in the use of crustacean chitin, which is being examined for biomedical uses.

• Mark Q. Martindale, Ph.D., was supported by the Erik B. Fries Endowed Fellowship and an MBL Associates Fellowship. He is an assistant professor of Organismal Biology and Anatomy at the University of Chicago, Illinois. Dr. Martindale continued his research on the evolution of embryonic development. He studied the ctenophore, Mnemiopsis leidii, and the flatworms, Hoploplana, Neochilidia, and Stylochus. His research could lead to a better understanding of birth defects.

• Allen Mensinger, Ph.D., is a research instructor in the Department of Otolaryngology at the Washington University School of Medicine, St. Louis, Missouri. His research was supported by a NASA Life Sciences Program Fellowship and the Esther A. and Joseph Klingenstein Fund. To understand nerve regeneration more fully, Dr. Mensinger studied the physiology of the toadfish, Opsanus tau.

• Charles G. Minkoff, B.A., is a graduate student in the Department of Molecular Cancer Biology at Duke University Medical Center in Durham, North Carolina. His work last summer was supported by the Frank A. Brown, Jr. Memorial Readership. Mr. Minkoff studied the effects of cholesterol-lowering drugs on the cell cycle in the surf clam, Spisula solidissima.

• Takehito Saito, Ph.D., is a professor in the Institute of Biological Sciences at the University of Tsukuba, Tsukuba, Japan. The Herbert W. Rand Fellowship supported Dr. Saito’s research on the cirradian rhythm of the horseshoe crab (Limulus polyphemus) eye. Dr. Saito hopes to gain a better understanding of how circcadian clocks influence vision.

• Alistair Simpson, B.S., is a graduate student in the Proti Research Laboratory at the University of Sydney, Sydney, Australia. His work last summer on the evolutionary relationships among protozoa was supported by the Bernard Davis Fund. By illustrating the relationships among structurally primitive protists, Mr. Simpson hopes to gain insight into the evolution of cells and a better understanding of microbial biodiversity in sediments.

• Peter A. Siver, Ph.D., is a professor in the Department of Botany and Chair of the Environmental Studies Program at Connecticut College. His work was supported by the Lucy B. Lemann Fellowship. Dr. Siver studied the remains of golden algae (Chrysophytes) archived in lake sediments to understand more fully the effects of environmental stresses on aquatic resources.

• Timothy P. Spann, Ph.D., is a research associate in the Department of Cell and Molecular Biology at Northwestern University Medical School, Chicago, Illinois. He worked with Dr. Robert Goldman as a NASA Life Sciences Program Fellow and a Frederik B. Bang Fellow. Dr. Spann studied the organization of the surf clam (Spisula) nucleus as a model system to understand more fully the relationship between nuclear architecture and nuclear function. His research could lead to new methods of regulating cell growth and gene expression.

• Walter Steffen, Ph.D., is an assistant professor at the Institute of Biochemistry and Molecular Cell Biology in Vienna, Austria. He was a Herbert W. Rand Fellow and an MBL Associates Fellow. Dr. Steffen’s research focused on the transport of membranous organelles by motor proteins in the frog, Xenopus laevis.

• Megumi Takahashi, M.D., Ph.D., is a psychiatrist at the Kanagawa Psychiatric Center in Yokohama, Japan. His research was supported by the Stephen W. Kuffer Fellowship and the Ann E. Kommer Memorial Fellowship Fund. Dr. Takahashi used the squid as a model for understanding the basic mechanisms of neurodegenerative diseases.
Grass Fellows

- Janet L. Casagrand, Ph.D., University of Colorado. Project: Pressure-sensitive auditory input to the mauthner cells in the goldfish: origin, response properties, and connectivity.
- John Gray, Ph.D., Queen’s University, Canada. Project: Neural circuitry underlying a novel motor pattern expressed during metamorphosis of the hawkmoth Manduca sexta.
- Matthew Halstead, University of Auckland, New Zealand. Project: Electrophysiology of the electrosensory midbrain of the little skate Raja erinacea to biologically realistic stimuli.
- John Layne, Duke University Marine Laboratory. Project: Coordination of optokinesis and locomotion during course control in the fiddler crab, Uca pugilator.
- Mark Levandowski, Ph.D., Brown University. Project: Chimeric analysis of $\alpha$-bungarotoxin binding sequences in nicotinic acetylcholine receptors.
- Quoc Thang Nguyen, Ph.D., University of California, Irvine. Project: Neurotransmitter synthesis in mRNA-injected Xenopus oocytes.
- Eleanor Palma, Ph.D., Regina Elina Cancer Research Institute, Italy. Project: Functional expression of neuronal nAChRs subunits in the lower vertebrate using Xenopus oocytes.
- Nadav Shashar, Ph.D., University of Maryland, Baltimore County. Project: Polarization sensitivity in cephalopods.
- Hiroshi Tokumaru, Ph.D., Duke University Medical Center. Project: The role of synapin/complexin in transmitter release at the squid giant synapse.
- Martina Wicklein, Ph.D., University of Arizona. Project: Motion sensitive neurons in the visual system of the fiddler crab.

MBL Science Writing Fellowships Program

Fellows
- Marc Airhart, Assistant Producer, Earth & Sky Radio Series
- Rita Baron-Faust, Producer, "Report on Medicine"
- Steven Benowitz, Senior Editor, The Scientist
- Lynne Chery, Children’s Book Author
- Carol Ezzell, Science Editor, Journal of NIH Research
- (Ms.) Ronny G. Frishman, Managing Editor, INQUIRY
- John Fleischman, Freelance
- Marguerite Holloway, Contributing Editor, Scientific American
- Meredith Small, Freelance
- Terra Ziporyn, Freelance

Program Directors
- Robert D. Goldman, Northwestern University
- Boyce Rensberger, The Washington Post

Hands-On Laboratory Course Directors
- Rex Chisholm, Northwestern University
- Robert Palazzo, University of Kansas

Hands-On Laboratory Course Instructors
- Shuo Ma, Northwestern University
- Brad Schnackenberg, University of Kansas
- Wendy Wolf, Northwestern University

SPINES—Summer Program in Neuroscience Ethics and Survival

SPINES is a month-long program directed by Joe L. Martinez, Jr., and James Townsel. The program is supported by grants from NIMH administered by the American Psychological Association and the Association of Neuroscience Departments and Programs. SPINES offers an introduction to the opportunities available at the MBL and in the field of neuroscience in general. Fellows are taught responsible conduct in research and other survival skills such as scientific writing, poster construction, presentations, grant mechanisms, and how to seek a postdoctoral or job position.

Predoctoral
- Adwoa Adjoumou-McKinney
- Marcus McFarren
- Jonathan Reasor
- Dani Smith
- Kenira Thompson
- Desiree Villarreal
- Nicole Wicha

Postdoctoral
- Gary O. Gaufo
Scholarships Awarded

Aline D. Gross Scholarship Fund
Brown, Elizabeth A., Medical College of Virginia

American Society for Cell Biology
Minorities Affairs Committee

Chitwood, Randy, University of Texas, San Antonio
DePass, Anthony, University of Massachusetts, Amherst
McKnight, Spontaneous, University of Arizona
Norman, Eric, University of Pittsburgh
Quintero, Omar, Duke University Medical Center
Reese, Eric, University of California

Arthur Klorfein Scholarship Fund
Cooper, Brian, National Institute of Medical Research, London, UK
Damen, Wim, University of Munich (LMU), Germany
Melti, Raffaella, Universita Delgi Studi di Palermo, Italy

Biology Club of the City of New York
Scholarships Fund
Yamaguchi, Ayako, Columbia University

Burroughs Wellcome Fund—Biology of Parasitism Course
Brouwer, Kimberly, Johns Hopkins School of Public Health
Camargo, Maristela, Federal University of Minas Gerais, Brazil
Gantt, Soren, New York University Medical Center
Gleeson, Michelle, University of Technology, Sydney, Australia
Hensmann, Meike, Yale School of Public Health
Jiang, David, Johns Hopkins University
Lingman, Andreas, Washington University Medical School
Mair, Gunnar, Queen’s University of Belfast, UK
Marsh, Antoinette, University of California, Davis
Oaklo, Lillian, University of Pennsylvania
Trentiger, Carl Johan, Karolinska Institute, Sweden
Wille, Ulrike, University of Tubingen, Germany

Burroughs Wellcome Fund—Molecular Mycology Course
Buchanan, Kent, University of Oklahoma Health Sciences Center
Clarke,ENDA E., Royal Postgraduate Medical School, London, UK
Doring, Tamara, Cornell Medical School
Hopfl, Roy, University of North Carolina Hospitals
Mathews, Herbert, Loyola University of Chicago
Zhang, Mason, University of Nevada

Caswell Grave Scholarship Fund
Evans, Kelly L., Queen’s University, Canada
Osborne, Leslie, University of California, Berkeley
Thongme, Acharawan, University of North Texas

C. Lalor Burdick Fellowship Fund
Melti, Raffaella, Universita Delgi Studi di Palermo, Italy

Daniel S. Grosch Endowed Scholarship Fund
Johnson, Hope, Stanford University
Vasconcelos, Crisogono, Universidade Federal Fluminense, Brazil

Edwin Grant Conklin Scholarship Fund
Wenuganen, S., Bogor Agricultural University, Indonesia

Frank R. Lillie Scholarship Fund
Davis, Gregory, University of Chicago
de Sa, Virginia R., University of California, San Francisco
Stone, Alexandra, Ohio State University
Valster, Aline, University of Massachusetts
Wang, Gang, University of Iowa

Gary Nathan Calkins Memorial Scholarship Fund
Giuliano, Paola, Stazione Zoologica, Italy

Herbert W. Rand Scholarship Fund
Giuliano, Paola, Stazione Zoologica, Italy
Kaufmann, Christoph, Massachusetts General Hospital, Boston
Ladurner, Peter P., University of Innsbruck, Austria
Lerchner, Walter, National Institute for Medical Research, London, UK
Takke, Christine, University of Köln, Germany

Howard A. Schneiderman Endowed Scholarship Fund
Hess, Samuel, Cornell University

Howard Hughes Medical Institute Educational Program Scholarship Funding
Aanstad, Pia, University of Newcastle upon Tyne, UK
Bacci, Alberto, University of Milano, Italy
Bayliss, Richard, University of Cambridge, UK
Faure, Jean-Emmanuel, University of California
Gasser, Paul, Arizona State University
Gries, Gundula, University of Pennsylvania
Hess, Samuel, Cornell University
Holzmann, Maria, University of Geneva, Switzerland
Karhikeyan, G., Tata Institute of Fundamental Research, India
Nelson, Craig, Harvard University
Nilsson, Helen, University of Göteborg, Sweden
Ozoren, Nesrin, University of Pennsylvania
Polnaai, Dori, Northeastern University
White, Kathryn, Scripps Institute of Oceanography
Zurek, Ludek, University of Alberta

Jacques Loeb Founder’s Scholarship Fund
Ketelaar, Tijis J., Wageningen Agricultural University, The Netherlands
Marjorie Roloff Stetten Scholarship Fund
Krause, Sabine, Max-Planck-Institut für Molekulare Genetik, Germany

Massachusetts Space Grant Consortium
Blank, Carrine, University of California, Berkeley
Gaidos, Eric, Massachusetts Institute of Technology

Merck and Company, Inc.
Shoda, Lisl, Washington State University
Treutiger, Carl Johan, Karolinska Institute, Sweden
Trippelt, Elisabeth, Cornell University
Villegas, Eric, University of Pennsylvania
Wille, Ulrike, University of Tübingen, Germany

Moshe Shilo Memorial Scholarship Fund
Banin, EHUD, Tel Aviv University, Israel

Mountain Memorial Fund
Bayliss, Richard, University of Cambridge, UK
Bell, George, University of Arizona
Broome, Jill, University of North Carolina, Chapel Hill
Diggins, John, Providence College
Ozoren, Nesrin, University of Pennsylvania
Ream, Rachael A., Stanford University, Hopkins Marine Station

Phillip H. Presley Memorial Scholarships, Carl Zeiss, Inc.
Bauer, Eric, University of Texas, Austin
Bonham, Ben, University of California, San Francisco
Broome, Jill, University of North Carolina, Chapel Hill
Hughes, Deborah, Scripps Institution of Oceanography
Jaspers, Elke, Universität Oldenburg, Germany
Kilroy, Christopher, University of North Carolina, Wilmington
Ream, Rachael A., Stanford University, Hopkins Marine Station

Pioneers Fund
Baghthu, Fikry, The Hebrew University of Jerusalem, Israel
Evans, Kelly L., Queen’s University, Canada

Planetary Biology Internships
Johnson, Hope, Stanford University
Vasconcelos, Crisogono, Universidade Federal Fluminense, Brazil

Post-Course Research Awards
Dale L. Beach, University of North Carolina, Chapel Hill, Physiology
Julie Canman, University of North Carolina, Chapel Hill, Physiology
Gregory Davis, University of Chicago, Embryology
Anthony DePass, University of Massachusetts, Amherst, Physiology
Gundula E. Gries, University of Pennsylvania, Physiology
Xiang Dong (Edward) Guo, Columbia University, Physiology
Kaoru Katoh, University of Tsukuba, Japan, Physiology
Matteus Ketelaar, Wageningen Agricultural University, The Netherlands, Physiology
Peter Ladurner, University of Innsbruck, Austria, Embryology
Susan Laessig, University of Maryland, Baltimore, Neural Systems & Behavior
Laura Linz, Louisiana State University, Physiology
Paul Maddox, University of North Carolina, Chapel Hill, Physiology
Lyne Merchant, University of California, San Diego, Neural Systems & Behavior
Helen Nilsson, University of Gothenburg, Sweden, Physiology
Yasushi Satoh, University of Tokyo, Japan, Physiology
Elaine Seaver, University of Texas, Austin, Embryology
Sen Song, Brandeis University, Neural Systems & Behavior
Aline Valster, University of Massachusetts, Amherst, Physiology
Cris Vasconcelos, ETH Zentrum, Zurich, Switzerland, Microbial Diversity
Gang Wang, University of Iowa, Physiology
S. Wenuganen, Bogor Agricultural University, Indonesia, Microbial Diversity

S. O. Mast Founders’ Scholarship Fund
Meyer, Axel, State University of New York

Society of General Physiologists’ Scholarships
Gregory K. Davis, University of Chicago
Timothy E. Holy, Princeton University
Justin S. Koble, Children’s Hospital of Pennsylvania

Surdna Foundation
Banin, Ehud, Tel Aviv University, Israel
Jaspers, Elke, Universität Oldenburg, Germany
Krause, Sabine, Max-Planck-Institut für Molekulare Genetik, Germany
Wenuganen, S., Bogor Agricultural University, Indonesia
Zurek, Ludek, University of Alberta, Canada

Walter L. Wilson Endowed Scholarship Fund
Katoh, Kaoru, Marine Biological Laboratory
Nilsson, Helen, University of Göteborg, Sweden

William F. and Irene C. Diller Scholarship Fund
Melli, Raffaella, Universita Degli Studi di Palermo, Italy
Stone, Alexandra, Ohio State University

William Morton Wheeler Family Founder’s Scholarship Fund
Wenuganen, S., Bogor Agricultural University, Indonesia

William Randolph Hearst Educational Endowment Scholarships
Kim, Warren, Yale University School of Medicine
Nelson, Craig, Harvard University
Shelton, Marilee, University of North Carolina, Chapel Hill

William Townsend Porter Scholarship Fund
DePass, Anthony, University of Massachusetts, Amherst
McKnight, Spontaneous, University of Arizona
Norman, Eric, University of Pittsburgh
Quintero, Omar, Duke University Medical Center
Board of Trustees and Committees

Corporation Officers and Trustees

Chairman of the Board of Trustees, Sheldon J. Segal, The Population Council
Co-vice Chair of the Board of Trustees, Frederick Bay, Josephine Bay Paul and C. Michael Paul Foundation
Co-vice Chair of the Board of Trustees, Mary J. Greer, New York, NY
President of the Corporation, James D. Ebert, The Johns Hopkins University
Director and Chief Executive Officer, John E. Burris, Marine Biological Laboratory*
Treasurer of the Corporation, Mary B. Conrad, Fiduciary Trust International*
Clerk of the Corporation, Neil Jacobs, Hale and Dorr
Chair of the Science Council, Ronald L. Calabrese, Emory University*

Class of 1998

Norman Bernstein, Diane and Norman Bernstein Foundation, Inc.
John R. Lakian, The Fort Hill Group, Inc.
Joan V. Ruderman, Harvard Medical School
Sheldon J. Segal, The Population Council
William T. Speck, Columbia-Presbyterian Medical Center
Alfred Zelen, The Gillette Company

Class of 1999

Mary-Ellen Cunningham, Grosse Pointe Farms, MI
Neil Jacobs, Hale and Dorr
Darcy Brisbane Kelley, Columbia University
Laurie J. Landeau, Marinetics, Inc.
Burton J. Lee, III, Edgartown, MA
Robert E. Mainier, The Boston Company

Class of 2000

Alexander W. Clowes, University of Washington School of Medicine
Story C. Landis, Case Western Reserve University
Irwin B. Levitan, Brandeis University
G. William Miller, G. William Miller & Co., Inc., Washington, DC

*Ex officio

Frank Press, Carnegie Institution of Washington, DC
Christopher M. Weld, Sullivan & Worcester, Boston

Class of 2001

Porter Anderson, North Miami Beach, FL
Frederick Bay, Josephine Bay Paul and C. Michael Paul Foundation, Inc.
Martha W. Cox, Hobe Sound, FL
Mary J. Greer, New York, NY
William C. Steere, Jr., Pfizer Inc.
Gerald Weissmann, New York University School of Medicine

Honorary Trustees

William T. Golden, New York, NY
Ellen R. Grass, The Grass Foundation

Trustees Emeriti

Edward A. Adelberg, Yale University, New Haven, CT
John B. Buck, Sykesville, MD
Seymour S. Cohen, Woods Hole, MA
Arthur L. Colwin, Key Biscayne, FL
Laura Hunter Colwin, Key Biscayne, FL
Donald Eugene Copeland, Woods Hole, MA
Sears Crowell, Indiana University, Bloomington, IN
Alexander T. Daignault, Falmouth, MA
Teru Hayashi, Woods Hole, MA
Ruth Hubbard, Cambridge, MA
Lewis Kleinholtz, Reed College, Portland, OR
Maurice E. Kral, Tucson, AZ
Charles B. Metz, Miami, FL (deceased)
Keith R. Porter, University of Pennsylvania, Philadelphia, PA (deceased)
C. Ladd Prosser, University of Illinois, Urbana, IL
W. D. Russell-Hunter, Syracuse University, Syracuse, NY
Mary Sears, Woods Hole, MA (deceased)
David Shepro, Boston University, Boston, MA
D. Thomas Trigg, Wellesley, MA
Walter S. Vincent, Woods Hole, MA
George Wald, Cambridge, MA (deceased)
Science Council

Ronald L. Calabrese, Chair
Donald Abt
Clay Armstrong
Robert Barlow, Jr. (from 8/97)
Kerry S. Bloom
John Burris,*
Vincent E. Dionne (from 8/97)
John Dowling
Barbara Ehrlich
Bruce J. Peterson (1998)
Mitch Sogin (1998)
Ann E. Stuart (ending 8/97)

Executive Committee of the Board of Trustees

Sheldon J. Segal, Chair
Frederick Bay, Co-vice Chair
Mary J. Greer, Co-vice Chair
John E. Burris*
Ronald L. Calabrese
Mary B. Conrad
Mary-Ellen Cunningham
Robert Mainier
Joan V. Ruderman
Gerald Weissmann

Standing Committees of the Board of Trustees

Development

Mary-Ellen Cunningham, Chair
Porter W. Anderson
Robert Barlow
Frederick Bay
Mary B. Conrad
Martha Cox
James Ebert
Neil Jacobs
John Lakian
Burton Lee
Irwin Levitan
G. William Miller
William Speck
William Steere
Christopher Weld

Finance and Investment

Robert Mainier, Chair
Norman Bernstein
Alexander Clowes
Mary B. Conrad
Donald DeHart
Neil Jacobs
Darcy Kelley
John Lakian
Laurie Landeau
Werner Loewenstein
Robert Manz
G. William Miller
Ronald P. O'Hanley
Irving Rabb
Alfred Zeien

Facilities and Capital Equipment

Joan Ruderman, Chair
Porter W. Anderson
Lawrence Cohen
Neal Cornell
Story Landis
Irwin Levitan
Frank Press
Christopher M. Weld

Nominating

Gerald Weissmann, Chair
Ronald Calabrese
Alexander Clowes
Martha Cox
Mary-Ellen Cunningham
Mary Greer
Story Landis
Tom Pollard
Sheldon Segal
William Steere

Standing Committees of the Corporation and Science Council

Buildings and Grounds

Lawrence B. Cohen, Chair
Barbara C. Boyer
Alfred B. Chaet
Richard Cutler*

William R. Eckberg
Barry Fleet*
Ferenc Harosi
Joe Hayes*
Bruce J. Peterson
Kenyon S. Tweedell

*Ex officio
Trustees and Committees R61

Education
John E. Dowling, Chair
Elaine L. Bearer
Vincent E. Dionne
Paul V. Dunlap
Rachel D. Fink
Roger T. Hanlon
Holger W. Jannasch
George M. Langford
Dorianne Melane*
Michael E. Mendelsohn
John D. Rummel*
Steven J. Zottoli

Fellowships
Thoru Pederson, Chair
Kathleen Dunlap
Barbara E. Ehrlich
Anne E. Giblin
José Lemos
Carol L. Reinisch
John D. Rummel*

Housing, Food Service, and Child Care
Kerry S. Bloom
Carole L. Browne
LouAnn King*
Robert P. Malchow
Darrell R. Stokes
Ann E. Stuart
Janis C. Weeks

MBL/WHOI Library Joint Advisory Committee
David Shepro, Chair, MBL
Judy Ashmore, MBL*
Cabell Davis, WHOI
David Dow, NMFS
John Hobbie, MBL
Colleen Hurter, WHOI*
Mark Kurz, WHOI
Catty Norton, MBL*
Monica Riley, MBL
Jim Robb, USGS
Peter J. S. Smith, MBL
Bruce Warren, WHOI

Research Services and Space
Hans Laufer, Chair
Peter B. Armstrong
Neal W. Cornell
Richard Cutler*
Kenneth H. Foreman
Louis M. Kerr
David Landowne
Andy Mattox*
Jerry M. Melillo
Merle Mizell
Peter J. S. Smith
Paul A. Steudler
Ivan Vahela

Discovery: The Campaign for Science at the Marine Biological Laboratory
Steering Committee
Frederick Bay, Campaign Chair
William T. Golden, Honorary Campaign Chair
Ellen R. Grass, Honorary Campaign Chair
Alexander Clowes, Campaign Vice-chair
Martha W. Cox, Campaign Vice-chair
G. William Miller, Campaign Vice-chair
Gerald Weissmann, Campaign Vice-chair
Porter Anderson
Robert B. Barlow, Jr.
Norman Bernstein
Jewel Plummer Cobb
Mary B. Conrad
Mary-Ellen Cunningham
John E. Dowling

James D. Ebert
Gerald D. Fischbach
Robert D. Goldman
Mary J. Greer
M. Howard Jacobson
Laurie J. Landeau
George M. Langford
Burton J. Lee, III
Robert A. Prendergast
David Shepro
William T. Speck
William C. Steere, Jr.
Christopher M. Weld, Esq.
Alfred M. Zeien

*Ex officio
# Administrative Support Staff

## Biological Bulletin

Greenberg, Michael J., Editor-in-Chief  
Clapp, Pamela L., Managing Editor  
Burns, Patricia  
DeBenedictis, Lisa M.  
Gibson, Victoria R.  
Pennington, Susan M.  
Schachinger, Carol H.

## Financial Services Office

Roddy, Timothy, Chief Financial Officer  
Bowman, Richard, Controller  
Ghetti, Pamela M., Controller  
Afonso, Janis  
Corrette, Ruth  
Dwyer, Patricia E.  
Hopkins, Ann E.  
Iwaszko, Roxanne M.\(^1\)  
Lancaster, Cindy  
Pacheco, Anthony F.\(^1\)  
Palmer, Pamela\(^2\)  
Poravas, Maria  
Ranzinger, Laura  
Sprague, Patricia A.  
Stark, Judy

## Stock Room

Schorer, Timothy M., Supervisor  
Cameron, Alicia A.\(^2\)  
Nelson, Beth A.  
O'Connor-Lough, Susan  
Robinson, Mary M.\(^2\)

## Purchasing

Hall Jr., Lionel E., Supervisor  
Mancini, Mary  
Nelson, Beth A.  
Shannon, Lynne R.\(^2\)  
Stone, Janice G.\(^2\)

1 Including persons who joined or left the staff during 1997.  
2 Summer or temporary.

## Director's Office

Burns, John E., Director and Chief Executive Officer  
Burrhus, I. Elaine  
Donovan, Marcia H.  
MacNeil, Jane L.

## External Affairs

Carotenuto, Frank C., Director  
Black, Nancy O.  
Faxon, Wendy P.  
Martin, Theresa H.  
Martinez, Mario R.\(^2\)  
Maxwell, Thanh L.\(^2\)  
Patch-Wing, Dolores  
Quigley, Barbara A.  
Scibek, John C.  
Shaw, Kathleen L.  
Wessling, Gail M.  
Wicklund, Eileen R.

## Associates Program

Bohr, Kendall B.  
Pratt, Jennifer A.\(^2\)

## Communications Office

Clapp, Pamela L., Director  
Clowes, Sarah W.\(^2\)  
Dykstra, Margaret L.\(^2\)  
Furley, Susan C.\(^2\)  
Kenna, Laura M.  
Liles, Beth R.  
Pratt, Sara  
Williams, Sara V.

## Housing and Conferences

King, LouAnn D., Director  
Barry, Maureen J.  
Johnson, Frances N.  
Hanlon, Arlene K.\(^2\)

## Switchboard

Baker, Ida M.  
Dunn-Fall, Martha F.\(^2\)  
Ridley, Alberta W.
Human Resources

Goux, Susan P., Director
Donovan, Marcia H.
Drange, Stacey B.

Marine Resources Center Administrative Staff

Hanlon, Roger T., Director
Moniz, Priscilla

Aquatic Resources Department
Enos, Jr., Edward G., Superintendent
Bourque, Ryan M.²
Chappell, P. Dreux²
DeGiorgis, Joseph A.²
Erlingsson, Erik C.²
Freeman, Darren M.²
Grossman, William M.
Klimm III, Henry W.
Luther, Herbert
Mansfield, Darren P.²
Parent, Scott M.²
Sullivan, Daniel A.
Tassinari, Eugene

MRC Life Support System
Mebane, William N., Systems Operator
Hanley, Janice S.
Kazirian, Alan
Stukey, Jetley M.
Till, Geoffrey A.

MBL/WHOI Library

Norton, Catherine N., Director
Ashmore, Judith A.
Connelly, Michelle F.A.
Costa, Marguerite E.
Cullen, Cynthia M.²
Deveer, Joseph M.
Duda, Laurel E.
Farrar, Stephen R. L.
Jackson, James R.
Medeiros, Melissa
Monahan, A. Jean
Moniz, Kimberly L.
Nelson, Heidi
Pratson, Patricia F.
Riley, Jacqueline
Ulbrich, Ciona²
Zuwallack, Barbara
Zuwallack, Raymond
Zuwallack, Ronald L.

Copy Center
Mountford, Rebecca J., Supervisor
Abisla, Richard L.²
Adams, Cathryn L.²
Clark, Tamara L.²
Johnson, Courtney M.²
Kefauver, Lee
LaPlante, Robert F.

Mancini, Mary E.
Warner, Kathleen²

Information Systems Division
Smith, Adrian P., Assistant Director
Ennis, Douglas E.²
Gage, Timothy J.²
Mahoney, Timothy P.
Moynihan, James V.
Mountford, Rebecca J.
Rens, David P.
Renna, Denis J.
Space, David B.
Swasey, Anne E.²

Safety Services
Mattox, Andrew H., Environmental, Health, and Safety Manager
Kelly, Niamh O.²
O’Neill, Maureen D.²

Service, Projects, and Facilities
Cutler, Richard D., Director
Enos, Joyce B.

Apparatus
Baptiste, Michael G.
Barnes, Franklin D.
Haskins, William A.

Building Services and Grounds
Hayes, Joseph H., Superintendent
Anderson, Lewis B.
Atwood, Paul R.
Baker, Harrison S.
Barnes, Susan M.
Berrios, Jessica L.²
Boucher, Richard L.
Brereton, Richard S.²
Callahan, John J.
Cameron, Lawrence M.²
Collins, Paul J.
Cowan, Matthew B.²
Cutler, Matthew D.²
Dole, Adam J.²
Dorris, John J.
Fernandez, Peter R.²
Gibbons, Roberto G.
Gonsalves, Nelson
Hannigan, Catherine
Harrington, James D.
Illgen, Robert F.
Kennette, Kirsten E.²
Lawrence, Adam G.²
Lawson, Christina C.²
Leary, Jason C.²
Luther, Herbert
Lynch, Henry L.
Maccaro, Jackie
McNamara, Noreen M.
Massey Eric²
Rattacasa, Frank D.
Sholkovitz, Nathan²
Schrontz, Mathieu D.2
Silva, Cynthia C.
Wessling, Kellen A.2
Varao, John2
Ware, Lynn M.

Plant Operations and Maintenance
Fleet, Barry M., Superintendent
Barnes, John S.
Blunt, Hugh F.
Bourgoin, Lee E.
Cadone, James W.
Carini, Robert J.
Carroll, James R.
Fish Jr., Davad L.
Fuglister, Charles K.
Gonsalves, Jr., Walter W.
Hathaway, Peter J.
Henderson, Jon R.
Justason, C. Scott
Lochhead, William M.
McAdams III, Herbert M.
McHugh, Michael O.
Mills, Stephen A.
Olive, Jr., Charles W.
Schoepf, Claude
Serrano, Robert A.
Shepherd, Denise M.
Toner, Michael

Machine Shop
Sylvia, Frank E.
Wetzel, Ernest D.2

Photolab
Nelson, Linda M., Supervisor
Clark, Tamara L.2
Golder, Robert J.
Hong, Theresa H.2
Richmond, Hazel E.2

Research Administration and Educational Programs
Rummel, John D., Director
Barry, Kevin2
Chandler, Marsha J.
Hamel, Carol C.
Hunt, Sharon L.
Huffer, Linda
Kaufmann, Sandra J.
Mebane, Dorianne C.
Moynihan, Brenda L.3

Central Microscopy Facility and General Use Rooms
Kerr, Louis M., Supervisor
DeProto, Jamin E.2
Lavalli, Kari Lee2
Peterson, Martha B.
Soucy, Lori A.2

Josephine Bay Paul Center for Comparative Molecular Biology and Evolution Administrative Staff
Amit, Udeni

Journal of Membrane Biology
Loewenstein, Werner R., Editor
Cicora, Judith M.2
Fay, Catherine H.
Howard, Linda L.
Lynch, Kathleen F.

NASA Center for Advanced Studies in the Space Life Sciences Administrative Staff
Dawidowicz, Eliezar A., Administrator
Amit, Udeni P.
Nixon, Jennifer L.

Satellite/Periwinkle Children’s Programs
Robinson, April2
Robinson, Paulina H.2
Brown, Shannon K.2
Browne, Jennifer L.2
Douglas, Alicia D.2
Gallant, Carolyn A.2
Griffin, Courtney A.2
Lee, Annette M.2
Martinez, Adria E.2
Robinson, Jayma L.2
Robinson, Milton G.2
Simpson, Christopher F.2
Strout, Kerry L.2

Ecosystems Center Administrative Staff
Berthel, Dorothy J.
Donovan, Suzanne J.
Nunez, Guillermo
Seifert, Mary Ann
Life Members

Acheson, George H., 25 Quissett Avenue, Woods Hole, MA 02543
Adelberg, Edward A., Lincoln Tower Apt. 802, 2400 Presidential Way, West Palm Beach, FL 33401
Afzelius, Björn, University of Stockholm, Wenner-Gren Institute, Department of Ultrastructure Research, Stockholm, SWEDEN
Amanatnick, Ernest, 1112 Northwest 5th Avenue, Gainesville, FL 32601
Arnold, John M., 329 Sippewissett Road, Falmouth, MA 02540
Bang, Betsy G., 76 F. R. Lillie Road, Woods Hole, MA 02543
Bartlett, James H., University of Alabama, Department of Physics, Box 870324, Tuscaloosa, AL 35487-0324
Bernie, Robert M., University of Virginia School of Medicine, Dept. of Physiology, Box 1116, MR4, Charlottesville, VA 22903
Bernheimer, Alan W., New York University Medical Center, Dept. of Microbiology, 550 First Avenue, New York, NY 10016
Berthoff, Lloyd M., Westminster Village, #2114, 2025 E. Lincoln Street, Bloomington, IL 61701-5995
Bosch, Herman F., Box 617, Woods Hole, MA 02543
Buck, John B., 7200 Third Avenue, #C-020, Sykesville, MD 21784
Burbank, Madeline P., Box 15134, Atlanta, GA 30333
Burbank, William D., P.O. Box 15134, Atlanta, GA 30333

Carlson, Francis D., Johns Hopkins University, Biophysics Dept., Jenkins Hall, N. Charles Street, Baltimore, MD 21218
Clark, Arnold M., 53 Wilson Road, Woods Hole, MA 02543
Clark, James M., 210 Emerald Lane, Palm Beach, FL 33480
Cohen, Seymour S., 10 Carrot Hill Road, Woods Hole, MA 02543
Colwin, Arthur L., 320 Woodcrest Road, Key Biscayne, FL 33149-1322
Colwin, Laura Hunter, 320 Woodcrest Road, Key Biscayne, FL 33149
Cooperstein, Sherwin J., University of Connecticut, School of Medicine, Department of Anatomy, Farmington, CT 06030-3405
Copeland, D. Eugene, 41 Fern Lane, Woods Hole, MA 02543
Corliss, John O., P.O. Box 2729, Bala Cynwyd, PA 19004-2116
Costello, Helen M., Carmelina Meadows, Villa 137, Chapel Hill, NC 27514-8512
Crouse, Helen, Rte. 3, Box 213, Hayesville, NC 28904

DeHaan, Robert L., Emory University School of Medicine, Department of Anatomy and Cell Biology, 1648 Pierce Drive, Rm. 108, Atlanta, GA 30322

Members of the Corporation

Dudley, Patricia L., 3200 Alki Avenue SW, #401, Seattle, WA 98116
Edwards, Charles, 2244 Harbour Court Drive, Longboat Key, FL 34228
Elliott, Gerald F., The Open University Research Unit, Foxcombe Hall, Berkeley Road, Boars Hill, Oxford OX1 5HR, UK
Faula, Patricia M., 2149 Loblolly Lane, Johns Island, SC 29455
Ferguson, James K. W., 56 Clarkehaven Street, Thornhill, Ontario L4J 2B4, Canada
Glusman, Murray, New York State Psychiatric Institute, 722 W. 168 Street, Unit #70, New York, NY 10032
Goldman, David E., 140 Ter Heun Drive, Rm 212, Falmouth, MA 02540
Graham, Herbert, 36 Wilson Road, Woods Hole, MA 02543

Hamburger, Viktor, Washington University, Department of Biology, 740 Trinity Avenue, St. Louis, MO 63130
Hamilton, Howard L., University of Virginia, Department of Biology, 238 Gilmer Hall, Charlottesville, VA 22901
Harding, Clifford V., 54 Two Ponds Road, Falmouth, MA 02540
Haschemeyer, Audrey E. V., 21 Glendon Road, Woods Hole, MA 02543-1406
Hauschka, Theodore S., 333 Fogler Road, Bremen, ME 04551
Hayashi, Teru, 15 Gardner Road, Woods Hole, MA 02543-1113
Hibbs, Frederick L., 1763 SW Tamarack Street, Apt 11, McMinnville, OR 97128-7416
Hoskin, Francis C. G., c/o Dr. John E. Walker, U.S. Army Natick RD&E Center, SAT NC-YSM, Kansas Street, Natick, MA 01760-5020
Huhyard, Ruth, Harvard University, Biological Laboratories, Cambridge, MA 02138
Humes, Arthur G., Marine Biological Laboratory, Boston University Marine Programs, Woods Hole, MA 02543
Hurwitz, Charles, Stratton VA Medical Center, Research Service, Albany, NY 12208

Katz, George, Merck, Sharp and Dohme, Fundamental & Experimental Research Laboratory, P.O. Box 2000, Rahway, NJ 07065
Kingsbury, John M., Cornell University, Dept. of Plant Biology, Plant Science Building, Ithaca, NY 14853

1 Including action of the 1997 Annual Meeting.
Anderson, Everett, Harvard Medical School, Dept. of Cell Biology, 240 Longwood Avenue, Boston, MA 02115-6092
Anderson, John M., 110 Roat Street, Ithaca, NY 14850
Anderson, Porter W., 100 Bayview Drive, Apt. 2224, North Miami Beach, FL 33160
Armott-Kibel, Christine, University of Massachusetts, Boston, Dean of Science Faculty, Boston, MA 02125
Armstrong, Clay M., University of Pennsylvania School of Medicine, B701 Richards Bldg., Department of Physiology, 3700 Hamilton Walk, Philadelphia, PA 19104-6085
Armstrong, Ellen Prosser, 57 Millfield Street, Woods Hole, MA 02543
Armstrong, Peter B., University of California, Davis, Dept. of Molec. & Cell. Biology, Davis, CA 95616-8755
Arnold, William A., Oak Ridge National Laboratory, Biology Division, 102 Balsam Road, Oak Ridge, TN 37830
Ashton, Robert W., Bay Foundation, 17 West 94th Street, New York, NY 10025
Atena, Jelle, Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA 02543

Baccetti, Baccio, University of Sienna, Institute of Zoology, 53100 Siena, Italy
Baker, Robert G., New York University Medical Center, Dept. of Physiol. & Biophysics, 550 First Avenue, New York, NY 10016
Baldwin, Thomas O., Texas A & M University, Department of Biochemistry and Biophysics, College Station, TX 77843
Baltimore, David, California Institute of Technology, 256-80, Pasadena, CA 91125
Barlow, Robert B., SUNY Health Science Center, Dept. of Physiology, 750 East Adams St., Weiskotten Hall, Syracuse, NY 13210
Barry, Daniel T., 2415 Fairwind Drive, Houston, TX 77062-4756
Barry, Susan R., Mount Holyoke College, Dept. of Biological Sciences, So. Hadley, MA 01075
Bass, Andrew H., Cornell University, Dept. of Neurobiology & Behavior, Seely Mudd Hall, Ithaca, NY 14853
Battelle, Barbara-Anne, University of Florida, Whitney Laboratory, 9505 Ocean Shore Boulevard, St. Augustine, FL 32086
Bay, Frederick, Bay Foundation, 17 W 94th Street, First Floor, New York, NY 10025-7116
Bayor, Martha B., P.O. Box 93, Woods Hole, MA 02543
Becar, Elaine L., Brown University, Div. of Biology & Medicine, Dept. of Pathology, Box G, Providence, RI 02912
Beatty, John M., University of Minnesota, Dept. of Ecology & Behavioral Biology, 1445 Gortner, St. Paul, MN 55108
Beauch, Luis Alberto, Instituto M. & M. Ferreyra, Dept. of Biophysics, Casilla de Correo 339, Cordoba, 5000, Argentina
Begensisch, Ted, University of Rochester, Medical Center, Box 642, 601 Elmwood Avenue, Rochester, NY 14642
Begg, David A., University of Alberta, Faculty of Medicine, Dept. of Cell Biology & Anatomy, Edmonton, Alberta T6G 2H1, Canada
Bell, Eugene, 305 Commonwealth Avenue, Boston, MA 02115
Benjamin, Thomas L., Harvard Medical School, Pathology, D2-230, 200 Longwood Avenue, Boston, MA 02115
Benett, Michael V. L., Albert Einstein College of Medicine, Dept. of Neuroscience, 1300 Morris Park Avenue, Bronx, NY 10461
Bennett, Miriam F., Colby College, Department of Biology, Waterville, ME 04901
Berg, Carl J., P.O. Box 681, Kilauea, Kauai, HI 96754-0681
Berlin, Suzanne T., 5 Highland Street, Gloucester, MA 01930
Bernstein, Norman, Diane and Norman Bernstein Foundation, 3501 Wisconsin Ave., NW. #600, Washington, DC 20015-2015
Bezanilla, Francisco, Health Science Center, Department of Physiology, 405 Hilgard Avenue, Los Angeles, CA 90024
Biggers, John D., Harvard Medical School, Department of Physiology, Boston, MA 02115
Bishop, Stephen H., Iowa State University, Dept. of Zoology, Ames, IA 50010
Blaustein, Mordecai P., University of Maryland, School of Medicine, Department of Physiology, Baltimore, MD 21201
Bleitman, W., 1117 E. Putnam Avenue, Apt. #174, Riverside, CT 06878-1333
Bloom, George S., University of Texas Southwestern, Medical Center, Cel/ Bio. & Neuroscience Dept., 5323 Harry Hines Blvd., Dallas, TX 75235-9039
Bloom, Perry S., University of North Carolina at Chapel Hill, Department of Biology, 623 Fordham Hall, CB #3280, Chapel Hill, NC 27599
Bodznick, David A., Wesleyan University, Department of Biology, Lawn Avenue, Middletown, CT 06457-0170
Boettiger, Edward G., 17 Eastwood Road, Storrs, CT 06269-2401
Borgese, Thomas A., Lehman College, CUNY, Department of Biology, Bedford Park Blvd., West, Bronx, NY 10468
Borst, David W., Illinois State University, Department of Biological Sciences, Normal, IL 61790
Bowles, Francis P., Marine Biological Laboratory, The Ecosystems Center, Woods Hole, MA 02543
Boyer, Barbara C., Union College, Biology Department, Schenectady, NY 12308
Brandhorst, Bruce C., Simon Fraser University, Inst. of Molec. Biol./Biochem, Barnaby, B.C. V5A 1S6, Canada
Brinley, F. J., NINCDS/NIH, Neurological Disorders Program, Rm. 812 Federal Building, Bethesda, MD 20892
Brounner-Fraser, Marcia, California Institute of Technology, Division of Biology 139-74, Pasadena, CA 91125
Brown, Stephen C., SUNY, Dept. of Biological Sciences, Albany, NY 12222
Brown, William L., BankBoston, 100 Federal Street, 01-23-11, Boston, MA 02106-2016
Bruno, Carole L., Wake Forest University, Dept. of Biology, Box 7325, Winston-Salem, NC 27109
Bruno, Robert A., Wake Forest University, Dept. of Biology, Box 7325, Winston-Salem, NC 27109
Bucklin, Anne C., University of New Hampshire, Ocean Process Analysis Lab, 142 Morse Hall, Durham, NH 03824
Bullis, Robert A., Marine Biological Laboratory, Laboratory of Aquatic Animal Medicine, Woods Hole, MA 02543
Burger, Max M., Friedrich Miescher Institute, P.O. Box 2543, CH 4002 Basel, Switzerland
Burgess, David R., University of Pittsburgh, Dept. of Biological Sciences, 234 Langley, Pittsburgh, PA 15260
Burgos, Mario, IHEM Medical School, UNC Conicet, Casilla de Correo 56, Mendoza, 5500, Argentina
Burky, Albert, University of Dayton, Department of Biology, Dayton, OH 45469
Burrus, John E., Marine Biological Laboratory, 7 MBL Street, Woods Hole, MA 02543
Burysta, Harold Lewis, United States Air Force, Air Force Materiel Command, Rome Research Site RLA, 26 Electronic Parkway, Rome, NY 1344-4814
Bursztajn, Sherry, LSU Medical Center, 1501 Kings Highway, Building BR1F 6-13, Shreveport, LA 71130
Calabrere, Ronald L., Emory University, Department of Biology, 1510 Clifton Road, Atlanta, GA 30322
Callaway, Joseph C., New York Medical College, Dept. of Physiology, Basic Sciences Bldg., Valhalla, NY 10595
Cameron, R. Andrew, California Institute of Technology, Division of Biology 156-29, Pasadena, CA 91125
Campbell, Richard H., Bang-Campbell Associates, El Pond Place, Box 402, Woods Hole, MA 02543
Candelas, Graciela C., University of Puerto Rico, Department of Biology, P.O. Box 23360, UPR Station, San Juan, PR 00931-3360
Cariello, Thomas J., Yale University, Department of Psychology, P.O. Box 11A, Yale Station, New Haven, CT 06520
Carillo, Lucio, Stazione Zoologica Villa Comunale, 80121 Naples, Italy
Cassidy, J. D., Providence College, Priory of St. Thomas Aquinas, Providence, RI 02918-0001
Cavaugh, Colleen M., Harvard University, Biological Laboratories, 16 Divinity Avenue, Cambridge, MA 02138
Chaut, Alfred B., University of West Florida, Dept of Cell & Molecular Biol., 11000 University Parkway, Pensacola, FL 32514
Chambers, Edward L., University of Miami School of Medicine, Dept. of Physiology & Biophysics, P.O. Box 016430, Miami, FL 33101
Chang, Donald C., Hong Kong University of Science and Technology, Department of Biology, Clear Water Bay, Kowloon, Hong Kong
Chappell, Richard L., Hunter College, CUNY, Dept. of Biological Sciences, Box 210, 695 Park Avenue, New York, NY 10021
Chikarmane, Hemant M., 12 Middle Street, Reading, MA 08673
Child, Frank M., 28 Lawrence Farm Road, Woods Hole, MA 02543-1416
Chisholm, Rex Leslie, Northwestern University, Medical School, Department of Cell Biology, Chicago, IL 60611
Citkowitz, Elena, Hospital of St. Raphael, Lipid Disorders Clinic, 1450 Chapel Street, New Haven, CT 06511
Clark, Eloise E., Bowling Green State University, Biological Sciences Department, Bowling Green, OH 43403
Clark, Hays, 26 Deer Park Drive, Greenwich, CT 06830
Clark, Wallis H., 12705 NW 112th Avenue, Alachua, FL 32615
Claude, Philippa, University of Wisconsin, Dept Zoology, Zoology Research Building 125, 1117 W Johnson St., Madison, WI 53706
Clay, John R., NIH-NINDS, Building 36, Room 2-202, Bethesda, MD 20892
Clohesy, Alexander W., University of Washington, School of Medicine, Dept. of Surgery, Box 356410, Seattle, WA 98195-6410
Clutter, Mary, 2555 Pennsylvania Avenue, N.W., Apt. 611, Washington, DC 20037-1646
Cohn, Jewell Plummer, California State University, Office of the President, 5151 University Drive, Los Angeles, CA 90032-8500
Cohen, Carolyn, Brandeis University, Rosenstiel Basic Medical Sciences Research Center, Waltham, MA 02254
Cohen, Lawrence B., Yale University School of Medicine, Dept. of Physiology, 333 Cedar Street, New Haven, CT 06520
Cohen, Maynard M., Rush Medical College, Dept. of Neurological Sciences, 600 South Paulina, Chicago, IL 60612
Cohen, William D., Hunter College, Dept. of Biological Sciences, 695 Park Avenue, Box 79, New York, NY 10021
Coleman, Annette W., Brown University, Div. of Biology and Medicine, Providence, RI 02912
Colinvaux, Paul, Smithsonian Tropical Research Institute, Unit 0948, Apo AA 34002-0948, USA
Collier, Jack R., P.O. Box 139, 3431 Highway #107, Effie, LA 71331
Collier, Marjorie McCann, P.O. Box 139, 3431 Highway 107, Effie, LA 71331
Collin, Carlos, NIH, Dept. of LAS, NINDS, Bldg. 36, 36 Convent Drive, Room B306, Bethesda, MD 20892-4124
Cook, Joseph A., Edna McConnell Clark Foundation, 250 Park Avenue, New York, NY 10177-0026
Correll, Neil W., Marine Biological Laboratory, Woods Hole, MA 02543
Cornwall, Melvin C., Boston University, School of Medicine, Dept. of Physiology L714, Boston, MA 02118
Corson, D. Wesley, Storm Eye Institute, Room 537, 171 Ashley Avenue, Charleston, SC 29425
Corwin, Jeffrey T., University of Virginia, School of Medicine, Dept. of Otolaryngology, HNS and Neuroscience, Charlottesville, VA 22908
Couch, Ernest F., Texas Christian University, Department of Biology, TCU Box 298930, Fort Worth, TX 76129
Cox, Rachel Llanelly, Woods Hole Oceanographic Institution, Biology Department, Woods Hole, MA 02543
Cramer, Sylvia E., 438 Wendover Drive, Princeton, NJ 08540
Cremer-Bartels, Gerhard, Universitats-Augenklinik, 44 Munster, Germany
Crow, Terry J., University of Texas Medical School, Dept. of Neurobiology, & Anatomy, Houston, TX 77225
Crowell, Seals, Indiana University, Department of Biology, Bloomington, IN 47405
Crowther, Robert J., Shriners Burns Institute Research Center, One Kendall Square, Building 1400, Cambridge, MA 02139
Cunningham, Mary-Ellen, 62 Cloverly Road, Grosse Pointe Farms, MI 48236-3313
Cutler, Richard D., Marine Biological Laboratory, Woods Hole, MA 02543

daignault, Alexander T., Edgewood, 575 Osgood Street, North Andover, MA 01875
Davidson, Eric E., CA Institute of Technology, Division of Biology, 156-29, 1201 E. California Blvd., Pasadena, CA 91125
Daw, Nigel W., 5 Old Pawson Road, Branford, CT 06405
De Weer, Paul J., University of Pennsylvania, B400 Richards Bldg., Department of Physiology, 3700 Hamilton Walk, Philadelphia, PA 19104-6085
Deegan, Linda A., Marine Biological Laboratory, The Ecosystems Center, Woods Hole, MA 02543
DeGroot, Robert C., 145 Water Crest Drive, Doylestown, PA 18901-3267
Denkla, Martha B., Johns Hopkins University, School of Medicine, Kennedy-Krieger Inst., 707 North Broadway, Baltimore, MD 21205
DePhillips, Henry A., Trinity College, Department of Chemistry, 300 Summit Street, Hartford, CT 06106
DeSimone, Douglas W., University of Virginia, Department of Cell Biology, Box 439, Health Sciences Ctr., Charlottesville, VA 22908
Dettbarn, Wolf-Dietrich, Vanderbilt University, School of Medicine, Department of Pharmacology, Nashville, TN 37232
Dionne, Vincent E., Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA 02543
Dixon, Keith E., Flinders University, School of Biological Sciences, Bedford Park, 5042, SA, Australia
Dowling, John E., Harvard University, Biological Laboratories, 16 Divinity Street, Cambridge, MA 02138
Drapeau, Pierre, Montreal General Hospital, Dept. of Neurology, 1650 Cedar Avenue, Montreal H3G 1A4, Canada
Duflois, Arthur Brooks, John B. Pierce Foundation Lab., 290 Congress Avenue, New Haven, CT 06519
Prior, David J., Northern Arizona University, Arts and Sci. Dean's Office, Box 5621, Flagstaff, AZ 86011
Prusch, Robert D., Gonzaga University, Department of Life Sciences, Spokane, WA 99258
Parves, Dale, Duke University Medical Center, Dept. of Neurobiology, Bx 3209, 1011 Bryan Res. Bldg., Durham, NC 27710

Quigley, James P., SUNY Health Sciences Center, Dept. of Pathology, BHS Tower 9, Rm. 140, Stony Brook, NY 11794-8691

Rabb, Irving W., 1010 Memorial Drive, Cambridge, MA 02138
Rabin, Harvey, P.O. Box 4022, Wilmington, DE 19807
Rabinowitz, Michael B., Marine Biological Laboratory, 7 MBL St., Woods Hole, MA 02543
Rafferty, Nancy S., Marine Biological Laboratory, 7 MBL, Woods Hole, MA 02543
Rakowski, Robert F., UHS/The Chicago Medical School, Dept. of Physiology & Biophysics, 3333 Greenbay Road, N. Chicago, IL 60664
Ramon, Fidel, UNAM-CU, Div. Est. Posgrado E Inv., Facultad de Medicina. 04510, D.F., Mexico
Ranzi, Silvio, Sce. Zoologia Scienze Naturali. Dip. Di Biologia, Via Celoria.26, 20133 Milano, Italy
Rastetter, Edward B., Marine Biological Laboratory, The Ecosystems Center, Woods Hole, MA 02543
Rehbun, Lionel L., University of Virginia, Department of Biology, Gilmer Hall 45, Charlottesville, VA 22901
Reddan, John R., Oakland University, Dept. of Biological Sciences, Rochester, MI 48309-4401
Reese, Thomas S., NIH, Bldg. 36, Room 2A21, 9000 Rockville Pike, Bethesda, MD 20892
Reinsch, Carol L., Marine Biological Laboratory, Woods Hole, MA 02543
Rickles, Frederick R., 2633 Danforth Lane, Decatur, GA 30033
Rieder, Conly L., Wadsworth Center, Division of Molecular Medicine, P.O. Box 509, Albany, NY 12201-0509
Riley, Monica, Marine Biological Laboratory, Woods Hole, MA 02543
Ripps, Harris, University of Illinois at Chicago, Dept. of Ophthalm/Vis. Sci., 1855 West Taylor Street, Chicago, IL 60612
Ritchie, J. M., Yale University School of Medicine, Dept. of Pharmacology, 333 Cedar Street, New Haven, CT 06510
Rome, Lawrence C., University of Pennsylvania, Dept. of Biology, Philadelphia, PA 19104
Rosenbaum, Joel L., University of Pennsylvania School of Medicine, c/o Brian Salzberg, Dept. of Physiology, Philadelphia, PA 19104
Rosenbloom, Jack, New York University School of Medicine, Dept. of Physiology, 174 University Ave., New York, NY 10016
Rosenbloom, Raja, Simon Fraser University, Inst. of Molec. Biology & Biochem., Burnaby, BC, Canada, V5A 1S6
Rosenfield, Allan, Columbia University School of Public Health, 600 West 168th Street, New York, NY 10032-3702
Rosenkranz, Herbert S., University of Pittsburgh, Dept. of Environ. & Occup. Hlth., 260 Kappa Drive, Pittsburgh, PA 15238
Rosansky, John D., 57 Buzzards Bay Avenue, Woods Hole, MA 02543
Rosansky, Priscilla F., Associates of Cape Cod, Inc., P.O. Box 224, Woods Hole, MA 02543-0224
Ross, William N., New York Medical College, Department of Physiology, Valhalla, NY 10595
Roth, Jay S., P.O. Box 692, Woods Hole, MA 02543-0692

Rottenfusser, Rudi, Carl Zeiss, Inc., Marine Biological Laboratory, Woods Hole, MA 02543
Rowland, Lewis F., Neurological Institute, 710 West 168th Street, New York, NY 10032
Ruderman, John V., Harvard Medical School, Dept. of Cell Biology, 240 Longwood Avenue, Boston, MA 02115
Rummel, John D., Marine Biological Laboratory, Woods Hole, MA 02543
Rushforth, Norman B., Case Western Reserve University, Department of Biology, Cleveland, OH 44106
Russell-Hunter, W. D., 711 Howard Street, Easton, MD 21601-3934

Saffo, Mary Beth, Arizona State University, Life Sci. Dept., MC 2352, P.O. Box 37100, Phoenix, AZ 85069-7100
Salama, Guy, University of Pittsburgh, Department of Physiology, Pittsburgh, PA 15261
Salmon, Edward D., University of North Carolina, Dept. of Biology, Wilson Hall, CB 3280, Chapel Hill, NC 27599
Salyers, Abigail, University of Illinois, Dept. of Microbiology, 407 S. Goodwin Avenue, Urbana, IL 61801
Salzberg, Brian M., University of Pennsylvania School of Medicine, Dept. of Neuroscience, 215 Stenammer Hall, Philadelphia, PA 19104-6074
Sanger, Jean M., University of Pennsylvania School of Medicine, Dept. of Anatomy, 36th and Hamilton Walk, Philadelphia, PA 19104
Sanger, Joseph W., University of Pennsylvania Medical Center, Dept. of Cell and Developmental Biology, 36th and Hamilton Walk, Philadelphia, PA 19104-6058
Saunders, John W., 118 Metoxit Road, P.O. Box 3381, Wapquot, MA 02536
Sachman, Howard K., University of California, Berkeley, Molecular & Cell Biology Dept., 229 Stanley Hall, #3206, Berkeley, CA 94720-3206
Schatten, Gerald P., University of Wisconsin, 1117 W. Johnson Street, Madison, WI 53706
Schatten, Heide, University of Wisconsin, Department of Zoology, Madison, WI 53706
Schmeck, Artene C., Mericence Cancer Research Institute, 790 Prospect Street, New Haven, CT 06511
Schuel, Herbert, SUNY, Buffalo, Dept. of Anatomy/Cell Biology, Buffalo, NY 14214
Schwartz, James H., New York State Psychiatric Institute, Research Annex, 722 West 168th St., 7th floor, New York, NY 10032
Schwartz, Lawrence, University of Massachusetts, Amherst, Department of Biology, Morrill Science Center, Amherst, MA 01003
Schweitzer, A. Nicola, Brigham & Women's Hospital, Immunology Division, Dept. of Pathology, 221 Longwood Ave., LMRC 521, Boston, MA 02115
Segal, Sheldon J., The Population Council, One Dag Hammarskjold Plaza, New York, NY 10036
Shanklin, Douglas R., University of Tennessee, Dept. of Pathology, Rm. 576, 800 Madison Avenue, Memphis, TN 38117
Shashona, Victor E., Harvard Medical School, Ralph Lowell Labs, McLean Hospital, 115 Mill St., Belmont, MA 02178
Shaver, Gains R., Marine Biological Laboratory, The Ecosystems Center, Woods Hole, MA 02543
Shaver, John R., Michigan State University, Dept. of Zoology, East Lansing, MI 48824
Sheetz, Michael P., Duke University Medical Center, Dept. of Cell Biology, Bx 3709, 388 Nonnaline Duke Bldg., Durham, NC 27710
Shepro, David, Boston University, CAS Biology, 5 Cummington Street, Boston, MA 02215
Members of the Corporation

Shinomura, Osamu, Marine Biological Laboratory, Woods Hole, MA 02543
Shipley, Alan M., P.O. Box 2036, Sandwich, MA 02563
Silver, Robert B., Marine Biological Laboratory, Woods Hole, MA 02543
Siewicki, Kathleen K., Swarthmore College, Biology Department, 500 College Avenue, Swarthmore, PA 19081-1397
Skinner, Dorothy M., Oak Ridge National Laboratory, Biology Division, P.O. Box 2009, Oak Ridge, TN 37831
Sloboda, Roger D., Dartmouth College, Dept. of Biological Sciences, 6044 Gilman Laboratory, Hanover, NH 03755
Sluder, Greenfield, University of Massachusetts Medical Center, Worcester Foundation Campus, 222 Maple Avenue, Shrewsbury, MA 01545
Smith, Peter J. S., Marine Biological Laboratory, Woods Hole, MA 02543
Smith, Stephen J., Stanford University School of Medicine, Dept. of Cell. & Molec. Phys., Beckman Center, Stanford, CA 94305-5426
Snoewidt, Roxanna S., Marine Biological Laboratory, Laboratory of Aquatic Animal Medicine, Woods Hole, MA 02543
Sogin, Mitchell L., Marine Biological Laboratory, Woods Hole, MA 02543
Sorensen, Martha M., Cidade Universitaria-UFRJ, Dept. Bioquimica Medica ICB, 21941-590 Rio de Janeiro, Brazil
Speck, William T., Columbia-Presbyterian Medical Center, 161 Fort Washington Avenue, 14th Floor, Room 1470, New York, NY 10032-3784
Spector, Abraham, Columbia University, Dept. of Ophthalmology, 630 West 168th Street, New York, NY 10032
Speksnijder, Johanna E., University of Groningen, Dept. of Genetics, Kerklaan 30, 9751 NN Haren, The Netherlands
Spray, David C., Albert Einstein College of Medicine, Dept. of Neurosci., 1300 Morris Park Avenue, Bronx, NY 10461
Spring, Kenneth R., National Institutes of Health, Building 10, Room 6N260, 10 Center Drive, MSC 1603, Bethesda, MD 20892-1603
Steele, John H., Woods Hole Oceanographic Institution, Woods Hole, MA 02543
Steinacker, Antoinette, University of Puerto Rico, Medical Sciences, Institute of Neurobiology, 201 Boulevard Del Valle, San Juan, PR 00901
Steinberg, Malcolm, Princeton University, Dept. of Molecular Biology, M-18 Moffett Laboratory, Princeton, NJ 08544-1014
Stemmer, Andreas C., Institut fur Robotik, ETH-Sentrum, 8092 Zurich, Switzerland
Stenlo, Johan, University of Lund, Dept. of Clinical Chemistry, Malmo General Hospital, S-205 02 Malmo, Sweden
Stetten, Jane Lazarow, 4701 Willard Ave #1413, Chevy Chase, MD 20815-4627
Stedull, Paul A., Marine Biological Laboratory, The Ecosystems Center, Woods Hole, MA 02543
Stokes, Darrell R., Emory University, Department of Biology, 1510 Clifton Rd., NE, Atlanta, GA 30322-1100
Stommel, Elijah W., Dartmouth-Hitchcock Medical Center, Neurology Dept., Lebanon, NH 03766
Stracher, Alfred, SUNY Health Science Center, Dept. of Biochemistry, 450 Clarkson Avenue, Brooklyn, NY 11203
Strunwasser, Felix, 39 Fox Run Drive, Hatichville, MA 02536
Stuart, Ann E., University of North Carolina, Department of Physiology, Medical Res. Bldg. 206H, Chapel Hill, NC 27599-7545
Sugimori, Mutsumuki, New York University Medical Center, Dept. of Physiology & Neuroscience, Rm 442, 550 First Avenue, New York, NY 10016
Summers, William C., Western Washington University, Huxley Coll. of Environ. Stud., Bellingham, WA 98225
Suprenant, Kathy A., University of Kansas, Dept. of Physiol. & Cell Biol., 4010 Hawthor Hall, Lawrence, KS 66045
Sweet, Frederick, Washington University, School of Medicine, Dept. of OB & GYN, Box 8064, St. Louis, MO 63110
Swenson, Katherine L., Duke University Medical Center, Dept. of Mol. Cancer Biology, Box 3666, Durham, NC 27710
Sydlik, Mary Anne, Hope College, Peale Science Center, 35 East 12th St., PO Box 9000, Holland, MI 49422
Szent-Gyorgyi, Andrew, Brandeis University, Department of Biology, Bassine 244, 415 South Street, Waltham, MA 02254
Tabares, Lucia, University of Seville School of Medicine, Dept. of Physiology, Avda. Sanchez Pazjuan, 4, Seville 41009, SPAIN
Tamm, Sidney L., Boston University, 725 Commonwealth Avenue, Boston, MA 02215
Tanzer, Marvin L., University of Connecticut School of Dental Medicine, Dept. of Biostructure & Funct., Farmington, CT 06030-3705
Tasaki, Ichiji, NIMH/NHL, Laboratory of Neurobiology, Building 36, Room 2B-16, Bethesda, MD 20892
Taylor, D. Lansing, Carnegie Mellon University, Ctr. for Fluorescence Res., 4400 Fifth Avenue, Pittsburgh, PA 15213
Taylor, Edwin W., University of Chicago, Dept. of Mol. Gen. & Cell Biol., 920 E. 58th Street, Chicago, IL 60637
Teal, John M., Woods Hole Oceanographic Institution, Department of Biology, Woods Hole, MA 02543
Teller, William H., University of Pennsylvania, Department of Biology, Philadelphia, PA 19104
Tolker, Bruce, Pomona College, Dept. of Biol., Thillle Bldg., 175 W. 6th Street, Claremont, CA 91711
Townsel, James G., Meharry Medical College, Dept. of Physiology, 1005 D. B. Todd Boulevard, Nashville, TN 37208
Travis, David M., 19 High Street, Woods Hole, MA 02543-1221
Treichman, Steven N., University of Massachusetts Medical Center, Department of Pharmacology, 55 Lake Avenue North, Worcester, MA 01655
Trigg, D. Thomas, One Federal Street, 9th Floor, Boston, MA 02211
Troll, Walter, NYU Medical Center, 550 First Avenue, New York, NY 10016
Trosler, Robert F., Boston University School of Medicine, Dept. of Biochem., 80 East Concord Street, Boston, MA 02118
Tucker, Edward B., Baruch College, CUNY, Dept. of Natural Sciences, 17 Lexington Avenue, New York, NY 10010
Turner, Ruth D., Harvard University, Museum of Comparative Zoology, Mollusk Department, Cambridge, MA 02138
Tweedell, Kenyon S., University of Notre Dame, Dept. of Biological Sciences, Notre Dame, IN 46556
Tykocinski, Mark L., Case Western Reserve University, Institute of Pathology, 2085 Adelbert Road, Cleveland, OH 44106
Tytell, Michael, Wake Forest University, Bowman Gray School of Medicine, Dept. of Anatomy & Neurobio., Winston-Salem, NC 27157
Ueno, Hiroshi, Kyoto University, AGR Chemistry Faculty, Sakyo, Kyoto, 606-8502, Japan
Valielea, Ivan, Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA 02543
Vallee, Richard, University of Massachusetts Medical Center, Worcester Foundation Campus, Cell Biol., 222 Maple Avenue, Shrewsbury, MA 01545
VALOIS, John J., 420 Woods Hole Road, Woods Hole, MA 02543
Van Dover, Cindy Lee, University of Alaska, P.O. Box 757220, Fairbanks, AK 99775
Van Holde, Kensal E., Oregon State University, Biochemistry & Biophysics Dept., Corvallis, OR 97331-7503
Vogl, Thomas P., Environmental Research Institute of Michigan, 1101 Wilson Boulevard, Arlington, VA 22209

Wainwright, Norman R., Marine Biological Laboratory, Woods Hole, MA 02543
Waksman, Byron, NYU Medical Center, Department of Pathology, 550 First Avenue, New York, NY 10016
Wall, Betty, 9 George Street, Woods Hole, MA 02543
Wang, Hsien-Yu, SUNY, Stony Brook, Univ. Medical Center, Physiology & Biophysics-HSC, Stony Brook, NY 11794-8633
Wangb, Lawrence J., Brandeis University, Dept. of Biology, 415 South Street, Waltham, MA 02254
Warner, Robert C., University of California, Irvine, Molecular Bio. & Biochemistry, Irvine, CA 92717
Warren, Leonard, Wistar Institute, 36th and Spruce Streets, Philadelphia, PA 19104
Waterbury, John B., Woods Hole Oceanographic Institution, Dept. of Biology, Woods Hole, MA 02543
Waxman, Stephen G., Yale Medical School, Neurology Department, 333 Cedar Street, P.O. Box 208018, New Haven, CT 06510
Webb, H. M., 426 Woods Hole Road, Woods Hole, MA 02543
Weber, Anne Marie, University of Pennsylvania School of Medicine, Dept. of Biochem. & Biophysics, Philadelphia, PA 19066
Weeks, Janis C., Institute for Neuroscience, University of Oregon, Box 1254, Eugene, OR 97403-1254
Weidner, Earl, Louisiana State University, Dept. of Zoology & Physiology, Baton Rouge, LA 70803
Weiss, Alice Sara, 105 University Blvd. West, Silver Spring, MD 20901
Weiss, Dieter, University of Rostock, Biology, Institute of Zoology, D-18051 Rostock, Germany
Weiss, Leon P., University of Pennsylvania School of Veterinary Medicine, Department of Animal Biology, Philadelphia, PA 19104
Weiss, Marisa C., Paoli Memorial Hospital, Department of Radiation Oncology, 255 W. Lancaster Avenue, Paoli, PA 19301
Weissmann, Gerald, New York University Medical Center, Dept. of Med/Div. Rheumatology, 550 First Avenue, New York, NY 10016
Westerfield, R. Monte, University of Oregon, Institute of Neuroscience, Eugene, OR 97403

Whittaker, J. Richard, University of New Brunswick, Dept. of Biology, BS 4511, Fredericton, NB E3B 6E1, Canada
Wilkening, Lon A., University of Missouri, St. Louis, Dept. of Biology, 8001 Natural Bridge Road, St. Louis, MO 63121-4499
Wilson, Darcy B., San Diego Regional Cancer Center, 3099 Science Park Road, San Diego, CA 92121
Wilson, T. Hastings, Harvard Medical School, Department of Physiology, 25 Shattuck Street, Boston, MA 02115
Witkovsky, Paul, NYU Medical Center, Department of Ophthalmology, 550 First Avenue, New York, NY 10016
Wittenberg, Beatrice, Albert Einstein College of Medicine, Dept. of Physiol. & Biophysics, Bronx, NY 10461
Wittenberg, Jonathan B., Albert Einstein College of Medicine, Dept. of Physiol. & Biophysics, Bronx, NY 10461
Wolken, Jerome J., Carnegie Mellon University, Dept. of Biological Sciences, 440 Fifth Avenue, Pittsburgh, PA 15213
Wonderlin, William F., West Virginia University, Pharmacology & Toxicology Dept., Morgantown, WV 26506
Worden, Mary Kate, University of Virginia, Dept. of Molecular Physics and Biological Physics, P.O. Box 10011, Charlottesville, VA 22906
Worgul, Basil V., Columbia University, Department of Ophthalmology, 630 West 168 Street, New York, NY 10032
Wu, Chau Hsiung, Northwestern University Medical School, Dept. of Pharmacology (S215), 303 E. Chicago Avenue, Chicago, IL 60611-3008
Wytkoebnach, Charles R., University of Kansas, Biological Sciences Dept., 2045 Haworth Hall, Lawrence, KS 66045-2106

Yeh, Jay Z., Northwestern University Medical School, Department of Pharmacology, Chicago, IL 60611

Zacks, Sumner L., 65 Saconset Road, Falmouth, MA 02540-1851
Zigman, Seymour, University of Rochester Medical School, Ophthalmol. Research, Box 314, 601 Elmwood Avenue, Rochester, NY 14640
Zigmund, Michael J., University of Pittsburgh, Dept. of Neuroscience, 570 Crawford Hall, Pittsburgh, PA 15260
Zimmerberg, Joshua J., LCMNB, NICHD, NIH, Building 10, Room 10D14, 10 Center Drive, MSC 1855, Bethesda, MD 20892-1855
Zutoli, Steven J., Williams College, Dept. of Biology, Williamstown, MA 01267
Zucker, Robert S., University of California, Neurobiology Div., Molecular & Cellular Biol. Dept., Berkeley, CA 94720
Zukin, R. Suzanne, Albert Einstein College of Medicine, Dept. of Neurosci., 1410 Pelham Parkway South, Bronx, NY 10461

MBL Associates

Executive Board
Julie S. Child, President
Ruth Ann Laster, Vice President
Priscilla Rosalsky, Secretary
Hanna Hastings, Treasurer
Mary Ulbrich, Membership Chair
Duncan Aspinwall
Barbara Atwood
Kitty Brown

Seymour Cohen
Molly Cornell
Elizabeth Farnham
Michael Fenlon
Megan Jones
Alice Knowles
Rebecca Lash
Barbara Little
Jack Pearce
Joan Pearlman

Deborah Senft
John Valois
Kensal Van Holde

Sustaining Associate
Josephine B. Crane Foundation
George Frederick Jewett Foundation
Mr. Edward F. MacNichol, Jr.
Plymouth Savings Bank
Mr. and Mrs. William A. Putnam, III
Supporting Associate

Mrs. George H. A. Clowes
Dr. and Mrs. James D. Ebert
Dr. and Mrs. Prosser Gifford
Drs. Alfred and Joan Goldberg
Mr. and Mrs. Lon Hocker
Dr. Luigi and Elaine Mastroianne
Dr. and Mrs. William M. McDermott
Dr. and Mrs. Courtland D. Perkins
Mr. Michael Feenan and Ms. Linda Sallop
Mrs. Anne W. Sawyer
Ms. Maxine F. Singer
Dr. John Tochko and Mrs. Christina Myles-Tochko
Drs. Walter S. Vincent and Dore J. Butler
Mr. and Mrs. Leslie J. Wilson

Dual Membership

Mr. David C. Ahearn
Mr. and Mrs. Douglas F. Allison
Drs. James and Helene Anderson
Dr. and Mrs. Samuel C. Armstrong
Mr. and Mrs. Duncan P. Aspinwall
Mr. and Mrs. Donald R. Aukamp
Mr. and Mrs. John M. Baitsell
Mr. and Mrs. William L. Banks
Dr. and Mrs. Robert B. Barlow, Jr.
Mr. and Mrs. John E. Barnes
Drs. Harriet and Alan Bernheimer
Mr. and Mrs. Robert O. Bigelow
Dr. and Mrs. Alfred G. Boettiger
Dr. and Mrs. Alfred F. Borg
Dr. and Mrs. Thomas A. Borgese
Dr. and Mrs. Francis P. Bowles
Dr. and Mrs. John B. Buck
Dr. and Mrs. John E. Burris
Mr. and Mrs. D. Brett Carlson
Dr. and Mrs. Alfred B. Chaet
Dr. and Mrs. Arnold M. Clark
Mr. and Mrs. James Cleary
Mr. and Mrs. Lawrence H. Coburn
Dr. and Mrs. Neal W. Cornell
Mr. and Mrs. Norman C. Cross
Mr. and Mrs. Bruce G. Daniels
Mr. and Mrs. Richard C. Dierker
Dr. and Mrs. Arthur Brooks DuBois
Mr. and Mrs. John Eustis, II
Dr. and Mrs. James J. Ferguson, Jr.
Mr. and Mrs. Harold Frank
Mr. and Mrs. Howard G. Freeman
Dr. and Mrs. Robert A. Frosch
Dr. and Mrs. Mordecai L. Gabriel
Dr. and Mrs. David Garber
Dr. and Mrs. James L. German, III
Dr. and Mrs. Philip Grant
Dr. and Mrs. Thomas C. Gregg
Prof. and Mrs. Lawrence Grossman
Dr. and Mrs. Maryl H. Halvorson
Capt. and Mrs. Frederick J. Hancox
Dr. and Mrs. Richard B. Harvey
Dr. and Mrs. J. Woodland Hastings

Mr. and Mrs. Gary G. Hayward
Dr. and Mrs. John E. Hobbie
Drs. Francis C. G. Hoskin and Elizabeth M. Farnham
Dr. and Mrs. Robert J. Huettner
Dr. and Mrs. Shinya Inoué
Dr. and Mrs. Benjamin Kaminter
Mr. and Mrs. Paul W. Knaplund
Dr. and Mrs. George M. Langford
Dr. and Mrs. Leonard Laster
Dr. and Mrs. Hans Laufer
Mr. William Lawrence and Mrs. Barbara Buchanan
Mr. and Mrs. James E. Lloyd
Dr. and Mrs. Julian B. Marsh
Mr. and Mrs. Joseph C. Martyna
Mr. and Mrs. John E. Matthews
Dr. and Mrs. Robert T. McCluskey
Dr. and Mrs. Jerry M. Melillo
Mr. and Mrs. Richard Meyers
Dr. and Mrs. Daniel G. Miller
Dr. and Mrs. Charles H. Montgomery
Dr. and Mrs. John E. Naugle
Mr. and Mrs. Frank L. Nickerson
Mr. and Mrs. Clifford T. O'Connell
Mr. David Palmer
Dr. and Mrs. George D. Pappas
Dr. and Mrs. John B. Pearce
Mr. and Mrs. William J. Pechulis
Mr. and Mrs. John B. Peri
Dr. and Mrs. Philip Person
Mr. and Mrs. George H. Plough
Dr. and Mrs. Audrey Pothier, Jr.
Mr. and Mrs. Allan Ray Putnam
Dr. and Mrs. George T. Reynolds
Mr. and Mrs. John Ripple
Dr. and Mrs. Harris Rippins
Mr. and Mrs. Jean Roberts
Drs. Priscilla and John Roszansky
Dr. and Mrs. John W. Saunders, Jr.
Dr. and Mrs. R. Walter Schlesinger
Mr. and Mrs. Harold H. Sears
Dr. and Mrs. Sheldon J. Segal
Dr. and Mrs. David Shepro
Mr. and Mrs. Bertram R. Silver
Mr. and Mrs. Jonathan O. Simonds
Drs. Frederick and Marguerite Smith
Dr. and Mrs. Heinz Specht
Drs. William and Phoebe Speck
Dr. and Mrs. William K. Stephenson
Mr. and Mrs. Gerard L. Swope, III
Mr. and Mrs. Emil D. Tietje, Jr.
Dr. and Mrs. Walter Troll
Mr. and Mrs. Volker Ullrich
Mr. and Mrs. Samuel Vincent
Mr. and Mrs. Samuel Ward
Mr. J. W. and Mrs. Sharon McCarthy
Dr. and Mrs. Henry B. Warren
Dr. and Mrs. Paul S. Wheeler
Dr. Martin Kelister White
Mr. and Mrs. Leonad M. Wilson
Mr. Dick S. Yeo
Dr. and Mrs. Sumner I. Zacks

Individual Associate

Mrs. Constance M. Allard
Mrs. Douglas P. Amon
Mr. Dean N. Arden
Mrs. Ellen Prosser Armstrong
Mrs. Kimball C. Arwood, III
Mr. Everett E. Bagley
Mr. C. John Berg
Mrs. Elnor W. Bodian
Mr. Thomas C. Bolton
Mrs. Frank A. Brown, Jr.
Mr. M. Kathryn S. Brown
Dr. Alan H. Barghauser
Mrs. Barbara Burwell
Mr. William O. Burwell
Dr. Graciela C. Candelas
Mrs. Winlow G. Carlton
Mr. Frank Carotenuto
Dr. Robert H. Carrier
Mrs. Patricia A. Case
Dr. Richard L. Chappell
Dr. Sallie Chisholm
Mrs. Octavia C. Clement
Mr. Allen W. Clowes
Dr. Jewell Plummer Cobb
Dr. Seymour S. Cohen
Ms. Anne S. Concannon
Mr. Robert J. Cook
Prof. D. Eugene Copeland
Dr. Helen M. Costello
Dr. Vincent Cowling
Ms. Dorothy Crossley
Miss Helen Crossley
Mrs. Villa B. Crowell
Mrs. Francis J. DeYoung
Dr. Marie A. DiBerardino
Mr. Stephen Doyle
Ms. Suzanne Droban
Roy A. Duffus
Mrs. Charles E. Eastman
Dr. Frank Egloff
Mr. William M. Ferry
Ms. Sylvia M. Flanagan
Mr. Robert P. Flynn, Jr.
Mr. John H. Ford
Dr. Krystyna Frenkel
Mr. Paul J. Freibet
Dr. John J. Funkhouser
Mrs. Paul M. Fye
Dr. Patricia E. Garrett
Mrs. Rebecca Glazerbrook
Murray Giusman, M.D.
Mrs. Mary L. Goldman
Ms. Muriel Gould
Mrs. Deborah Ann Green
Dr. B. Harold Griffith
Mrs. Edith T. Grosch
Mrs. Valerie A. Hall
Ms. Mary Elizabeth Hamstrom
Ms. Elizabeth E. Hathaway
Dr. Robert R. Haubrich
Mr. Michael W. Herlihy
Mrs. Nathan Hirschfield
Mrs. Eleanor D. Hodge
Miss Elizabeth B. Jackson
Gary Jacobson
Dr. Joseph Jacobson
Mrs. Margaret H. Jones
Mrs. Barbara Kanellopoulos
Mrs. Marcella Katz
Ms. Patricia E. Keoughan
Dr. Peter N. Kirvy
Ms. Norma Kamin
Mrs. Rodney C. Larkin
Ms. Rebecca Lash
Dr. Marian E. LeFevre
Dr. Mortimer Levitz
Mr. Edwin M. Labbin
Mr. Lennart Lindberg
Mrs. Sarah J. Loessel
Mr. Richard C. Lovering
Mrs. Margaret M. Mackris
Dr. Philip B. Maples
Mr. Daniel R. Martin
Dr. G. C. Mathiessen
Mrs. Mary Hartwell Mavor
Mrs. Jane C. McCormack
Ms. Suzanne McDermott
Mr. Paul McGonagle
Ms. Mary W. McIown
Ms. Geraldine G. McLean
Ms. Cornelia Hanna McMurtrie
Dr. Martin Mendelson
Mrs. James A. Miles
Mrs. Florence E. Mizer
Ms. Cynthia Moor
Mr. Stephen A. Moore
Mr. Alan F. Morrison
Mrs. Eleanor M. Nace
Mr. William G. Neall
Dr. Pamela Nelson
Mr. Thomas J. Novitsky
Mr. John J. O'Connor
Dr. Judith Pederson
Ms. Joyce S. Pendery
Dr. Murray E. Pendleton
Mr. Raymond W. Peterson
Ms. Victoria A. Powell
Mrs. Julia S. Rankin
Mr. Fred J. Ravens, Jr.

Mrs. Adell R. Rawson
Dr. Lionel I. Rebhun
Dr. Robert M. Reece
Dr. Mary Rice
Mr. John Rima
Dr. Monica Riley
Mrs. Alison A. Robb
Mrs. Lola E. Robertson
Mrs. Ariene Rogers
Mrs. Elise M. Scott
Dr. Cecily C. Selby
Mrs. Deborah G. Senft
Mrs. Charlotte Shemin
Mrs. Cynthia C. Smith
Mrs. Perle Sonnenblick
Dr. Evelyn Spiegel
Dr. Guy L. Steele, Sr.
Mrs. Judith G. Stetson
Mrs. Jane Lazarov Stetten
Dr. Dorothy A. Stracher
Mr. Robert Stump
Dr. Maurice Sussman
Mr. Albert H. Swain
Mr. James K. Taylor
Mrs. Alice Todd
Mr. Arthur D. Traub
Ms. Natalie Trousof
Ms. Ciona Ulbrich
Mrs. Barbara Van Holde
Mrs. Eve Warren
Mr. John T. Weeks
Ms. Lilian Wendorff
Mrs. Barbara Whitehead
Mrs. A.A.T. Wickersham
Mrs. Clare M. Wilber
Mr. Albert Wilson
Dr. T. Hastings Wilson
Ms. Nancy Worokoski
Mrs. Elizabeth S. Yntema
Mrs. Donald J. Zimm

MBL Associates Gift Shop

Volunteers

Marion Adelberg
Marianne Angell
Barbara Atwood

Harriet Bernheimer
Gloria Borgese
Jennie Brown
Elizabeth Buck
Jewel Cobb
Janet Daniels
Carol DeYoung
Fran Eastman
Alma Ebert
Pat Ferguson
Becky Glazebrook
Muriel Gould
Rose Grant
Edie Grosch
Bobbie Grossman
Pat Hancock
Hanna Hastings
Sally Karush
Alice Knowles
Barbara Little
Sally Loessel
Winnie Mackey
Miriam Mauzerraal
Mary Mavor
Elizabeth Mosley
Jane McCormack
Polly Miles
Florence Mixer
Lorraine Mizell
Eleanor Nace
Bertha Person
Liz Price
Julie Rankin
Jean Ripps
Arlene Rogers
Lilyan Saunders
Meryln Shepro
Cynthia Smith
Peggy Smith
Louise Specht
Jane Stetten
Elaine Troll
Natalie Trousof
Mary Ulbrich
Barbara Van Holde
Mabel Whelpy
Barbara Whitehead
Clare Wilber

MBL Summer Tour Guides

Kevin Barry
John Buck
Scars Crowell
Barbara Little
Giselle Magnusson
Kathy Mullin
Julie Rankin
Lola Robertson
Priscilla Roslansky
Erin Smyth
Mary Ulbrich
John Valois
Certificate of Organization

(On File in the Office of the Secretary of the Commonwealth)

No. 3170

We, Alpheus Hyatt, President, William Stanford Stevens, Treasurer, and William T. Sedgwick, Edward G. Gardiner, Susan Mims and Charles Sedgwick Minot being a majority of the Trustees of the Marine Biological Laboratory in compliance with the requirements of the fourth section of chapter one hundred and fifteen of the Public Statutes do hereby certify that the following is a true copy of the agreement of association to constitute said Corporation, with the names of the subscribers thereto:

We, whose names are hereto subscribed, do, by this agreement, associate ourselves with the intention to constitute a Corporation according to the provisions of the one hundred and fifteenth chapter of the Public Statutes of the Commonwealth of Massachusetts, and the Acts in amendment thereof and in addition thereto.

The name by which the Corporation shall be known is THE MARINE BIOLOGICAL LABORATORY.

The purpose for which the Corporation is constituted is to establish and maintain a laboratory or station for scientific study and investigations, and a school for instruction in biology and natural history.

The place within which the Corporation is established or located is the city of Boston within said Commonwealth.

The amount of its capital stock is none.

In Witness Whereof, we have hereunto set our hands, this twenty seventh day of February in the year eighteen hundred and eighty-eight, Alpheus Hyatt, Samuel Mills, William T. Sedgwick, Edward G. Gardiner, Charles Sedgwick Minot, William G. Farlow, William Stanford Stevens, Anna D. Phillips, Susan Mims, B. H. Van Vleck.

That the first meeting of the subscribers to said agreement was held on the thirteenth day of March in the year eighteen hundred and eighty-eight.

In Witness Whereof, we have hereunto signed our names, this thirteenth day of March in the year eighteen hundred and eighty-eight, Alpheus Hyatt, President, William Stanford Stevens, Treasurer, Edward G. Gardiner, William T. Sedgwick, Susan Mims, Charles Sedgwick Minot.

(Approved on March 20, 1888 as follows:

I hereby certify that it appears upon an examination of the within written certificate and the records of the corporation duly submitted to my inspection, that the requirements of sections one, two and three of chapter one hundred and fifteen, and sections eighteen, twenty and twenty-one of chapter one hundred and six, of the Public Statutes, have been complied with and I hereby approve said certificate this twentysecond day of March A.D. eighteen hundred and eighty-eight.

Charles Endicott
Commissioner of Corporations)

Certificate of Organization Articles of Amendment

Articles of Amendment

(On File in the Office of the Secretary of the Commonwealth)

We, James D. Ebert, President, and David Shepro, Clerk of the Marine Biological Laboratory, located at Woods Hole, Massachusetts 02543, do hereby certify that the following amendment to the Articles of Organization of the Corporation was duly adopted at a meeting held on August 15, 1975, as adjourned to August 29, 1975, by vote of 444 members, being at least two-thirds of its members legally qualified to vote in the meeting of the corporation:

Voted. That the Certificate of Organization of this corporation be and it hereby is amended by the addition of the following provisions:

"No Officer, Trustee or Corporate Member of the corporation shall be personally liable for the payment or satisfaction of any obligation or liabilities incurred as a result of, or otherwise in connection with, any commitments, agreements, activities or affairs of the corporation.

"Except as otherwise specifically provided by the Bylaws of the corporation, meetings of the Corporate Members of the corporation may be held anywhere in the United States.

"The Trustees of the corporation may make, amend or repeal the Bylaws of the corporation in whole or in part, except with respect to any provisions thereof which shall by law, this Certificate or the bylaws of the corporation, require action by the Corporate Members."

The foregoing amendment will become effective when these articles of amendment are filed in accordance with Chapter 189, Section 7 of the General Laws unless these articles specify, in accordance with the vote adopting the amendment, a later effective date not more than thirty days after such filing, in which event the amendment will become effective on such later date.

In Witness whereof and Under the Penalties of Perjury, we have hereto signed our names this 2nd day of September, in the year 1975, James D. Ebert, President, David Shepro, Clerk.

( Approved on October 24, 1975, as follows:

I hereby approve the within articles of amendment and, the filing fee in the amount of $10 having been paid, said articles are deemed to have been filed with me this 24th day of October, 1975.

Paul Guzzi
Secretary of the Commonwealth)

Bylaws

(Revised August 7, 1992 and December 10, 1992)

ARTICLE I—THE CORPORATION

A Name and Purpose: The name of the Corporation shall be The Marine Biological Laboratory. The Corporation's purpose shall be to establish and main-
A. **Members.** The Members of the Corporation ("Members") shall consist of persons elected by the Board of Trustees (the "Board"), upon such terms and conditions and in accordance with such procedures, not inconsistent with law or these Bylaws, as may be determined by the Board. Any regular or special meeting of the Board, the Board may elect new Members. Members shall have no voting or other rights with respect to the Corporation or its activities except as specified in these Bylaws, and any Member may vote at any meeting of the Members in person only and not by proxy. Members shall serve until their death or resignation unless earlier removed with or without cause by the affirmative vote of two-thirds of the Trustees then in office. Any Member who has retired from his or her home institution may, upon written request to the Corporation, be designated a Life Member. Life Members shall not have the right to vote and shall not be assessed for dues.

B. **Meetings.** The annual meeting of the Members shall be held on the Friday following the first Tuesday in August of each year, at the Laboratory of the Corporation in Woods Hole, Massachusetts, at 9:30 a.m. The Chairperson of the Board shall preside at meetings of the Corporation. If no annual meeting is held with such accordance with the foregoing provision, a special meeting may be held in lieu thereof with the same effect as the annual meeting, and in such case all references in these Bylaws, except in this Article II.B., to the annual meeting of the Members shall be deemed to refer to such special meeting. Members shall transact business, as may properly come before the meeting. Special meetings of the Members may be called by the Chairperson or the Trustees, and shall be called by the Clerk, or in the case of the death, absence, incapacity or refusal of the Clerk, by any other officer, upon written application of Members representing at least ten percent of the smallest quorum of Members required for a vote upon any matter at the annual meeting of the Members, to be held at such time and place as may be designated.

C. **Quorum.** One hundred (100) Members shall constitute a quorum at any meeting. Except as otherwise required by law or these Bylaws, the affirmative vote of a majority of the Members voting in person at a meeting attended by a quorum shall constitute action on behalf of the Members.

D. **Notice of Meetings.** Notice of any annual meeting or special meeting of Members, if necessary, shall be given by the Clerk by mailing notice of the time and place and purpose of such meeting at least 15 days before such meeting to each Member at his or her address as shown on the records of the Corporation.

E. **Waiver of Notice.** Whenever notice of a meeting is required to be given a Member, under any provision of the Articles of Organization or Bylaws of the Corporation, a written waiver thereof, executed before or after the Meeting by such Member, or his or her duly authorized attorney, shall be deemed equivalent to such notice.

F. **Adjournments.** Any meeting of the Members may be adjourned to any other time and place by the vote of a majority of those Members present at the meeting, whether or not such Members constitute a quorum, or by any officer entitled to preside at or to act as Clerk of such meeting, if no Member is present or represented. It shall not be necessary to notify any Members of any adjournment unless no Member is present or represented at the meeting which is adjourned, in which case, notice of the adjournment shall be given in accordance with Article II.D. Any business which could have been transacted at any meeting of the Members as originally called may be transacted at an adjournment thereof.

**ARTICLE III—ASSOCIATES OF THE CORPORATION**

**Associates of the Corporation.** The Associates of the Marine Biological Laboratory shall be an unincorporated group of persons (including associations and corporations) interested in the Laboratory and shall be organized and operated under the general supervision and authority of the Trustees. The Associates of the Marine Biological Laboratory shall have no voting rights.

**ARTICLE IV—BOARD OF TRUSTEES**

**A. Powers.** The Board of Trustees shall have the control and management of the affairs of the Corporation. The Trustees shall elect a Chairperson of the Board who shall serve until her successor is elected and qualified. They shall annually elect a President of the Corporation. They shall annually elect a Vice Chairperson of the Board who shall be Vice Chairperson of the meetings of the Corporation. They shall annually elect a Treasurer. They shall annually elect a Clerk, who shall be a resident of Massachusetts. They shall elect Trustees-at-Large as specified in this Article IV. They shall appoint a Director of the Laboratory for a term not to exceed five years, provided the term shall not exceed one year if the candidate has attained the age of 65 years prior to the date of the appointment. They may add such other officers and agents as they think best. They may fix the compensation of all officers and agents of the Corporation and may remove them at any time. They may fill vacancies occurring in any of the offices.

**B. Composition and Election.**

1. The Board shall include 24 Trustees elected by the Board as provided below:
   a. At least six Trustees ("Corporate Trustees") shall be Members who are scientists, and the other Trustees ("Trustees-at-Large") shall be individuals who need not be Members or otherwise affiliated with the Corporation.
   b. The 24 elected Trustees shall be divided into four classes of six Trustees each, with one class to be elected each year to serve for a term of four years, and with each such class to include at least one Corporate Trustee. Such classes of Trustees shall be designated by the year of expiration of their respective terms.

2. The Board shall also include the Chair Executive Officer, Treasurer, and the Chairperson of the Science Council, who shall be ex officio voting members of the Board.

3. Although Members or Trustees may recommend individuals for nomination as Trustees, nominations for Trustee elections shall be made by the Nominating Committee in its sole discretion. The Board may also elect Trustees who have not been nominated by the Nominating Committee.

C. **Eligibility.** A Corporate Trustee or a Trustee-at-Large who has been elected to an initial four-year term or remaining portion thereof, of which he/she has served at least two years, shall be eligible for re-election to a second four-year term, but shall be ineligible for re-election to any subsequent term until one year has elapsed after he/she has last served as a Trustee.

D. **Removal.** Any Trustee may be removed from office at any time with or without cause, by vote of a majority of the Members entitled to vote in the election of Trustees, or for cause, by vote of two-thirds of the Trustees then in office. A Trustee may be removed for cause only if notice of such action shall have been given to all of the Trustees or Members entitled to vote, as the case may be, prior to the meeting at which such action is to be taken and if the Trustee to be so removed shall have been given reasonable notice and opportunity to be heard before the body proposing to remove him or her.

E. **Vacancies.** Any vacancy in the Board may be filled by vote of a majority of the remaining Trustees present at a meeting of Trustees at which a quorum is present. Any vacancy in the Board resulting from the resignation or removal of a Corporate Trustee shall be filled by a Member who is a scientist.

F. **Meetings.** Meetings of the Board shall be held from time to time, not less frequently than twice annually, as determined by the Board. Special meetings of Trustees may be called by the Chairperson, or by any seven Trustees, to be held at such time and place as may be designated. The Chairperson of the Board, when present, shall preside over all meetings of the Trustees. Written notice shall be sent to a Trustee's usual or last known place of residence at least two weeks before the meeting. Notice of a meeting need not be given to any Trustee if a written waiver of notice executed by such Trustee before or after the meeting is filed with the records of the meeting, or if such Trustee shall attend the meeting without protesting prior thereto or at its commencement the lack of notice given to him or her.

G. **Quorum and Action by Trustees.** A majority of all Trustees then in office shall constitute a quorum. Any meeting of Trustees may be adjourned by vote of a majority of Trustees present, whether or not a quorum is present, and the meeting may be held in adjourned form. When a quorum is present at any meeting of the Trustees, a majority of the Trustees present and voting (including abstentions) shall decide any question, including the election of officers, unless otherwise required by law, the Articles of Organization or these Bylaws.

H. **Transfers of Interests in Land.** There shall be no transfer of title or long-term lease of real property held by the Corporation without prior approval of not less than two-thirds of the Trustees. Such real property transactions shall be finally acted upon at a meeting of the Board only if presented and discussed at a prior meeting of the Board. Either meeting may be a special meeting and no less than four weeks shall elapse between the two meetings. Any property acquired by the
Corporation after December 1, 1989 may be sold, any mortgage or pledge of real property (regardless of when acquired) to secure borrowings by the Corporation may be granted, and any transfer of title or interest in real property pursuant to the foreclosure or endorsement of any such mortgage or pledge of real property may be effected by any holder of a mortgage or pledge of real property of the Corporation, with the prior approval of not less than two-thirds of the Trustees (other than any Trustee or trustees with a direct or indirect financial interest in the transaction being considered for approval) who are present at a regular or special meeting of the Board at which there is a quorum.

ARTICLE V—COMMITTEES

A. Executive Committee. There shall be an Executive Committee of the Board of Trustees which shall consist of not more than eleven (11) Trustees, including ex officio Trustees, elected by the Board.

The Chairperson of the Board shall act as Chairperson of the Executive Committee and the Vice Chairperson as Vice Chairperson. The Executive Committee shall meet at such times and places and upon such notice and appoint such subcommittees as the Committee shall determine.

The Executive Committee shall have and may exercise all the powers of the Board during the intervals between meetings of the Board except for powers specifically withheld, from time to time, by vote of the Board or by law. The Executive Committee may also appoint such committees, including persons who are not Trustees, as it may, from time to time, approve to make recommendations with respect to matters to be acted upon by the Executive Committee or the Board.

The Executive Committee shall keep appropriate minutes of its meetings, which shall be reported to the Board. Any actions taken by the Executive Committee shall also be reported to the Board.

B. Nominating Committee. There shall be a Nominating Committee which shall consist of not fewer than four nor more than six Trustees appointed by the Board in a manner which shall reflect the balance between Corporate Trustees and Trustees-at-Large on the Board. The Nominating Committee shall nominate persons for election as Corporate Trustees and Trustees-at-Large, Chairperson of the Board, Vice Chairperson of the Board, President, Treasurer, Clerk, Director of the Laboratory and such other officers, if any, as needed, in accordance with the requirements of these Bylaws. The Nominating Committee shall also be responsible for overseeing the training of new Trustees. The Chairperson of the Board of Trustees shall appoint the Chairperson of the Nominating Committee. The Chairperson of the Science Council shall be an ex officio voting member of the Nominating Committee.

C. Science Council. There shall be a Science Council (the “Council”) which shall consist of Members of the Corporation elected to the Council by vote of the Members of the Corporation, and which shall advise the Board with respect to matters concerning the Corporation’s mission, its scientific and instructional endeavors, and the appointment and promotions of persons or committees with responsibility for matters requiring scientific expertise. Unless otherwise approved by a majority of the members of the Council, the Chairperson of the Council shall be elected annually by the Council.

The chief executive officer of the Corporation shall be an ex officio voting member of the Council.

D. Board of Overseers. There shall be a Board of Overseers which shall consist of not fewer than five nor more than eight scientists who have expertise concerning matters with which the Corporation is involved. Members of the Board of Overseers may or may not be Members of the Corporation and may be appointed by the Board of Overseers on the basis of recommendations submitted from scientists and scientific organizations or societies. The Board of Overseers shall be available to review and offer recommendations to the officers, Trustees and Science Council regarding scientific activities conducted or proposed by the Corporation and shall meet from time to time, not less frequently than annually, as determined by the Board of Trustees.

E. Board Committees Generally. The Trustees may elect or appoint one or more other committees (including, but not limited to, an Investment Committee, a Development Committee, an Audit Committee, a Facilities and Capital Equipment Committee and a Long-Range Planning Committee) and may delegate to any such committee or committees any or all of their powers, except those which by law, the Articles of Organization or these Bylaws the Trustees are prohibited from delegating, provided that any committee to which the powers of the Trustees are delegated shall consist solely of Trustees. The members of any such committee shall have such tenure and duties as the Trustees shall determine. The Investment Committee, which shall oversee the management of the Corporation’s endowment funds and marketable securities shall include ex officio members, the Chairperson of the Board, the Treasurer and the Chairperson of the Audit Committee, together with such Trustees as may be required for not less than two-thirds of the Investment Committee to consist of Trustees. Except as otherwise provided by these Bylaws or determined by the Trustees, any such committee may make rules for the conduct of its business, but, unless otherwise provided by the Trustees or in such rules, its business shall be conducted as nearly as possible in the same manner as is provided by these Bylaws for the Trustees.

F. Actions Without a Meeting. Any action required or permitted to be taken at any meeting of the Executive Committee or any other committee elected by the Trustees may be taken without a meeting if all members of such committees consent to the action in writing and such written consents are filed with the records of meetings. Members of the Executive Committee or any other committee elected by the Trustees may also participate in any meeting by means of a telephone conference call, or otherwise take action in such a manner as may, from time to time, be permitted by law.

G. Manual of Procedures. The Board of Trustees, on the recommendation of the Executive Committee, shall establish guidelines and modifications thereof to be recorded in a Manual of Procedures. Guidelines shall establish procedures for: (1) Nomination and election of members of the Corporation, Board of Trustees and Executive Committee; (2) Election of Officers; (3) Formation and Function of Standing Committees.

ARTICLE VI—OFFICERS

A. Enumeration. The officers of the Corporation shall consist of a President, a Treasurer and a Clerk, and such other officers having the powers of President, Treasurer and Clerk as the Board may determine, and a Director of the Laboratory. The Corporation may have such other officers and assistant officers as the Board may determine, including (without limitation) a Chairperson of the Board, Vice Chairperson and one or more Vice Presidents, Assistant Treasurers or Assistant Clerks. Any two or more offices may be held by the same person. The Chairperson and Vice Chairperson of the Board shall be elected by and from the Trustees, but other officers of the Corporation need not be Trustees or Members. If required by the Trustees, any officer shall give the Corporation a bond for the faithful performance of his or her duties in such amount and with such surety or sureties as shall be satisfactory to the Trustees.

B. Tenure. Except as otherwise provided by law, by the Articles of Organization or by these Bylaws, the President, Treasurer, and all other officers shall hold office until the first meeting of the Board following the annual meeting of Members and thereafter, until his or her successor is chosen and qualified.

C. Resignation. Any officer may resign by delivering his or her written resignation to the Corporation at its principal office or to the President or Clerk and such resignations shall be effective upon receipt unless it is specified to be effective at some other time or upon the happening of some other event.

D. Removal. The Board may remove any officer with or without cause by a vote of a majority of the entire number of Trustees then in office, at a meeting of the Board called for that purpose and for which notice of the purpose thereof has been given, provided that an officer may be removed for cause only after having an opportunity to be heard by the Board at a meeting of the Board at which a quorum is personally present and voting.

E. Vacancy. A vacancy in any office may be filled for the unexpired balance of the term by vote of a majority of the Trustees present at any meeting of Trustees at which a quorum is present or by written consent of all of the Trustees, if less than a quorum of Trustees remain in office.

F. Chairperson. The Chairperson shall have such powers and duties as may be determined by the Board and, unless otherwise determined by the Board, shall serve in that capacity for a term coterminous with his or her term as Trustee.

G. Vice Chairperson. The Vice Chairperson shall perform the duties and exercise the powers of the Chairperson in the absence or disability of the Chairperson, and shall perform such other duties and possess such other powers as may be determined by the Board. Unless otherwise determined by the Board, the Vice Chairperson shall serve for a one-year term.

H. Director. The Director shall be the chief operating officer and, unless otherwise voted by the Trustees, the chief executive officer of the Corporation. The Director shall, subject to the direction of the Trustees, have general supervision of the Laboratory and control of the business of the Corporation. At the annual meeting, the Director shall submit a report of the operations of the Corporation for such year and a statement of its affairs, and shall, from time to time, report to the Board all matters within his or her knowledge which the interests of the Corporation may require to be brought to its notice.

I. Deputy Director. The Deputy Director, if any, or if there shall be more than one, the Deputy Directors in the order determined by the Trustees, shall, in the absence of disability of the Director, perform the duties and exercise the powers
of the Director and shall perform such other duties and shall have such other powers as the Trustees may, from time to time, prescribe.

3. President. The President shall have the powers and duties as may be vested in him or her by the Board.

4. Treasurer. The Treasurer shall perform the duties and exercise the powers of the Treasurer, as the Trustees may, from time to time, prescribe.

5. Clerk and Assistant Clerk. The Clerk shall be a resident of the Commonwealth of Massachusetts, unless the Corporation has designated a resident agent in the manner provided by law. The minutes or records of all meetings of the Trustees and Members shall be kept by the Clerk who shall record, upon the record books of the Corporation, minutes of the proceedings at such meetings. He or she shall have custody of the record books of the Corporation and shall have such other powers and shall perform such other duties as the Trustees may, from time to time, prescribe.

6. Assistant Clerk. If any, or if there shall be more than one, the Assistant Clerks in the order determined by the Trustees, shall, in the absence or disability of the Clerk, perform the duties and exercise the powers of the Clerk and shall perform such other duties and shall have such other powers as the Trustees may, from time to time, prescribe.

L. Clerk and Assistant Clerk. The Clerk shall be a resident of the Commonwealth of Massachusetts, unless the Corporation has designated a resident agent in the manner provided by law. The minutes or records of all meetings of the Trustees and Members shall be kept by the Clerk who shall record, upon the record books of the Corporation, minutes of the proceedings at such meetings. He or she shall have custody of the record books of the Corporation and shall have such other powers and shall perform such other duties as the Trustees may, from time to time, prescribe.

M. Other Powers and Duties. Each officer shall have in addition to the duties and powers specifically set forth in these Bylaws, such duties and powers as are customarily incident to his or her office, and such duties and powers as the Trustees may, from time to time, designate.

ARTICLE VII—AMENDMENTS

These Bylaws may be amended by the affirmative vote of the Members at any meeting, provided that notice of the substance of the proposed amendment is stated in the notice of such meeting. As authorized by the Articles of Organization, the Trustees, by a majority of their number then in office, may also make, amend or repeal these Bylaws, in whole or in part, except with respect to (a) the provisions of these Bylaws governing: (i) the removal of Trustees and (ii) the amendment of these Bylaws and (b) any provisions of these Bylaws which by law, the Articles of Organization or the Bylaws, require action by the Members.

No later than the time of giving notice of meeting of Members next following the making, amending or repealing by the Trustees of any Bylaw, notice thereof stating the substance of such change shall be given to all Members entitled to vote on amending the Bylaws.

Any Bylaw adopted by the Trustees may be amended or repealed by the Members entitled to vote on amending the Bylaws.

ARTICLE VIII—INDEMNITY

Except as otherwise provided below, the Corporation shall, to the extent legally permissible, indemnify each person who is, or shall have been, a Trustee, director or officer of the Corporation or who is serving, or shall have served at the request of the Corporation as a Trustee, director or officer of another organization in which the Corporation directly or indirectly has any interest as a shareholder, creditor or otherwise, against all liabilities and expenses (including judgments, fines, penalties, and reasonable attorneys’ fees and all amounts paid, other than to the Corporation or such other organization, in compromise or settlement) imposed upon or incurred by such person in connection with, or arising out of, the defense or disposition of any action, suit or other proceeding, whether civil or criminal, in which he or she may be a defendant or with which he or she may be threatened or otherwise involved, directly or indirectly, by reason of his or her being or having been such a Trustee, director or officer.

The Corporation shall provide no indemnification with respect to any matter as to which any such Trustee, director or officer shall be finally adjudicated in such action, suit or proceeding not to have acted in good faith in the reasonable belief that his or her action was in the best interests of the Corporation. The Corporation shall provide no indemnification with respect to any matter settled or comprised unless such matter shall have been approved as in the best interests of the Corporation, after notice that indemnification is involved, by (i) a disinterested majority of the Board of the Executive Committee, or (ii) a majority of the Members.

Indemnification may include payment by the Corporation of expenses in defending a civil or criminal action or proceeding in advance of the final disposition of such action or proceeding upon receipt of an undertaking by the person indemnified to repay such payment if it is ultimately determined that such person is not entitled to indemnification under the provisions of this Article VIII, or under any applicable law.

As used in this Article VIII, the terms “Trustee,” “director,” and “officer” include their respective heirs, executors, administrators and legal representatives, and an “interested” Trustee, director or officer is one against whom in such capacity the proceeding in question or another proceeding on the same or similar grounds is then pending.

To assure indemnification under this Article VIII of all persons who are determined by the Corporation or otherwise to be or to have been “inductees” of any employee benefits plan of the Corporation which may exist, from time to time, this Article VIII shall be interpreted as follows: (i) “another organization” shall be deemed to include such an employee benefit plan, including without limitation, any plan of the Corporation which is governed by the Act of Congress entitled “Employee Retirement Income Security Act of 1974,” as amended, from time to time, (“ERISA”); (ii) “Trustee” shall be deemed to include any person requested by the Corporation to serve as such for an employee benefit plan where the performance by such person of his or her duties to the Corporation also imposes duties on, or otherwise involves services by, such person to the plan or participants or beneficiaries of the plan; (iii) “fines” shall be deemed to include any fine tax plan pursuant to ERISA; and (iv) actions taken or omitted by a person with respect to an employee benefit plan in the performance of such person’s duties for a purpose reasonably believed by such person to be in the interest of the participants and beneficiaries of the plan shall be deemed to be for a purpose which is in the best interests of the Corporation.

The right of indemnification provided in this Article VIII shall not be exclusive of or affect any other rights to which any person, director or officer may be entitled under any agreement, statute, vote of Members or otherwise. The Corporation’s obligation to provide indemnification under this Article VIII shall be subject to the extent of any other source of indemnification of any otherwise applicable insurance coverage under a policy maintained by the Corporation or any other person. Nothing contained in the Article shall affect any rights to which employees and corporate personnel other than Trustees, directors or officers may be entitled by contract, by vote of the Board or of the Executive Committee or otherwise.

ARTICLE IX—DISSOLUTION

The consent of every Trustee shall be necessary to effect a dissolution of the Marine Biological Laboratory. In case of dissolution, the property shall be disposed of in such a manner and upon such terms as shall be determined by the affirmative vote of two-thirds of the Trustees then in office in accordance with the laws of the Commonwealth of Massachusetts.

ARTICLE X—MISCELLANEOUS PROVISIONS

A. Fiscal Year. Except as otherwise determined by the Trustees, the fiscal year of the Corporation shall end on December 31st of each year.

B. Seal. Unless otherwise determined by the Trustees, the Corporation may have a seal in such form as the Trustees may determine, from time to time.

C. Execution of Instruments. All checks, deeds, leases, transfers, contracts, bonds, notes and other obligations authorized to be executed by an officer or the Corporation in its behalf shall be signed by the Director or the Treasurer except as the Trustees may generally or in particular cases otherwise determine. A certificate by the Director or the Assistant Director, or a temporary Clerk, as to any action taken by the Members, Board of Trustees or any officer or representative of the Corporation shall as to all persons who rely thereon in good faith be conclusive evidence of such action.

D. Corporate Records. The original, or attested copies, of the Articles of Organization, Bylaws and records of all meetings of the Members shall be kept in Massachusetts at the principal office of the Corporation, or at an office of the Corporation's Clerk or resident agent. Said copies and records need not all be kept in the same office. They shall be available at all reasonable times for inspection by any Member for any proper purpose, but not to secure a list of Members for a purpose other than in the interest of the applicant, as a Member, relative to the affairs of the Corporation.
E. Articles of Organization. All references in these Bylaws to the Articles of Organization shall be deemed to refer to the Articles of Organization of the Corporation, as amended and in effect, from time to time.

F. Transactions with Interested Parties. In the absence of fraud, no contract or other transaction between this Corporation and any other corporation or any firm, association, partnership or person shall be affected or invalidated by the fact that any Trustee or officer of this Corporation is pecuniarily or otherwise interested in or is a director, member or officer of such other corporation or of such firm, association or partnership or in a party to or is pecuniarily or otherwise interested in such contract or other transaction or is in any way connected with any person or person, firm, association, partnership, or corporation pecuniarily or otherwise interested therein; provided that the fact that he or she individually or as a director, member or officer of such corporation, firm, association or partnership in such a party or is so interested shall be disclosed to or shall have been known by the Board of Trustees or a majority of such Members thereof as shall be present at a meeting of the Board of Trustees at which action upon any such contract or transaction shall be taken, any Trustee may be counted in determining the existence of a quorum and may vote at any meeting of the Board of Trustees for the purpose of authorizing any such contract or transaction with like force and effect as if he/she were not so interested, or were not a director, member or officer of such other corporation, firm, association or partnership, provided that any vote with respect to such contract or transaction must be adopted by a majority of the Trustees then in office who have no interest in such contract or transaction.