



PLOTTING  
*the* Course  
FY2008 Annual Report

SfN  
SOCIETY FOR NEUROSCIENCE

# PLOTTING

# the COURSE

# Course

FY2008 Annual Report

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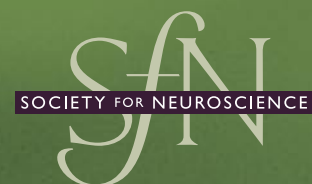
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Patricia S. Goldman-Rakic, PhD, 1989–90

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Mortimer Mishkin, PhD, 1986–87

Bernice Grafstein, PhD, 1985–86

William D. Willis, Jr., MD, PhD, 1984–85

Gerald D. Fischbach, MD, 1983–84

Dominick P. Purpura, MD, 1982–83

David H. Cohen, PhD, 1981–82

Eric R. Kandel, MD, 1980–81

Solomon H. Snyder, MD, 1979–80

Torsten N. Wiesel, MD, 1978–79

W. Maxwell Cowan, MD, PhD, 1977–78

Floyd E. Bloom, MD, 1976–77

Robert W. Doty, PhD, 1975–76

Edward V. Evars, MD, 1974–75

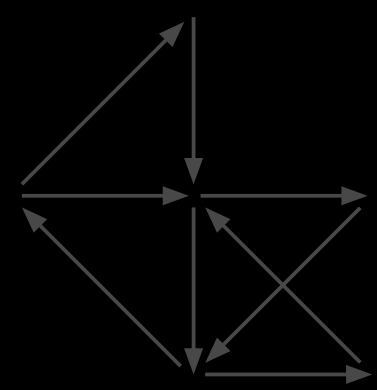
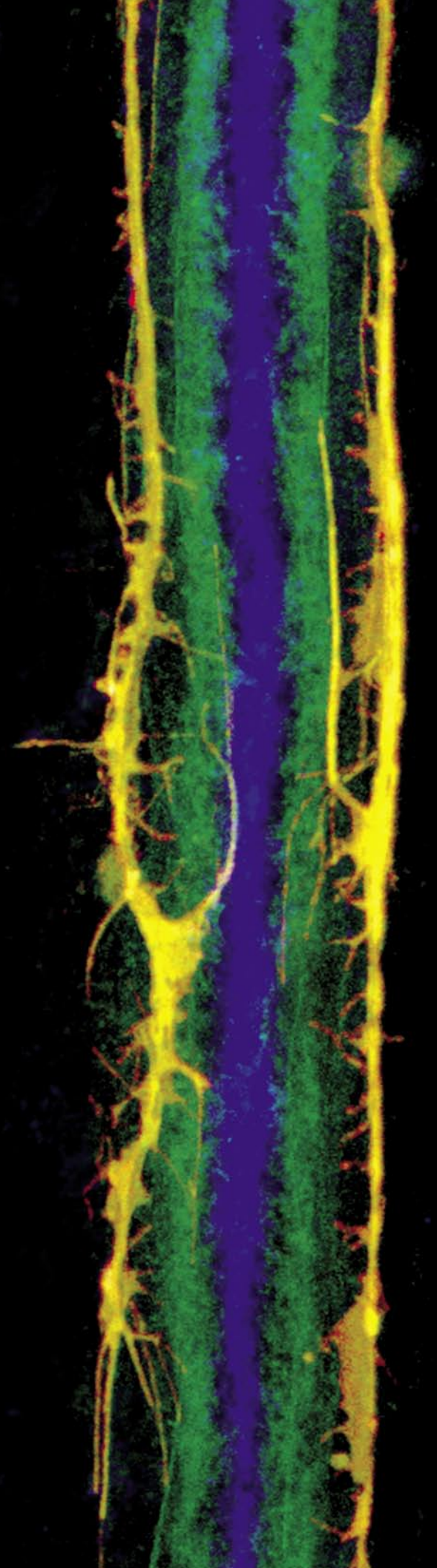
Theodore H. Bullock, PhD, 1973–74

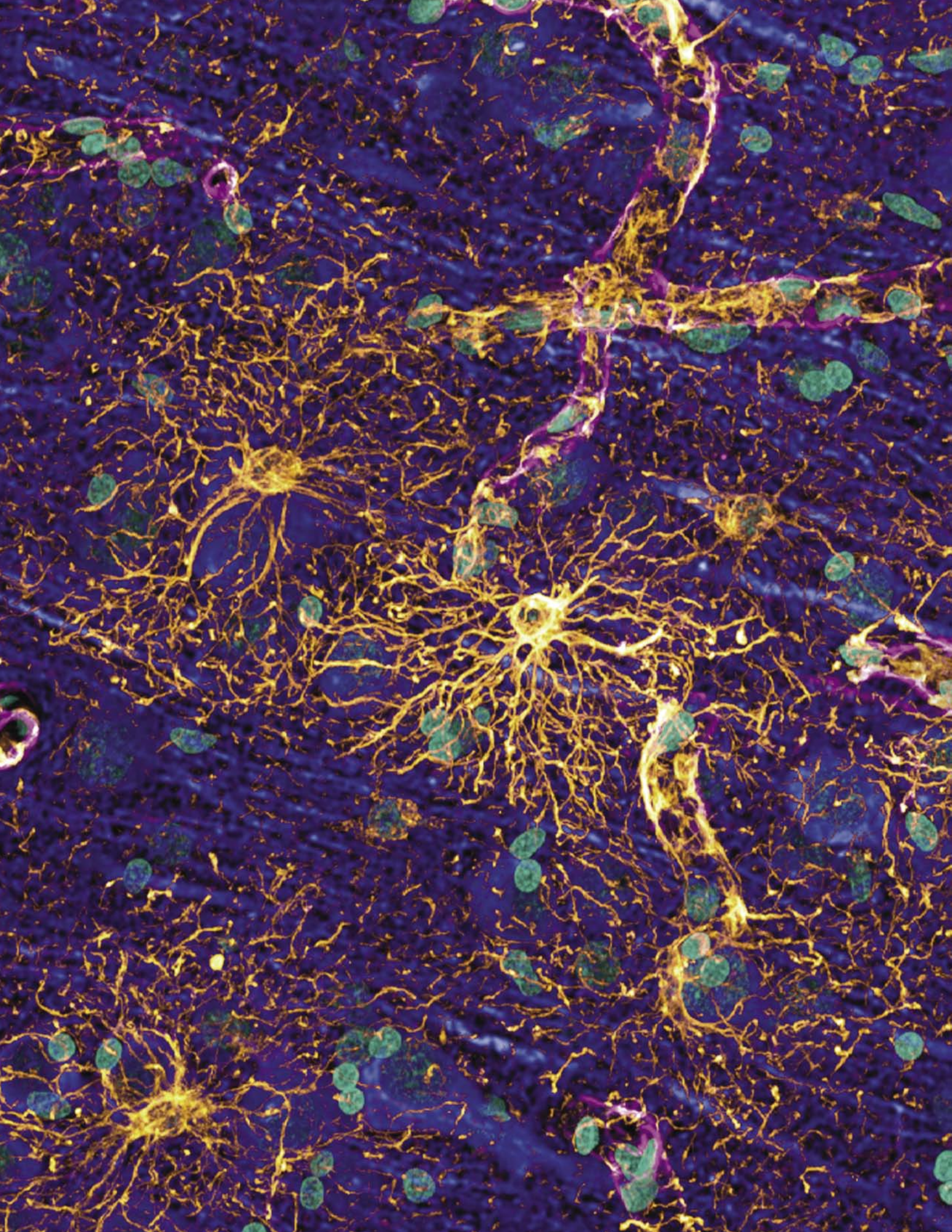
Walle J.H. Nauta, MD, PhD, 1972–73

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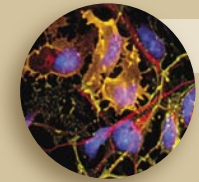
Vernon B. Mountcastle, MD, 1970–71

Edward R. Perl, MD, 1969–70





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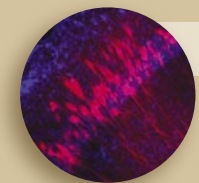
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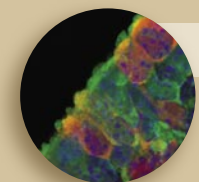
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# Mission

**Advance** the understanding of the brain and the nervous system by bringing together scientists of diverse backgrounds, by facilitating the integration of research directed at all levels of biological organization, and by encouraging translational research and the application of new scientific knowledge to develop improved disease treatments and cures.

**Provide** professional development activities, information, and educational resources for neuroscientists at all stages of their careers, including undergraduates, graduates, and postdoctoral fellows, and increase participation of scientists from diverse cultural, ethnic, and geographic backgrounds.

**Promote** public information and general education about the nature of scientific discovery and the results and implications of the latest neuroscience research. Support active and continuing discussions on ethical issues relating to the conduct and outcomes of neuroscience research.

**Inform** legislators and other policymakers about new scientific knowledge, recent developments, and emerging opportunities in neuroscience research and their implications for public policy, societal benefit, and continued scientific progress.

# Vision

## SfN's Scientific Vision

Guided by its mission and its values, the Society for Neuroscience (SfN)'s vision is that the next decade should be one of breakthrough discovery that will lead to the translation of scientific advances to improve the health of people everywhere.

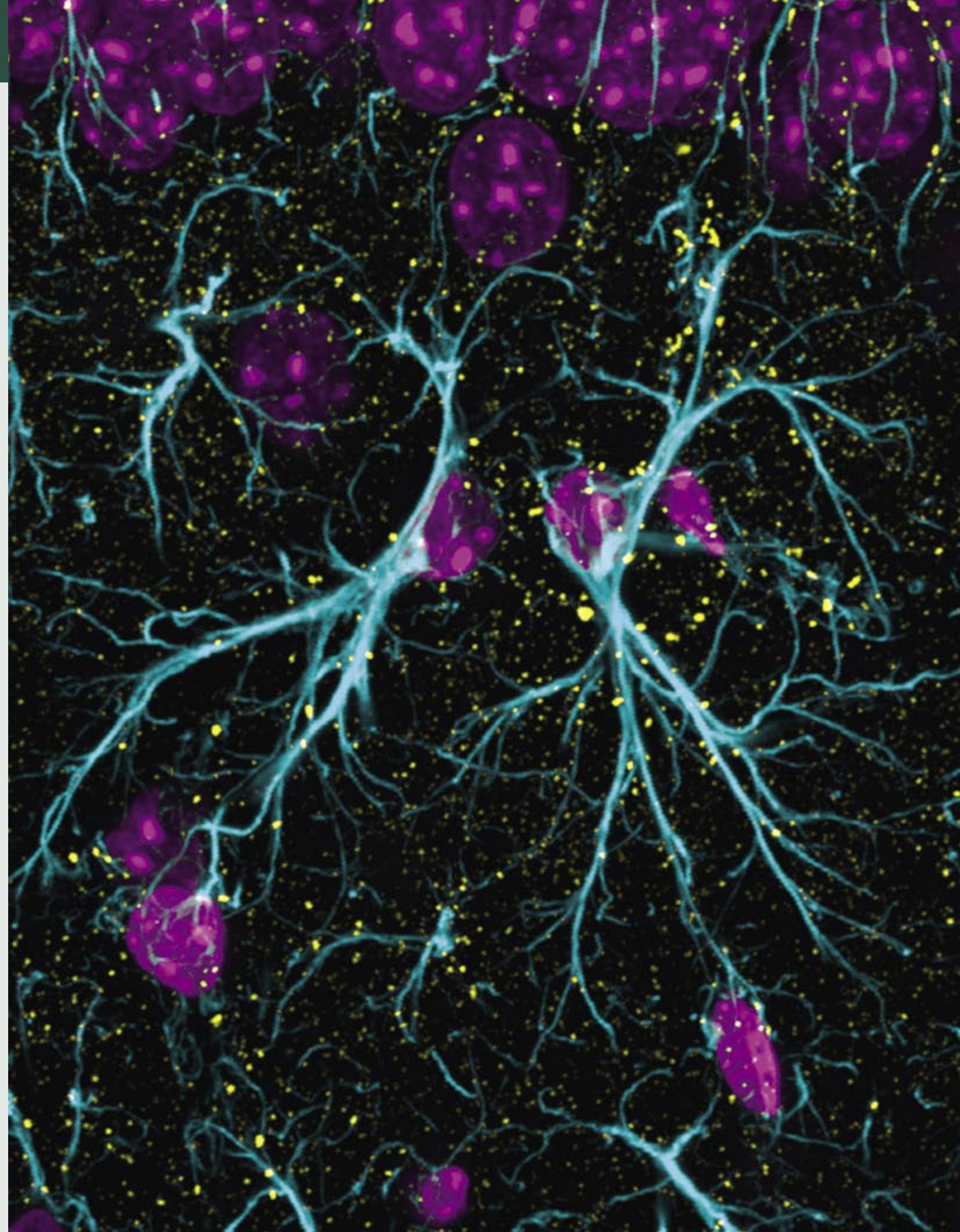
As SfN represents the entire range of scientific research endeavors aimed at understanding, treating, and preventing nervous system disorders, it fosters the broad interdisciplinarity of the field that uses multiple approaches to study the nervous systems of organisms ranging from invertebrates to humans across various stages of development, maturation, and aging. SfN also facilitates the translation of research findings into treatment strategies, encourages information transfer from the clinic back to the basic research arena, and contributes to the breadth of the field of neuroscience, and its creative use of all the tools of modern biology to understand neural function in health and disease.

Neuroscience is a rapidly evolving field that benefits greatly from, and helps to drive, the ongoing development of powerful new tools used to acquire and analyze experimental data. The effort to make efficient use of the staggering amounts of diverse information known about the nervous system raises challenges that have social, ethical, and technical dimensions. Some of these challenges are common to biomedical research and its subdisciplines of bioinformatics and scientific ethics. Others are unique to neuroscience by virtue of the tremendous complexity of neural circuits and their role in controlling behavior. These challenges prompt opportunities, as well as responsibilities, to develop new tools and approaches for integrating and advancing the understanding of the nervous system.

SfN will play a key role in confronting new issues by challenging and energizing the field through active dialogue with federal funding agencies, such as the National Institutes of Health, National Science Foundation, and others, to define current needs and to develop strategies for meeting them. SfN's perspective on the field's current nature and its future trajectory permeates all the elements of the strategic plan and will guide the initiatives aimed at enhancing key scientific functions, including the annual meeting and *The Journal of Neuroscience*. This perspective will guide the ways in which SfN will strive to serve its membership and frame the public outreach and governmental interactions.

# Values

- Identifying and serving the evolving needs of SfN members as well as the field of neuroscience.
- Continuing to promote greater diversity of representation of women, minorities, and young investigators, along with geographic and specialty balance, in SfN's meetings, conferences, committees, and governance processes.
- Seeking new and innovative ways to utilize technology in ongoing activities to better serve members and to help manage the problems of scale as a successful association in the 21<sup>st</sup> century.
- Fulfilling its Mission in a socially, economically and environmentally responsible fashion, including minimizing SfN's environmental footprint through energy, efficiency, recycling, and other initiatives, and being mindful of the broader impact of its day-to-day practices, decisions, and actions.
- Developing effective strategic relationships and collaborative initiatives with appropriate external partners, including other scientific societies and associations, health advocacy groups, foundations, public agencies, government entities, educational institutions, corporate entities, information technology service providers, etc.
- Building a model of iterative planning into the fabric of SfN governance and management processes, incorporating regular evaluation of the impact and success of initiatives and activities and periodic revisiting of major programs and activity clusters.





# A Message FROM THE President

In an era rich with discovery and even greater promise, the Society for Neuroscience is plotting a course to advance science and science education, as well as health and well-being. In FY2008, the Society did so by delivering value for its members, while recognizing changes in its world. While maintaining signature programs that advance and disseminate scientific knowledge, the Society leadership is finding opportunities to support and leverage new trends, such as globalization, new technologies, and a younger scientific community.

## Facilitating Emerging Science

Reflecting the diversity and potential of the field, SfN's annual meeting, Neuroscience 2007, featured leaders from the worlds of science, business, and politics, as well as more than 16,000 abstracts on new scientific discoveries, and it offered a particular emphasis on technological advances in brain research. Drawing more than 32,000 scientists, clinicians, and advocates, it was the second largest meeting in the Society's history. While the annual meeting is a singular venue for science, *The Journal of Neuroscience* reported discovery and innovation throughout the year. Yet it was also a time for *The Journal* to prepare for changes in its own leadership and the future of scientific publishing. Under new editorial leadership, *The Journal* launched a new manuscript submission system and a new cascading review process in partnership with more than two dozen other neuroscience journals. It is also launching an experiment providing members with the option of open access publishing.

## Supporting Neuroscience and Scientists

Professional development programs remain a cornerstone of SfN activity to cultivate the next wave of leading researchers. The Society worked — through the Committee on Women in Neuroscience and the Committee on Diversity in Neuroscience, as well as mentoring and jobs services — to increase opportunities for all. New awards also recognized scientists at many stages, including young leaders through the Next Generation Award and established neuroscientists through the Julius Axelrod Prize.

International efforts are expanding as well. Given growing numbers of both international and younger

SfN President Eve Marder

Dye fill of a single neuron from the stomatogastric ganglion of the lobster.

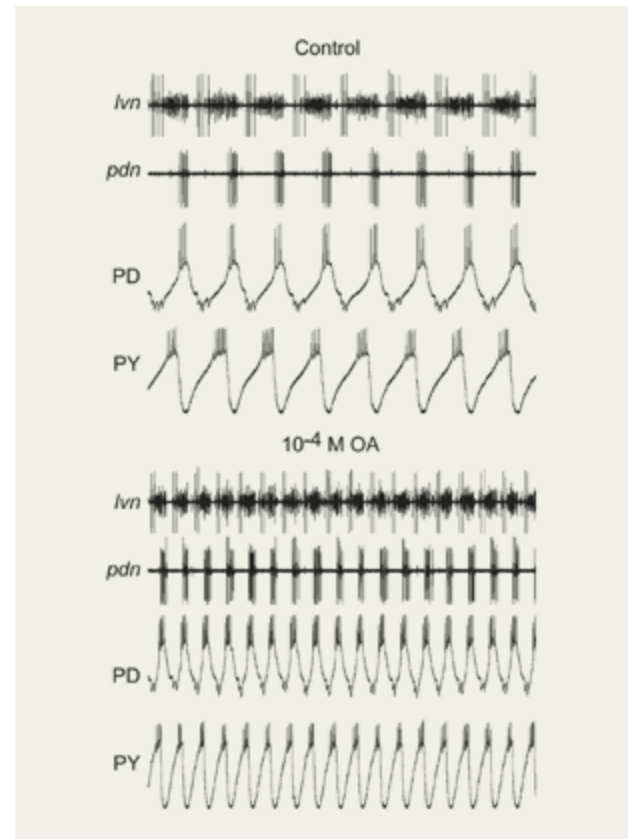


members, SfN has more than doubled the number of international travel awards to defray annual meeting expenses. Additionally, one SfN chapter partnered with the International Brain Research Organization and the University of Zambia to support and cultivate neuroscience's global reach, while the Ricardo Miledi Neuroscience Training Program supported an innovative program for young scientists in Latin America and the Caribbean.

The SfN Council and committees are also leading a major planning initiative based on an analysis of the 2007 membership survey. With feedback from more than 9,000 members, there is much to applaud: 93 percent of members were satisfied with their membership. Nonetheless, there were also identified growth areas: a desire for more professional programming, as well as more engagement in the community, with advocacy, and with other neuroscientists. The survey also confirmed changing demographics: 45 percent of respondents were 35 or younger — and 36 percent of SfN members live and work outside the United States.

Interest is growing in more sophisticated communications tools to help SfN reach its technologically savvy and geographically diverse membership. For instance, staff is exploring communications resources that could connect members, regardless of location, to facilitate learning and professional development, as well as new technologies like wikis to enhance public education efforts and provide more

*With feedback from more than 9,000 members, there is much to applaud: 93 percent of members were satisfied with their membership. Nonetheless, there were also identified growth areas.*



The chemical octopamine affects the firing rate of stomatogastric neurons in crab. At top, control, and below, after octopamine application. Studying this neural communication in simple nervous systems advances basic knowledge and helps scientists approach more complex nervous systems.

member engagement opportunities. Chapters are also a growing component of future strategies to engage members and the broader community. Fifteen new or reactivated chapters — including six from outside the U.S. — emerged in 2008, bringing the total to 129 established and five pending.

### Educating and Advocating

SfN educational outreach engages this generation of scientists to spark excitement in the minds of future scientists. As partners in the Brain Awareness Campaign, SfN members worked from Livingston, New Jersey, to Eskisehir, Turkey to educate thousands of people, young and old, about the “universe between their ears,” and there was considerable growth in member involvement in local schools through the Neuroscientist-Teacher Partner Program. FY2008 also focused on creating more and better neuroscience resources to support K-12 educators, ranging from online material to participation in major teacher conferences. *Neuroscience Core Concepts*, a major SfN initiative, has created the first set of essential principles about the brain and nervous system that the public should know.

SfN is also working to build capacity as an advocate for sustained research funding, which is crucial to medical and scientific advances. On behalf of the Society, I submitted testimony to the U.S. Congress urging funding increases for the National Institutes of Health and the National Science Foundation. Yet one voice alone cannot create change: in April, dozens of SfN members fanned out across the U.S. Capitol during Capitol Hill Day to convey the national, and local, importance of investments in science, and the newly launched SfN Advocacy Network will also expand our effectiveness. We are also exploring

ways to partner with others around the globe — this year, 15 of SfN’s *Brain Research Success Stories* were translated into Spanish for the first time and were used in advocacy by Mexican colleagues.

Finally, given a disturbing trajectory of increasing violence against researchers, the Society took a major step forward to help protect research with the release of *Best Practices for Protecting Researchers and Research*. *Best Practices* assists research institutions, which bear primary responsibility for protecting their employees, to develop proactive plans that increase public support and personal safety when a researcher faces violence or threat from animal rights activists or any other source.

### Guided by Values

Our efforts reflect SfN’s understanding that the needs of members will continually evolve; that we must consistently work to ensure a diversity of discipline, gender, race, ethnicity, and age throughout our ranks; and that iterative planning is essential to successful leadership and Society growth. Two additional values underscore the interwoven nature of today’s research and tomorrow’s potential: the use of technology and our collective responsibility to the environment.

As you will see in the coming pages, the Society has played a convening and guiding role as the field of neuroscience moves to deploy new computing and technology applications that can collect and analyze the staggering amount of scientific data now available. Yet new technology is also learning from neuroscience — the next generation of computer memory may be informed by a growing understanding of brain function. In the face of near scientific unanimity on global warming, increasing environmental sustainability is no longer a choice and must be a global priority for individuals, corporations, and organizations. The Society will remain a leader among scientific and nonprofit societies in leading change and this year’s report highlights a growing body of research about the impact of the environment on brains and behavior.

### A Core Strength: Neuroscience Pioneers

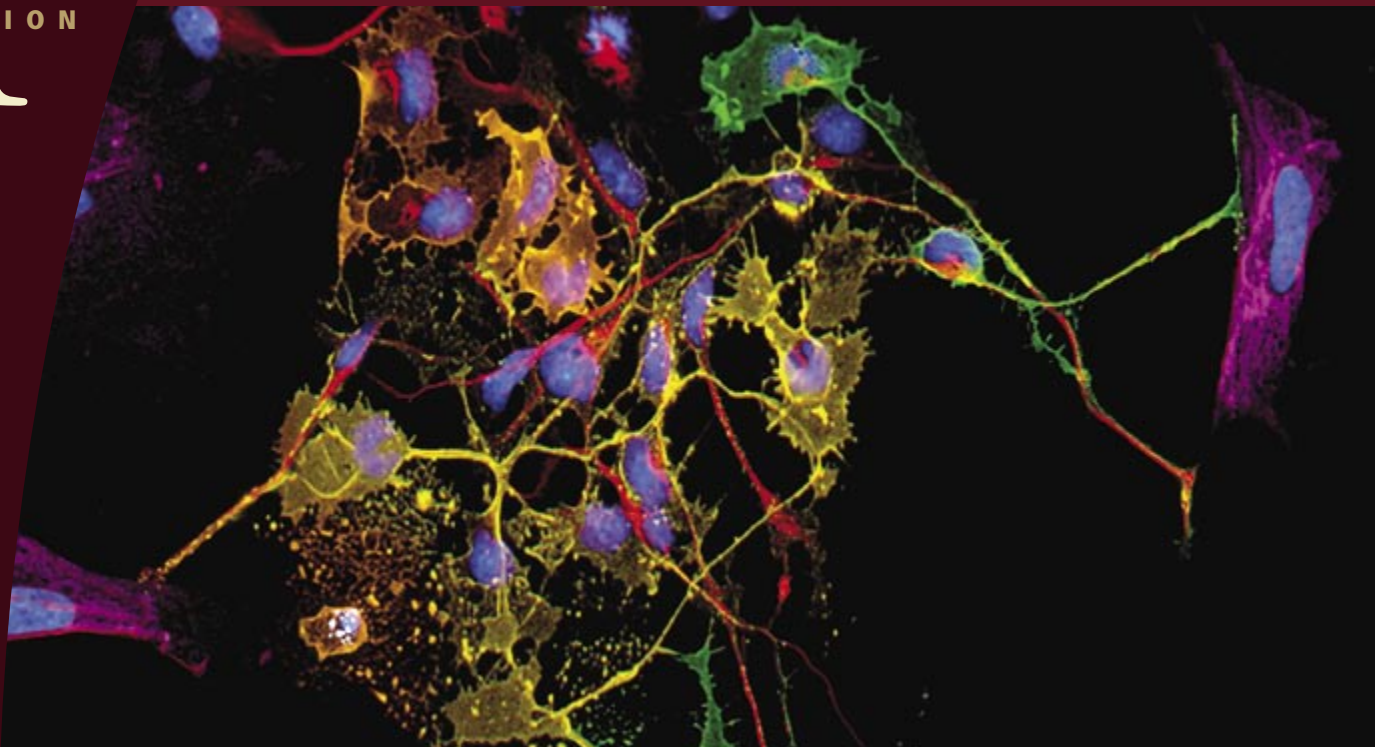
The SfN Council views an ever-changing membership composition and enduring values as core strengths on which SfN’s future will be built. Another pillar is the contributions of neuroscience pioneers and past leaders. As the Society prepares to celebrate its 40th anniversary in 2009, Council is finding new ways to continue to honor the formation of the field. SfN will post on its Web site reflections by past presidents on their years as leaders and the challenges the Society faced during their tenure. Many challenges will likely sound familiar, some humorous, and perhaps, some portentous, as the Society worked to anticipate, and shape, the future we inhabit today.

Since its founding in 1969, SfN has grown beyond all expectations to more than 38,000 members last year. Throughout the Society’s history, fundamental tenets have remained the same: we should be useful to members wherever they live and work, and we earn trust one member at a time. It has been an honor to serve as president this year, and to make my personal contributions to keeping great science at the heart of this wonderful Society as we plot a course to future discovery that advances science and education, and helps to improve the health and welfare of people everywhere.

Sincerely,

Eve Marder, President

*Our efforts reflect SfN’s understanding that the needs of members will continually evolve; that we must consistently work to ensure a diversity of discipline, gender, race, ethnicity, and age throughout our ranks; and that iterative planning is essential to successful leadership and Society growth.*



# Creating Venues for Great Science

Neuroscientists share a powerful drive to uncover the deep mysteries of how the brain works. Their research happens in real time, every day, in laboratories around the world. In such a dynamic and diverse field, SfN serves as a vital convener, creating venues to explore promising discoveries. In FY2008, the 37th annual meeting was the world's largest neuroscience forum and drew near record attendance, while *The Journal of Neuroscience* published emerging news and is helping to lead change in scientific publishing.

## Neuroscience 2007: *Attendance tops 32,000*

Neuroscience 2007 was the second largest of the Society's annual meetings, next in size to the 2005 meeting in Washington, DC and drew 32,186 attendees. The event, held November 3 – 7 in San Diego, drew a diverse group, reflecting the changing face of SfN membership. While the majority of attendees were U.S. residents, nearly one-third resided outside the United States. More than 16,300 abstracts were presented during the five-day conference, while participants chose among 11 featured lectures, 13 special lectures, 24 symposia, and 22 minisymposia.

Many topics presented at the conference drew press coverage and scientific interest, including research on the teenage brain, a robot guided by a moth brain, and neural prosthetics. Other topics attracting news coverage included the roots of aggression, mirror neurons, and the role of neurogenesis in depression.

The meeting's guest speakers were high-profile as well. In the opening lecture, **Jeff Hawkins**, developer of the PalmPilot and Treo Smart Phone and founder of the Redwood Neuroscience Institute, discussed the way biologically inspired principles influence digital computing. The talk was part of "Dialogues between Neuroscience and Society," a series of annual lectures. **Andy Grove**, the former CEO of Intel Corporation, who has emerged as an advocate for accelerating the pace of biomedical research, presented a provocative discussion of new approaches for federal research funding to a standing-room-only crowd. He advocated for disease-specific research efforts massive in scale and highly integrated, similar to those in the systems engineering field. Grove also suggested creating an "X01" grant class with a mission determined by the NIH director and funding in the billions of dollars.

**Newt Gingrich**, former Speaker of the U.S. House of Representatives, shared his ideas and arguments in support of research that resonate with U.S.



One of the most trafficked areas at the annual meeting is the poster floor, where members present the latest neuroscience research findings. The floor buzzes as researchers share ideas and information.



policy-makers and expressed his views in support of increased research funding. He urged audience members to remember the responsibilities entrusted to their profession and act as “citizen-scientists” by contacting elected officials and educating them.

The **Presidential Special Lectures** illustrated how leading neuroscientists advance the field using new technologies. Karel Svoboda of Janelia Farm Research Center/Howard Hughes Medical Institute (HHMI) presented highlights of imaging synapses

in the last decade and discussed emerging advances. H. Sebastian Seung of the Massachusetts Institute of Technology/HHMI discussed the impact of new data-gathering methods on the science of neural networks. Mark H. Ellisman of the University of California, San Diego highlighted current accomplishments in human and model studies

as starting an SfN chapter, preparing a successful annual meeting symposium proposal, obtaining NIH and NSF funding, teaching neuroscience, and pursuing a neuroscience-based career path. The popular **Brain Awareness Campaign Event** featured Richard Morris, then president of the Federation of European Neuroscience Societies, who noted the exponential growth of Brain Awareness Week (BAW) activity throughout Europe. At Neuroscience 2008 in Washington, DC, the Brain Awareness event will examine the future of the Brain Awareness campaign as we approach its 15th anniversary. Plus, for Neuroscience 2008, education will continue to be a priority, given the expansion and renaming of Theme H. Now titled “History, Teaching, Public Awareness, and Societal Impacts in Neuroscience,” Theme H will entail presentations of history, teaching, public awareness, and ethical and policy issues.

The meeting continues to maintain a sterling reputation among tradeshows. In 2007, the meeting was ranked by scientists and exhibitors as having one of the best exhibit halls, as reported by BioInformatics, LLC, a research and advisory firm offering trade show exhibition strategies in the life science market. The meeting was also ranked fifth in *EXPO* magazine’s “Top 25 Medical Shows.”

To meet evolving needs as the event grows, the Society is making several organizational changes. During FY2008, SfN took in-house responsibility for managing hundreds of exhibitors showcasing biomedical products, equipment, and services. In addition, the Society’s annual meeting program and logistics departments have been integrated to streamline meeting planning and execution into one division.

SfN will continue moving forward with positive changes to help the annual meeting maintain the highest quality and expand in size, scope, and diversity. The Society’s goal is to have the annual meeting remain an internationally renowned arena for presenting and discussing the groundbreaking neuroscience research that drives the field.

**LEARN MORE:**  
[www.sfn.org/am2008](http://www.sfn.org/am2008)

*The meeting was also ranked fifth in EXPO magazine’s “Top 25 Medical Shows.”*

and illustrated what future neuroscientists might expect from neuroinformatics. Heidi Johansen-Berg of the University of Oxford described new imaging techniques used to estimate paths of connections in the brain.

The conference offered attendees a wealth of professional development and networking opportunities. As part of the “**Meet-the-Expert**” series, seasoned researchers described their techniques and accomplishments while sharing tips with attendees. Two **short courses** enabled attendees to explore strategies for phenotyping rodent behavior, and applications and limitations of inhibitory RNAs mediating gene silencing. The **Neurobiology of Disease Workshop** focused on sleep and related disorders, while a roundtable discussion moderated by SfN Past President David Van Essen explored **New Directions in Data Mining** and examined synergies between databases and online journal publications. A **professional skills workshop** spanned two days and covered a range of topics, including career development, graduate school admission, selecting postdoctoral positions, and writing grants. Other workshops covered topics such

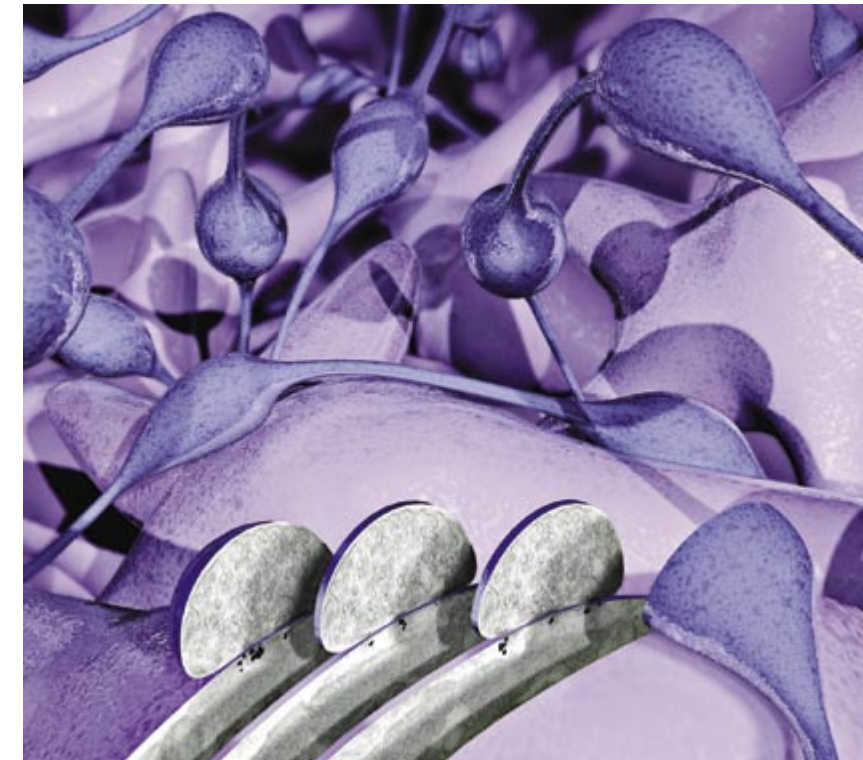
# THE Journal OF Neuroscience: *Reporting science and shaping publishing*

For *The Journal of Neuroscience*, FY2008 marked a year of accomplishment and transition. *The Journal* remained a leading source for emerging news, welcomed a new editor-in-chief, and began a series of initiatives to prepare for future scientific and publishing opportunities.

John Maunsell, professor of neurobiology at Harvard Medical School and an HHMI Investigator, was named *The Journal’s* seventh editor-in-chief and succeeded Gary Westbrook. After eight years as a reviewing and senior editor of *The Journal*, Maunsell started his five-year term on Jan. 1, 2008. He has guided *The Journal* through a number of initiatives designed to keep it on the leading edge of scientific publishing: the launch of a new manuscript submission and peer review system, and enhanced access to online research data and scientific information.

Improving access to data was discussed at a well-attended Neuroscience 2007 roundtable, “New Directions in Data Mining: Synergistic Enhancements of Online Journals and Databases,” which built on the PubMed Plus conference held in June 2007. One major initiative discussed was the launch of a “cascading review” system, a process for expedited manuscript evaluation that can be initiated at the author’s request. As a result, *The Journal* partnered with nine other neuroscience journals to form the **Neuroscience Peer Review Consortium**, which began its one-year trial period on Jan. 1, 2008. Its goals are to support efficient and thorough peer review in neuroscience, speed the publication of research reports, and reduce the burden on peer reviewers. If successful, it may be extended indefinitely. Thirty-seven journals have joined the Consortium, and more are in the process of joining.

The San Diego roundtable also focused on opportunities to help neuroscientists obtain more efficient access to the vast amounts of information available in online journal articles and in various



Scientific images help convey the beauty and mystery of the brain. An example of a scientific image used on the cover of a 2007 issue of *The Journal*, showing a three-dimensional reconstruction of a hippocampal synapse.

neuroscience-related databases. One set of recommendations involves improving the collection and organization of **metadata** — key words such as scientific terms or topics that describe study content — that would allow for more accurate online searches and data retrieval. SfN’s Neuroinformatics Committee has been focusing on an experiment with *The Journal of Neuroscience* to determine what metadata should be collected to facilitate improved data mining: when and how to collect and store data are among the issues. Metadata has been harvested from approximately 100 articles published in 2007, and queries are being developed to test the collected metadata. The results will be compared to regular Medline searches.

*An expansion of public access took effect in January 2008 for articles in The Journal, which gives authors the option of paying an additional fee to make their published papers freely available online upon publication.*

An expansion of **public access** took effect in January 2008 for articles in *The Journal*, which gives authors the option of paying an additional fee to make their published papers freely available online upon publication. The SfN Council approved the *Open Choice* option in November 2007 in response to the dramatic transformation that scientific publishing is undergoing due to technological changes. SfN joins a growing number of publishers offering an open choice option for authors; results of a June 2006 author survey played a role in the Society’s decision to launch the Open Choice experiment. In the survey, half of the respondents said they would, in principle, support SfN adopting an open access business model, but authors offered conflicting responses about how much they would be willing to pay.

A provision in the federal fiscal year 2008 omnibus appropriations bill, which President Bush signed in late December, requires that all NIH-funded investigators submit electronic copies of their peer-reviewed manuscripts to the National Library of Medicine’s PubMed Central. As a service to authors, *The Journal of Neuroscience* deposits in

PubMed Central final versions of manuscripts that describe work funded by the NIH, HHMI, and the Wellcome Trust, and which are accepted for publication in *The Journal* on or after April 7, 2008.

*The Journal* has also been working to improve its technology platform. A **new manuscript submission and tracking system**, eJournal Press, was launched in FY2008. In February, *The Journal* launched its **redesigned Web site**, which will continue to offer its readers the complete line of online features such as CITE-TRACK, eLetters, and collected papers, as well as links to cited articles through CrossRef.

**Submissions** of manuscripts continue to rise in 2008. *The Journal* is projecting 5,860 submissions for calendar year (CY) 2008. This is a projected

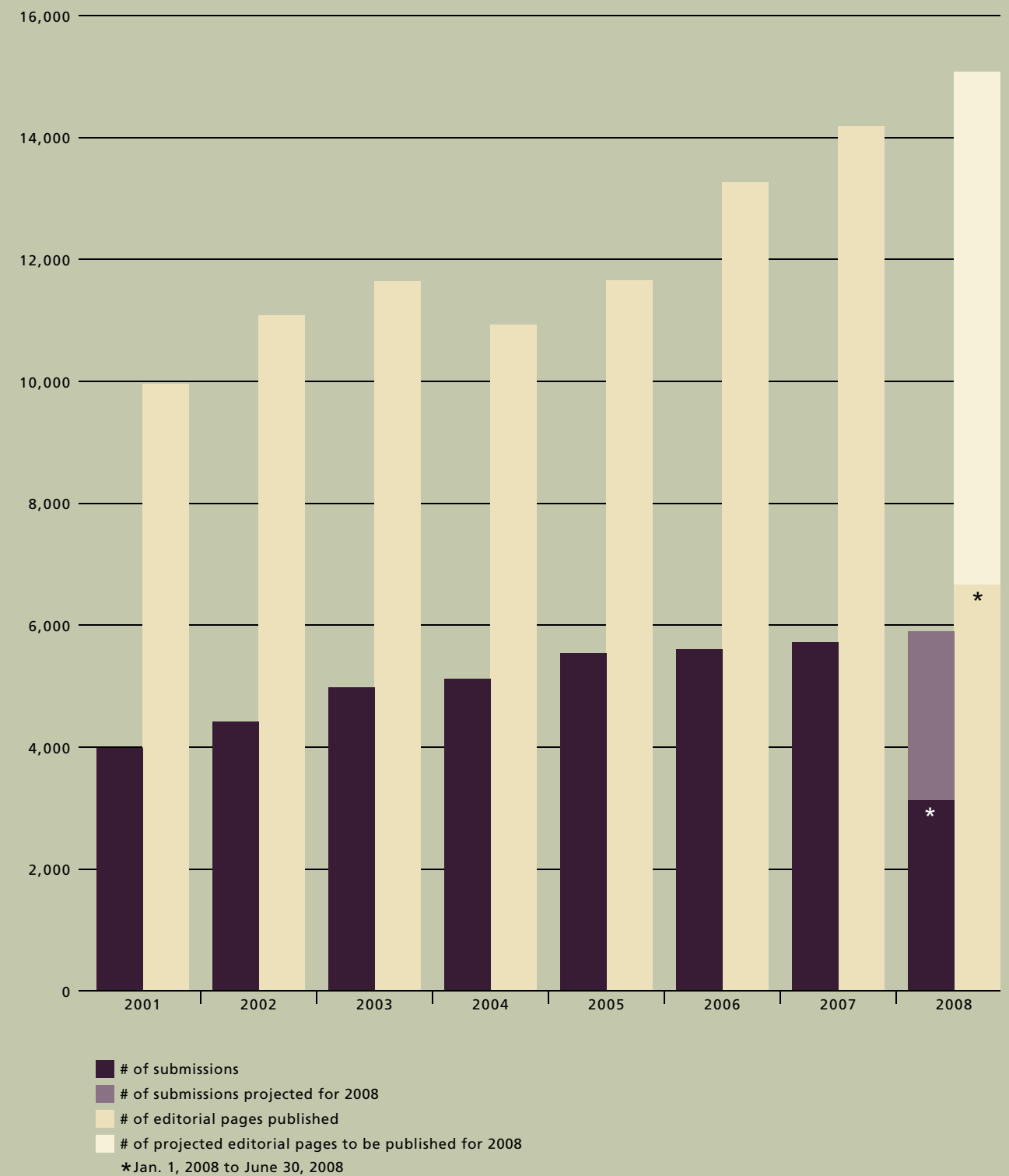
increase of two percent over CY2007. New submissions in CY2007 totaled 5,722.

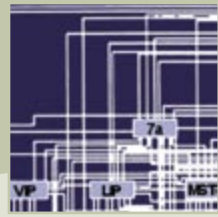
**Acceptance rates** have remained stable. The acceptance rate during CY2008 is 14 percent for Brief Communications and 19 percent for Regular Manuscripts. Time to first decision for manuscripts is approximately 33 days for both Brief Communications and Regular Manuscripts. The production time from acceptance to publication has dropped to 22 working days.

**Institutional subscription** units are projected to increase by approximately one percent over CY2007. CY2007 subscription units totaled 1,087 and we are anticipating subscription units to exceed 1,100 by the end of CY2008. Multi-site subscriptions account for the increase in overall subscribers. These multi-site units more than doubled in CY2008 to 95. An example of a multi-site subscription is a university subscribing at three different campuses.

[www.sfn.org/journal](http://www.sfn.org/journal)

**FIGURE 1** Manuscript Submissions and Editorial Pages Published by Calendar Year





# Neuroscience: Informing the next generation of computers

Technology is a key driving force for progress in neuroscience — from advanced computing to high resolution microscopes. For example, from very thin brain sections, researchers are able to reconstruct the way actual neurons connect to each other and computers can display the data in ways that increase scientific knowledge about brain function.

How are neuroscientists returning the favor? Scientific findings about the brain are indeed informing advances in technology, notably in efforts to enhance the power and performance of intelligent computers.

Leading computer entrepreneurs are now working to integrate concepts of *neural computation* into the development of the next generation of computers. Neural computation studies how neurons in the brain transfer and process information. This broad field of study includes an effort to understand the hierarchical structure of the human neocortex, the region of the brain that is involved in complex processes like memory storage and decision-making. If a computer were able to mimic the incredibly sophisticated memory storage and retrieval system of the human brain, yet do so at a much faster rate, computer technology could be faster, more efficient, and more

intuitive, while also potentially being trained to conduct analysis based on learning and prediction.

At Neuroscience 2007, Jeff Hawkins, the architect of the PalmPilot mobile technology tool, tackled this very question when he delivered the third lecture in the “Dialogues between Neuroscience and Society” series, entitled “Why Can’t a Computer Be More Like a Brain?” Hawkins, long interested in neuroscience and also a founder of the Redwood Neuroscience Institute, discussed the past and future of computing, particularly how biologically inspired principles could drive a range of advances in the coming decade.

Hawkins discusses the possibility of building intelligent machines and what one might look like in the last chapter of his book, *On Intelligence*: “What makes it intelligent is that it can understand and interact with its world via a hierarchical memory model and can think about its world in a way analogous to how you think and I think about our world,” he writes. “Its thoughts and actions might be completely different from anything a human does; yet it still will be intelligent.”

Hawkins came to the topic based on a longtime interest in neuroscience. Following a degree in electrical engineering, he initially pursued an academic path of studying neuroscience. But other interests beckoned and, in 1992,

Hawkins was a co-founder of Palm Computing, eventually bringing to market the PalmPilot and Treo smartphone, which have been leaders in mobile technology for their intuitive ease of use.

In March 2005, Hawkins and Palm co-founder Donna Dubinsky founded Numenta, Inc., along with Stanford graduate student Dileep George, to develop a new type of computer memory system based, in part, on brain function. Specifically, Numenta’s concept for Hierarchical Temporal Memory (HTM) technology is modeled after the structure and function of the neocortex, and Numenta believes HTM “offers the promise of building machines that approach or exceed human level performance for many cognitive tasks.”

Using a method called “machine learning,” HTM systems literally “learn” to recognize patterns through observation. One aim is to develop a vision system that can reliably recognize faces, or technology that can recognize dangerous traffic situations.

The development of the HTM technology by Hawkins and colleagues entails applying this memory model to develop computers that are “trained” to recognize objects despite differences in size, position, and viewing angle. Such computers would be capable of executing four “basic functions”:

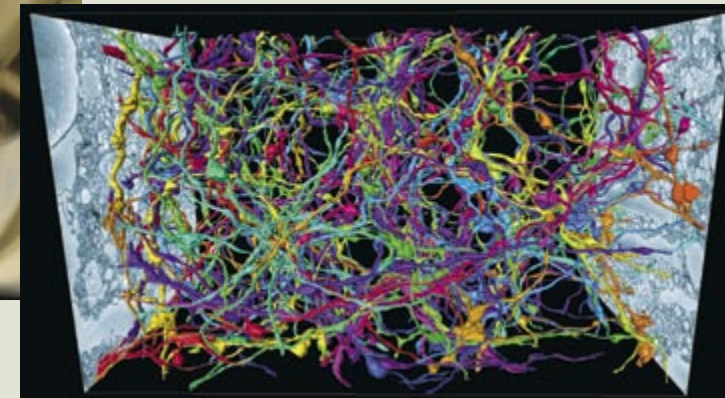
- 1) discovering causes in the world;
  - 2) inferring causes of novel input;
  - 3) making predictions; and 4) directing behavior.
- Numenta believes this kind of innovation would bring computers closer to being able to process problems previously thought to be exceedingly difficult, if not impossible, for machines to solve.

At the SfN lecture, Hawkins discussed efforts to develop hierarchical memory systems that capitalize on our understanding of maps of the mammalian neocortex. Research has revealed that the cerebral cortex in primates is organized as a “distributed hierarchical system” containing as many as ten distinct processing levels just within the visual system.

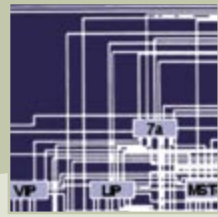
The potential that scientists anticipate for this emerging computer technology spans many areas — from the monitoring of data centers, to building a “smart car,” to online tracking of consumer behavior, to medical research and disease models for developing successful treatment approaches (for example, drug regimens).

A computer that can find abnormalities and process information based on pattern recognition and machine learning could yield significant findings and outcomes. For instance, Web and technology businesses, which store immense amounts of data using huge energy-consuming data centers, are seeking more efficient operations. Intelligent machines could reduce

Three-dimensional computer-generated images show intricate patterns of connections between neurons that “wire” the brain. These wiring patterns shed new light on how the brain processes information.



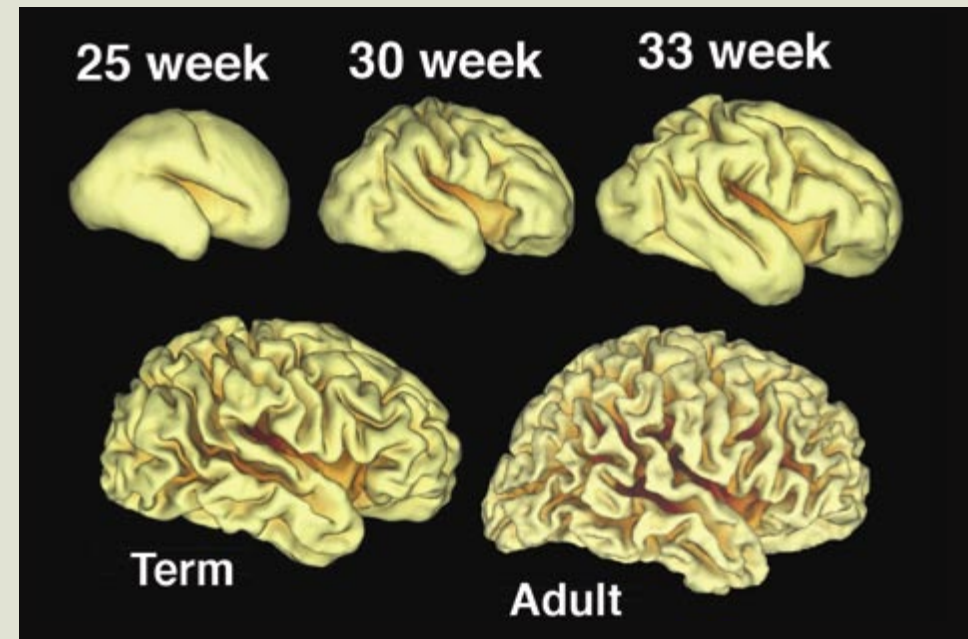
Computer entrepreneur Jeff Hawkins delivering the “Dialogues between Neuroscience and Society” lecture at Neuroscience 2007.



# Brain Atlases and “Cortical Cartography”

Intrepid explorers of the 16th century, like Vespucci and Magellan, helped navigate the earth. Their new-found knowledge traveled home with them in the form of maps — static, two-dimensional representations of their fragmentary knowledge about the earth’s surface. Today, maps are informed by satellite imagery and computer technology that offer extraordinarily detailed overlays of many types of information. Like map makers of old, today’s neuroscientists face the challenge of representing new discoveries and mapping detailed physical structures. Using rapidly evolving technologies, “brain atlases” enable progressively more accurate charting of this promising new territory.

In the past five years, several brain atlas projects have shed new light on brain function, knowledge that may one day contribute to improved treatment of many brain diseases. Bolstered by the publication of the human and mouse genomes, several research groups developed brain atlases that locate thousands of genes in the adult and developing nervous system. Other research groups developed brain atlases that reveal normal brain structure in increasingly intricate detail. Researchers at Washington University in St. Louis,



↑ Scientists are gaining a better understanding about brain development from scans of cortical surfaces of premature infants (shown at several gestational ages), full-term infants, and adults.

including SfN Past President David Van Essen, developed one such atlas that may soon illuminate how disease and premature birth affect normal brain development.

This research on mapping the cerebral cortex, the highly convoluted tissue on the surface of the brain, has been referred to as “cortical cartography.” To help visualize the surface of the cerebral cortex, the surface maps show the depth and height of folds in the brain — akin to topographical land maps. Because

cortical folding patterns vary from person to person, these researchers have generated “population-average” atlases of the cortical surface by aggregating maps from brain scans of many individuals.

By comparing individual brain structure to the population average, scientists are identifying how cortical structure differs among people and how it may be disrupted by disease. Ongoing

research is testing for cortical differences between men and women and exploring the impact of aging on the brain. Using these same techniques, researchers have also identified cortical folding abnormalities in people with autism, schizophrenia, and Williams syndrome, all considered to be neurodevelopmental disorders. In this way, surface-based brain atlases may become important tools for medical science.

New brain atlas projects may also improve diagnoses for preterm infants at risk of developing neurological problems. While the improved survival of very preterm infants (born before 30 weeks of gestation) is a tremendous research and medical accomplishment, it comes with challenges. Many of these children develop cerebral palsy, and 30-60 percent experience cognitive impairments, including learning disabilities, visual-motor problems, impaired memory, and attentional deficits. In addition, premature infants are at increased risk for developmental disorders such as attention-deficit hyperactivity disorder, autism, and schizophrenia.

How does brain development in the womb differ from brain development in the neonatal intensive care unit of a hospital? Neuroscientists are generating brain atlases of preterm infants at several key time points in early development. By imaging over one hundred children, each several times over the course of several years, these researchers will literally be able to construct movies of individual brain development. They have already identified

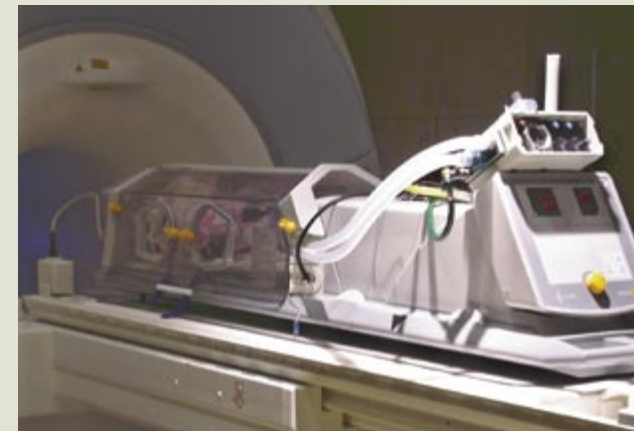
structural differences between brains of newborn babies born at full term (40 weeks) and brains of preterm infants imaged at their scheduled due date.

These researchers are chronicling not just brain development, but medical and behavioral outcomes in the very preterm population. By comparing cortical folding patterns in preterm infants with neurological, behavioral, and psychiatric challenges to those of infants who develop normally, the researchers hope to identify brain signatures of disease. These biomarkers may help diagnose at-risk children before complications arise, when early intervention may prevent or reduce the severity of disease.

In addition to their medical applications, brain atlases aid scientific discovery in the broader neuroscience community. Different laboratories use a variety of procedures to acquire, analyze, and represent neuroimaging data. This often creates a problem, with different data sets speaking different “languages.” The problem is reduced when researchers plot their data on the same maps — effectively translating them to the same language. In this way, data collected by different researchers can be directly compared, and data collected by one researcher can be shared and searched by others, stretching research dollars and helping prompt new collaborations.

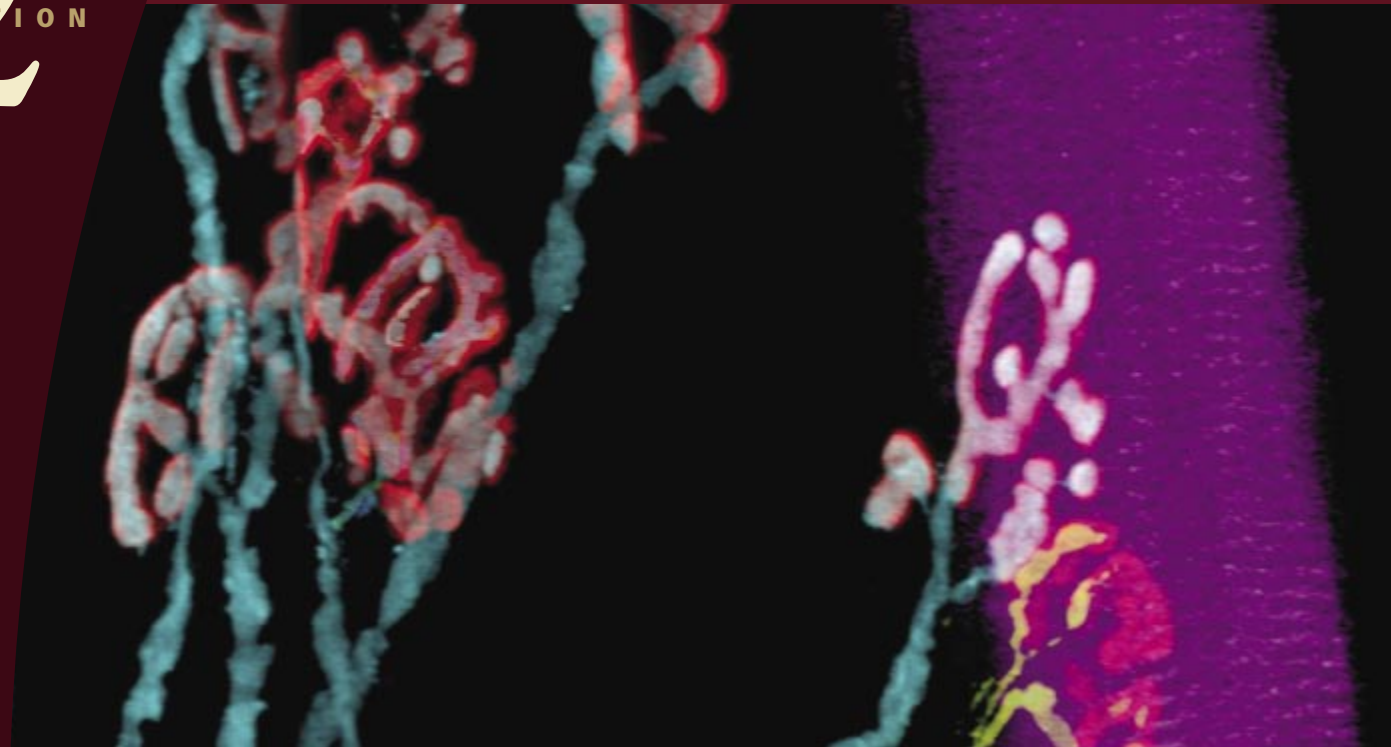
Multiple technical advances were necessary to generate the new structural brain atlases. A growing arsenal of neuroimaging tools, particularly structural magnetic resonance imaging (MRI), allow the visualization of brain anatomy with

↓ Technology like the MRI is driving discovery. Here, a premature infant, secure in its hospital incubator, is about to have a brain scan.



increased resolution. Within the last decade, engineers and mathematicians have devised mathematical formulas (algorithms) to extract the shape of the brain from structural MRI images. Through computational advances, these structural data sets can be combined into a single atlas. Advances in bioinformatics allow all of these data sets to be stored, managed, and navigated in a searchable and freely accessible resource.

From detailed maps of the cortex to improved medical treatment for premies, brain atlases are impacting scientific discovery and medical intervention. Like Vespucci’s maps, these new atlases communicate our current depth of knowledge — how much we are learning — and yet also further illustrate just how much there is left to discover.



# Supporting *the* Neuroscience Community

SfN programs facilitate the growth of the neuroscience community and individual scientists. In today's global context, there are new opportunities to strengthen connections across a diverse field — and challenges to doing so effectively. In FY2008, SfN made a strategic effort to learn more about the needs of its changing community, one that is younger, more international, and interested in getting engaged locally, nationally, and internationally. This information is now driving planning and action for the future.

## Membership: *Growing and changing*

The field of neuroscience and SfN, the profession's largest membership association, continue to grow — even at a time of significant external pressure on the scientific community. SfN membership reached a **record high** of 38,677 at the end of 2007 and remained strong as of summer 2008.

During the year, the Society focused efforts on analyzing and developing strategies to meet changing member needs. Enhancing the member experience was one of several goals identified in the Society's revised strategic plan, adopted in 2006. SfN launched a **comprehensive electronic survey** in June 2007 to help identify member demographics and needs. A total of 9,290 members participated — an impressive survey response rate of 27 percent that demonstrates a strong commitment to helping SfN strengthen its role as a membership organization.

The information gathered provided a quantifiable overview of member composition and satisfaction. Results revealed a diverse membership with evolving, dynamic needs. In the coming months and years, SfN will use this information to craft a membership enhancement plan targeting member engagement and communication, as well as expanded programming and services.

The survey results reflected what has been a gradual but dramatic shift in **membership composition**. The Society is increasingly drawing new and younger members. Over the last six years, student membership increased 93 percent to comprise 26 percent of SfN's membership in 2007. Among survey respondents, 45 percent were 35 years old or younger.

SfN has already taken steps to accommodate this demographic shift and encourage and facilitate participation of younger members, who are especially hard-hit by the current research funding climate. The Society created and highlighted new resources for student attendees at the annual meeting. The online roommate matching service, featured for the first time at Neuroscience 2007, was a small but suc-

cessful experiment and will continue for the 2008 annual meeting in Washington, DC. More significantly, SfN leadership approved the creation of new membership dues and annual meeting registration fee categories for postdoctoral trainees. The reduced dues and fees go into effect in 2009.

As SfN increasingly reaches younger members, embracing new communication methods is imperative. For this reason, the Society is exploring Web-based communication strategies and services. SfN's **Membership and Chapters Committee** has been spearheading discussions about the potential uses of Web technologies such as social networking forums,



Attendees at Neuroscience 2007. At a time of significant external pressure on the scientific community, SfN continues to grow. Membership reached a record high of 38,677 at the end of 2007 and remained strong as of summer 2008.

*SfN will use this information to craft a membership enhancement plan targeting member engagement and communication, as well as expanded programming and services.*

podcasts, and blogs to serve the professional needs of its members. As SfN explores these and other Web communication strategies, members can expect more improvement on this front in the future.

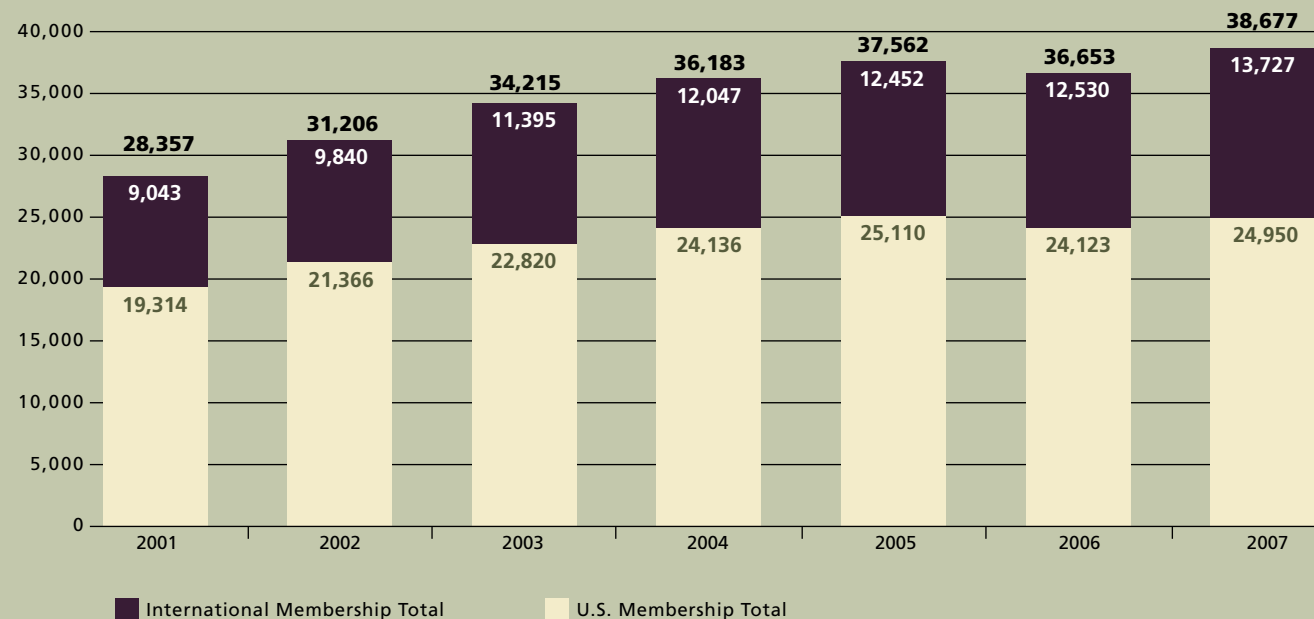
In addition to younger members, the Society's **international member base** continues to grow with international membership statistics climbing more than any other segment. Between 2001 and 2007, regular international membership grew by 39 percent and international student membership outside North America grew by a considerable 117 percent. Today, 29 percent of members live outside North America and 36 percent outside of the United States.

Given the increasingly global nature of neuroscience, the Society must work to better meet the needs of its growing international membership. This imperative is affirmed by the finding that 70 percent of non-U.S. members surveyed cited SfN as their primary membership organization, very close to the portion (76 percent) of U.S. respondents to the same question. SfN continues to strengthen **international partnerships** including with the Federation of European Neuroscience Societies (FENS) and International Brain Research Organization (IBRO), among others, to explore ways to expand collaborative initiatives that will help us achieve our common goals.

Over the coming fiscal year, SfN Council, committees, and staff will continue to analyze the survey findings and develop a broad-based, multi-year membership enhancement plan that seeks to build on the already high 93 percent membership satisfaction level found among survey respondents.

[www.sfn.org/membership](http://www.sfn.org/membership)

**FIGURE 2** Membership Growth



# Chapters: Expanding engagement and reach

Chapter expansion and member engagement at the local level continues to grow, and reflects the needs and desires reported in SfN's membership survey. As of mid-2008, the Society had **129 established and pending chapters in 45 of the United States and 15 other countries**, with international chapters growing at a fast pace. This broad network of local and regional chapters is vital to enabling increased member participation.

The Society's membership base is already actively engaged in promoting the cause of neuroscience, as revealed in the survey. Roughly 30 percent of survey respondents have participated in community or media outreach focused on neuroscience or related areas at the state or local community level within the past two years. Outreach activities include events such as a lab open house and lectures for the general public, classroom presentations for K-12 students, and speeches at teacher workshops, contact with the media, and legislative advocacy.

While member participation is relatively strong, nearly 60 percent of survey respondents expressed interest in becoming further involved. Younger members, in particular, are motivated to find meaningful ways to become more engaged with SfN.

One way the Society is hoping to meet the desire for greater participation is by increasing and strengthening the role of SfN chapters and creating stronger local affiliations. Current SfN programs for chapters include grants for a variety of professional development and outreach activities. In FY2008, SfN funded a total of 30 grants, which enabled

**FIGURE 3** Chapters

<b>NORTH AMERICA</b>		<b>114</b>
Canada		11
Mexico		2
United States		100
Puerto Rico		1
<b>EUROPE</b>		<b>5</b>
Denmark	Aarhus	1
Switzerland	Swiss Alpine	1
Turkey	(Izmir)	1
Ukraine	Kiev	1
United Kingdom	London	1
<b>ASIA &amp; THE PACIFIC</b>		<b>7</b>
Australia	Brisbane and Melbourne	2
China	Shanghai	1
India	Bangalore	1
Pending		3
<b>LATIN AMERICA &amp; THE CARIBBEAN</b>		<b>2</b>
Chile	(Santiago)	1
Pending		1
<b>AFRICA</b>		<b>1</b>
Pending		1
<b>TOTAL</b>		<b>129</b>

## SfN Members' Interest in Engagement

### Interest in getting involved

**58 percent** responded that they are interested in getting more involved in SfN.

**70 percent** agreed or strongly agreed with the following statement: "SfN should find ways to enable and encourage more members to participate directly in the Society's educational, advocacy, and policymaking activities."

### Ways of getting involved

In what ways would you be interested in getting involved in SfN?

- Public education and outreach to schools (K-12): **50 percent**
- Local advocacy efforts: **37 percent**
- Participate in SfN leadership (i.e., Council, committees, etc.): **37 percent**
- Local media relations: **31 percent**
- Participate in mentorship program as a mentor: **26 percent**

### Potential for engagement/room for greater involvement through chapters

**19 percent** are currently a member of an SfN chapter.

Of those who are chapter members, **70 percent** are satisfied or very satisfied with their chapter but **34 percent** of chapter members currently are not involved at all in their local chapters.

Source: SfN 2007 Membership Survey



Top: An SfN chapter's educational program in Eskisehir, Turkey. Bottom: The participation of committee and chapter members in advocacy, including Capitol Hill Day visits (above), is part of the Society's expanding outreach and member engagement efforts.

*One way the Society is hoping to meet the desire for greater participation is by increasing and strengthening the role of SfN chapters and creating stronger local affiliations.*

chapters to organize visiting lectures by eminent neuroscientists at campuses across North America and in Australia through the **Grass Traveling Scientist Program**, supported by The Grass Foundation.

**Direct grants to SfN chapters** enabled 29 different chapters to engage in a wide range of innovative activities including the Turkey Chapter's "Brain and Behavior in Artistic Cinema" movie series and discussions involving neuroscientists, cinematographers, students, and public guests. The Kingston Chapter in Ontario used its grant funds to support a student-initiated community outreach program on mental health and aging and rehabilitation. SfN leadership has committed to a 60 percent increase in chapter grant funding starting in FY2009, including provision of seed money to help new chapters get off to a strong start.

The vital role of chapters in fostering public outreach and education about neuroscience was given added recognition with the newly created **Next Generation Awards**. Presented for the first time at Neuroscience 2007, the awards recognize exceptional outreach efforts by chapter members while promoting engagement in educational outreach by young neuroscientists.

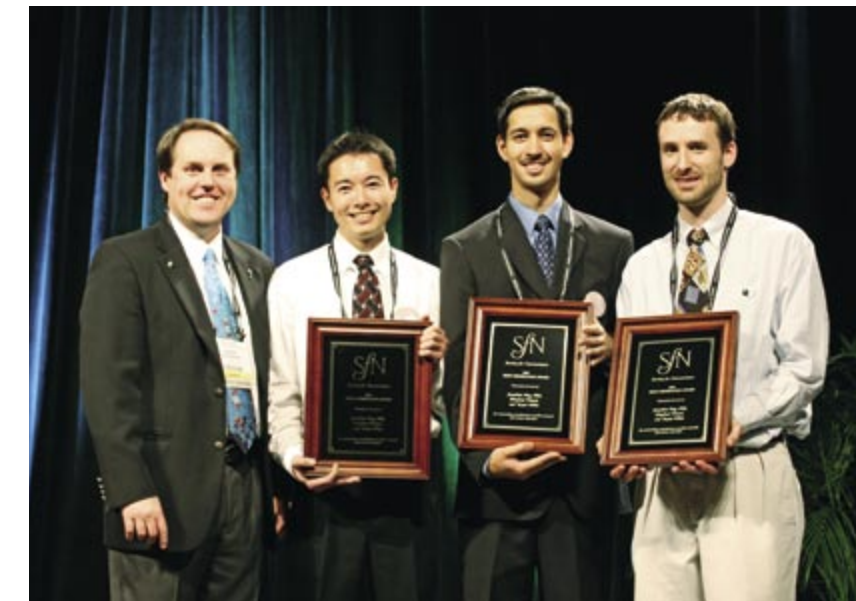
Another new effort to increase focus on and support for chapters was the **Chapters Workshop** at the 2007 annual meeting. Organized and led by the Membership and Chapters Committee, the workshop provided information, resources, and networking opportunities to enable participants to start or revive a chapter and to successfully apply for funding from SfN. The focus of the workshop at Neuroscience 2008 will be on expanding the role of international chapters, a growing component of the chapter and membership base.

Due to the interest in chapter expansion and the success of the 2007 workshop, seven chapters became reactivated and eight new chapters were established in FY2008, including the first SfN chapter in the state of Nevada and a second in Oklahoma.

The rapid growth of international membership was reflected in six of the new chapters being outside the U.S. — in **China (Shanghai)**, **Denmark (Aarhus)**, **India (Bangalore)**, **Switzerland (Swiss Alpine)**, **Ukraine (Kiev)**, and a second chapter in **Mexico (Southeastern)**.

With strong chapters worldwide and increasingly engaged members, SfN will continue to develop strategies to ensure coverage of important initiatives and programs at the local level.

**LEARN MORE:**  
[www.sfn.org/chapters](http://www.sfn.org/chapters)



2007 ushered in the first annual Next Generation Awards to recognize educational outreach by young neuroscientists. Selected through chapters, two awards were presented at Neuroscience 2007, including one to a team at the pre/postdoctoral level.

# Professional Development: Supporting all neuroscientists



↑ Neuroscientists at all stages of their careers benefit from SfN's professional development activities: programs at the annual meeting and elsewhere, fellowships and award opportunities, mentoring programs for women, men, and minorities, and an online career center.

The Society is committed to promoting professional achievement for all its members. As the needs of a changing membership base came into sharper focus in FY2008, SfN is actively developing new ways to better serve members' professional development interests.

In the past year, external funding allowed the Society to establish and administer several major new awards recognizing the work of neuroscientists. An endowment from the Eli Lilly and Company Foundation created the **Julius Axelrod Prize** for distinguished achievements in neuropharmacology and mentoring, and funding from the Astellas USA Foundation established the **SfN Research Awards for Innovation in Neuroscience**. Both new awards were presented at Neuroscience 2007.

The latest addition is the **Swartz Prize for Theoretical and Computational Neuroscience**, funded by the Swartz Foundation. The award will be presented for the first time at Neuroscience 2008 and recognizes achievement in neuroscience theoretical models or computational methods. The Waletzky prize was fully endowed in early FY2008, enabling the Society to continue to recognize research in the area of substance abuse and the nervous system.

SfN member survey respondents placed a strong value on professional development opportunities and indicated a desire for expanded programs to meet their needs. High on the list of younger members is **mentoring**. At Neuroscience 2007, the Society's Committee on Women in Neuroscience (C-WIN) guided a program that paired experienced scientists, researchers, and clinicians with 200 students and early-career professionals — a 25 percent increase from the previous year. Together

with other committees comprising the Professional Development Cluster — the Committee on Diversity in Neuroscience (C-DIN) and the International Affairs Committee (IAC) — C-WIN is working to expand the effort by facilitating year-round mentoring beyond the annual meeting.

The Society is committed to enhancing diversity in neuroscience — gender, racial and ethnic, and geographic diversity. In FY2008, SfN continued its commitment to actively advocating for the role of women and minorities in neuroscience, and to serving international members.

**C-WIN's annual guest speaker luncheon**, featuring SfN President-Elect Eve Marder, showcased the accomplishments of women in neuroscience. In its second year, attendance increased to over 200 attendees at Neuroscience 2007. In a related effort, SfN began building a relationship with the Association for Women in Science and will seek to expand its strategic partnerships in the future.

The Society supported 42 diversity trainees during FY2008 under the **Neuroscience Scholars Program**, a three-year fellowship for minority neuroscience trainees. Funded by the National Institute of Neurological Disorders and Stroke (NINDS), SfN completed a survey of program participants since 1995 as part of preparations for a grant renewal proposal to NINDS in 2008.

Given the growth of international membership, expanding professional development opportunities for those members has become a central theme. SfN doubled to 30 the number of annual meeting travel grants awarded to young members from developing countries. Through its collaboration with IBRO and the National Academy of Sciences, SfN co-sponsored a **workshop** on neurodegenerative diseases for developing country students. The workshop was held in collaboration with the University of Melbourne just prior to the IBRO World Congress in July 2007. The Society also distributed nine travel awards to North American graduate students attending the IBRO World Congress.

As in past years, SfN organized the **Ricardo Miledi Neuroscience Training Program** for 15 Latin American and Caribbean neuroscience students. The Society was awarded, in FY2008, a four-year grant renewal by The Grass Foundation, the program's sponsor.



↑ **Top:** The 2008 Ricardo Miledi Neuroscience Training Program students at the Institute of Neurobiology-UNAM, Queretaro, Mexico.

**Bottom:** The Graduate Student Travel Awards, administered by the Committee on Women in Neuroscience, honor outstanding graduate students from around the world. The awards offset travel expenses to the Society's annual meeting.

□ **LEARN MORE:**  
[www.sfn.org/professional\\_development](http://www.sfn.org/professional_development)





# SfN Environmental Responsibility: Leading the greening of business practices

Environmental responsibility is an integral part of SfN's business decision-making, grounded in our strategic plan, and an everyday practice. SfN's commitment to a sustainable environment is part of a far-reaching goal to help promote change in ways that are environmentally, socially, and fiscally responsible wherever possible. In 2008, SfN expanded environmental efforts, was recognized by leading environmental management awards, and has begun being recognized in its own community as a visible advocate for improving sustainability.

At the August 2008 American Society of Association Executives (ASAE) & The Center for Association Leadership meeting, SfN led a presentation on "Embracing a Green Culture: Taking an Organization-Wide Approach To Reduce Your Environmental Footprint." The panel included three vendors with which SfN collaborates: Envision Design, Good Printers, and the San Diego Convention Center. A key message was the importance of forming strategic partnerships, such as with vendors, to accomplish goals. In making choices about office design and construction, printing methods and paper selections, and where and how to hold a convention, SfN is working

with its partners to make environmentally responsible choices.

Convening this panel reflects SfN's belief that the association sector can play a powerful role in advancing sustainable practices. Not only does eco-responsibility provide good stewardship for an individual association's members, together these organizations serve as an important channel for reaching millions around the globe with a consistent and repeated message about sustainability. SfN communications alone reaches more than 38,000 members, as well as thousands of school teachers, public policy officials, and the general public. In turn, ASAE has more than 22,000 members representing nearly 11,000 associations and other organizations that represent more than 287 million people and organizations worldwide. Imagine the opportunities to reinforce, in large and small ways, the benefits of "green" business practices.

This outreach builds on SfN's own consistent improvements in its environmental stewardship following the completion of its headquarters building in 2006. At the time, SfN's new office space was recognized as one of only five in the Washington, DC area to receive gold certification for environmentally responsible design by the U.S. Green Building

Council (GBC) Leadership in Energy and Environmental Design (LEED). It put SfN on the leading edge of "green" construction around the country, which is increasingly becoming the rule, rather than the exception. The environmental "savings" from green construction are monumental: 30-50 percent less energy consumption, 35 percent less carbon dioxide emissions, 40 percent less water, and 70 percent less solid waste.

During the past year, SfN was recognized for its environmental commitment. In July 2008, the headquarters building received the Environmental Protection Agency (EPA) Energy Star designation, marking superior performance and recognizing it as one of the most efficient buildings in the country. Envision Design and SfN also received the distinction of "Highly Commended" for promotion of sustainability in its office space, part of the Sustainable Leadership Awards for Design and Development. Envision Design was also awarded a Presidential Citation for Sustainable Design from the DC Chapter of the American Institute of Architects.

Finally, SfN received the Green Power Leadership Award for purchasing 100 percent wind power for the headquarters building, and



Gold Certification from U.S. Green Building Council. Having received LEED gold certification in fall 2006 for its new office space, SfN is applying for LEED Existing Building certification.

SfN headquarters building in Washington, DC. SfN is on the leading edge of "green" business practices in the association sector.

consumer waste, saving nearly 138 full-grown trees, 25,806 gallons of water, 6,791 pounds of solid waste, and 10,014 pounds of hazardous effluents per year.

For Neuroscience 2007, SfN hosted the meeting at the San Diego Convention Center, an environmentally conscious partner with an extensive "recycle, reduce and reuse" policy. Today the building recycles everything from used batteries to used cooking oil, the latter of which is converted into bio-diesel fuel. In 2007 alone, 24 percent of its total waste was diverted or 520 tons. Infrastructural improvements like low flow sinks and toilets have helped save an estimated 81,000 gallons of water per year. Presently, the convention center is in the process of conducting a solar energy analysis and once completed, anticipates the installation of rooftop panels in 2009 to help generate electricity.

SfN recognizes the value of large and small efforts that truly make a difference. By being mindful of the broader impact of its day-to-day practices, decisions, and actions the Society is setting a successful example within the association community about the key strategies that help reach green and sustainable business goals: organizational commitment, making green part of the culture, and forming strategic partnerships.

as a result was awarded membership to the 2007 Green Power Leadership Club, an elite group of U.S. EPA Green Power Partners. The EPA co-sponsors the Green Power program in conjunction with the U.S. Department of Energy and the Center for Resource Solutions to recognize the leading actions of organizations, programs, and individuals that significantly advance the development of green power sources.

Green efforts have been integrated into SfN daily operations. Filtered taps, along with automatic faucets and flush devices, help reduce the building's use of water by 22 percent. Desk lamps hold fluorescent bulbs. Kitchen paper

products are at least 25 percent recycled and plastic cups made from a U.S.-grown corn product that is 100 percent compostable and environmentally sustainable. Printer paper is manufactured from 100 percent farm-grown eucalyptus trees, which are rapidly renewing.

The Society's printing choices also make a difference. For instance, the Society strategically partners with printers certified by the Forest Stewardship Council, including Good Printers, ColorCraft, and Harris Lithographics of the Washington, DC area. In addition, *Neuroscience Quarterly*, SfN's quarterly newsletter, is printed with vegetable inks on a processed chlorine-free paper made with up to 100 percent recycled fiber and 50 percent post-



# Brain, Behavior, and Environmental Change

According to environmental scientists, Planet Earth is in for a bumpy ride. The climate is changing due to the burning of fossil fuels and deforestation, and as it does, the U.S. Climate Change Science Program reports that we can expect more extreme weather, including droughts, strong storms, floods, and heat waves. Now research is showing that for many animal species and potentially for humans as well, environmental change is a very real stressor, affecting brain and behavior.

For instance, the stress of climate change literally makes young desert amphibians grow up too soon. These animals live in unpredictable environments, in which rainfall is necessary, but hard to come by. Desert toads breed in ponds filled after rare rainfall, and their tadpole offspring develop in the water. Under ideal climate conditions, metamorphosis from tadpoles to adult toads proceeds slowly. However, when conditions rapidly change, and the pond dries up, metamorphosis speeds up, and tadpoles develop into adult toads faster than usual.

How does environmental stress speed up maturation? Metamorphosis and many of its hallmark physiological changes are induced

by thyroid hormone. In mammals, thyroid hormone secretion is initiated by a dedicated hormone produced in the brain. However, in tadpoles, thyroid hormone secretion is initiated by other brain hormones, including the stress hormone, corticotropin-releasing hormone. Researchers studying desert toad tadpoles found that reducing the amount of water in desert toad aquaria increased corticotropin-releasing hormone levels in the brain. These data suggest that environmental change speeds up maturation of desert toad tadpoles by literally stressing them out, a reminder that stress takes a physical toll on the body.

In some songbirds, climate change may impact breeding seasons, which could affect species survival. During mating season, male songbirds sing to attract mates and to mark their territories. Song-related brain regions show seasonal plasticity — they expand during mating season compared to other times of the year. For most songbirds, changes in day length induce these brain changes and indicate that it is time for breeding. However, research has shown that songbirds that live near the equator, where day length does not vary much seasonally, still show seasonal brain changes. These changes occur in response to other local environmental cues, potentially including



Environmental stress speeds up maturation of some species of desert toad.

temperature, rainfall, and food availability. The data suggest that the brain is sensitive to many aspects of the environment, and that climate change could have effects on species survival.

Some species may be able to adapt to ongoing change in the ecosystem. Recent research suggests that some birds can influence the social behaviors of their offspring, potentially as a response to environmental conditions. In many species, exposure to male hormones called androgens during development can affect the growth of neural circuits that impact social behaviors later in life. In birds, mothers can choose to



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- Collaborating Endogenous Calcium Buffers
- ▲ Take a Trophic Factor and Pass it Along
- Locating One's Self at the Temporoparietal Junction
- ◆ Pre-mRNA Splicing and Retinal Degeneration

The timing of equatorial songbirds' breeding season and behavior may be affected by environmental change such as global warming.

severe due to global climate change — can also instigate mental illness in people. Immediately following a natural disaster or extreme weather event, rates of depression, post-traumatic stress disorder, and mood and anxiety disorders increase, although these rates usually drop off within two years. How well society responds to these challenges may also influence how well mental health rebounds — research has shown that rates of mental illness persist or worsen with extended periods of disaster recovery.

There is much scientists are still learning about global climate change, from its likely severity to its impact on human and nonhuman physiology. In many ways, the scope of the challenge will involve a wide range of scientific disciplines. For neuroscience, these data suggest that extreme events can influence processes in the brain, and thus behavior, for years to come, and indicate the need for further study.

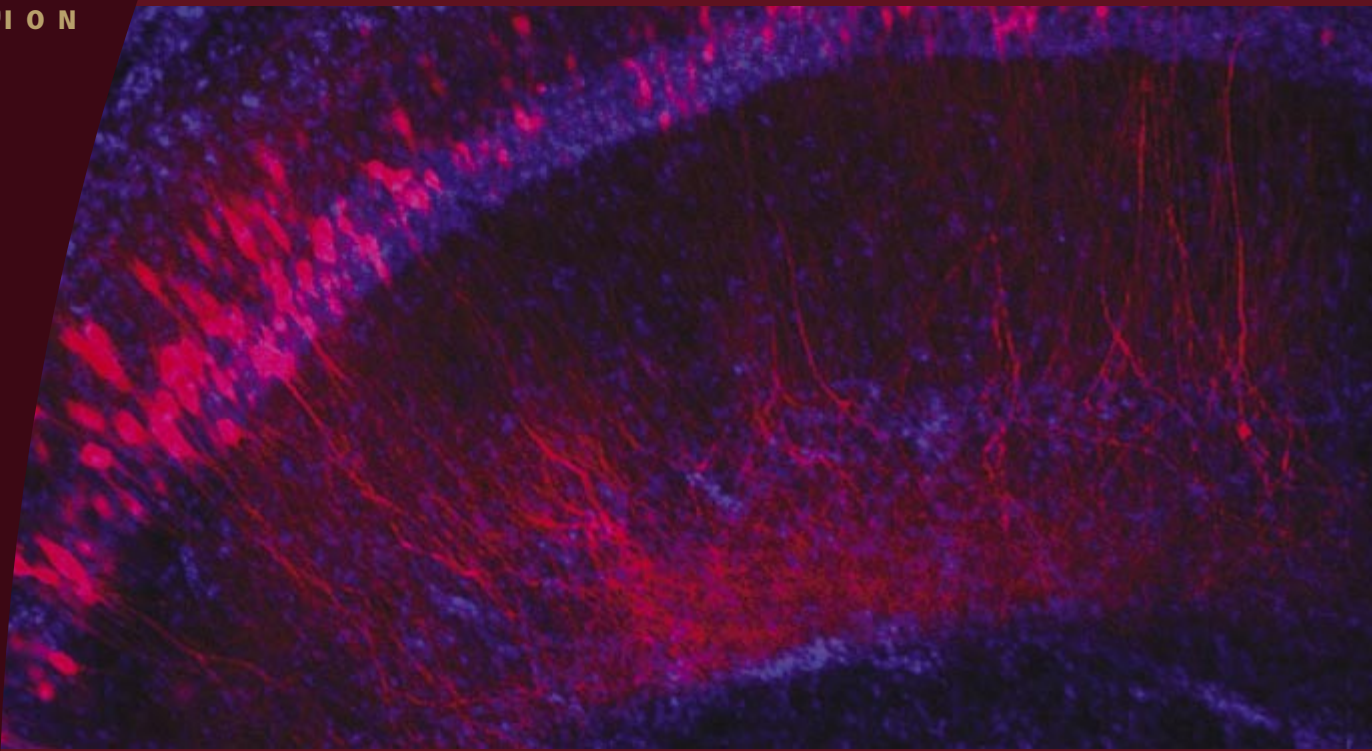
inject their eggs with androgens. Birds exposed to more androgens show increased aggressive and sexual behaviors as adults, which could improve their chances of successfully reproducing. However, there are consequences to androgen exposure: androgens also suppress immune function in chicks and reduce long-term survival. Depending on environmental conditions, mothers may be faced with the decision of increasing their offspring's chances for either reproduction or survival.

How environmental change may affect humans is still unclear and more research is needed. According to the World Health Organization, "Climate change is a significant and emerging threat to public

health," and scientists and clinicians are exploring how it impacts mental and physical health. Animal and human research on chronic stress may shed some light on how climate change affects the brain.

For example, among the threats posed by climate change are food and water shortages, according to the U.S. Centers for Disease Control and Prevention. Research indicates that competition for such scarce resources and enduring uncontrollable conditions cause chronic stress. Recent research showed that women who reported chronically high stress levels over many years had a smaller hippocampus, a brain region important for learning and memory.

Moreover, extreme weather events — which are forecasted to become more common and more



# Educating *and* Engaging the Public

Helping the public and its leaders better understand the brain and nervous system and support crucial research is fundamental to the progress of neuroscience and SfN's mission. In FY2008, SfN focused on providing improved access to educational resources, partnering with teachers, and engaging public policy officials to support science. With the launch of new initiatives like the *Neuroscience Core Concepts* and the SfN Advocacy Network, SfN is focused on educating the public about "the universe between their ears" and engaging members to serve as vocal public advocates for science funding.

## Public Outreach: *Advancing understanding of brain research*

The Society is continually working to develop new initiatives and alliances that support its public education and information work, which is led by the Public Education and Communication Committee.

A major project of FY2008 was to develop and refine the *Neuroscience Core Concepts*, which lay the groundwork for multiple public education and information purposes. These include providing benchmarks for teachers as they integrate neuroscience into educational activities, and clarifying essential principles that the public should know about the brain and nervous system. Following a year of development, eight concepts are organized within four "mega-concepts" and contain facts to stimulate further thinking and exploration. The *Neuroscience Core Concepts* have been correlated to the National Science Education Standards to align with teaching requirements. Dissemination to the K-12 community will include print and Web material, along with integration into a new SfN online source for resources for teaching about the brain.

The 2008 **Brain Awareness Week**, March 10 – 16, was celebrated locally by SfN staff and joined by SfN President Eve Marder in Washington, DC. In a collaborative effort with the Dana Alliance for Brain Initiatives and the National Museum of Health and Medicine, SfN assisted with a week's worth of educational activities at the Walter Reed Army Medical Center for 800 DC metro-area students. Worldwide, SfN members and partners from Turkey to New Jersey to Australia worked with thousands of students, young and old, to make the 2008 Brain Awareness Week a success. In February, the Society also supported the Washington, DC, and New York City Brain Bees, hosted and organized by the Dana Alliance for Brain Initiatives.

In an ongoing effort to provide readily accessible, high-quality, accurate education resources to K-12 educators, SfN has developed the core of a neuroscience education portal to serve as its public education gateway. The first two components of the portal were



A student at the 2008 Brain Awareness Week event. The public learns about the progress and promise of neuroscience research through SfN's public information and general education outreach.

the expansion of SfN's **Neuroscience Resources for the K-12 Classroom CD-ROM** and the migration and enhancement of the CD contents onto a Web site with sophisticated search capability. The updated CD-ROM, completed in October 2007 with over 300 resources, has been distributed widely to both SfN members and educators. The full online portal, **Neuroscience Education Resources Virtual Encycloportal (NERVE)**, has recently launched. The year ahead will include efforts to enhance and expand

the site's contents and functionality while promoting its availability. As the *Neuroscience Core Concepts* are finalized and integrated online, SfN will link the concepts and NERVE. Efforts will continue to secure inclusion of SfN education resources in major science education online libraries such as the Gateway to 21st Century Skills, the National Science Resource Center, and Science NetLinks at the American Association for the Advancement of Science.

Since 2003, the Society has maintained a strong presence at the **National Science Teachers Association** conference. This annual event represents one of the Society's largest public education efforts and illustrates its commitment to working with K-12 teachers. SfN's educational resources and an SfN

*A new publication, Research & Discoveries, focuses on the role of basic research in advancing science and creating the platform on which new health discoveries are made.*

team of members and staff joined 15,000 educators in Boston. SfN also exhibited and sponsored workshops at the **National Association of Biology Teachers 2007 Conference**, with more than 1,200 educators.

The Society continued its partnership with the **Science Olympiad**, one of the premier national science competitions. Middle and high school students participate in local and state competitions at more than 14,000 schools nationwide in efforts to reach the national tournament. SfN sponsored two team-based events, Health Science and Anatomy, which included a neuroscience focus. The Health Science event's winning team from California was presented, before a crowd of more than 4,200 competitors, coaches and parents, with a special award by SfN — a trip to Neuroscience 2008.

Reflecting the successful collaboration between SfN members and educators, the Society's **Neuroscientist-Teacher Partner Program** experienced notable growth in FY2008 with more than 425 SfN members par-

ticipating. The program partners K-12 educators and others involved in teacher preparation at the college or university level with Society members. At Neuroscience 2007, 12 educators and their neuroscientist partners were honored as special guests at a neuroscience education breakfast, along with the recipient of the Science Educator Award, who was recognized for outstanding contributions to public education.

Another highlight from FY2008 is an online educational collaboration between the **National Health Museum (NHM)** and SfN. These two groups are planning to develop an online education series focused on key themes and knowledge related to the brain and nervous system. The project's innovative components will meet two key objectives: providing NHM's growing audiences with exciting science-based, health-related educational content, and enhancing SfN's extensive communications efforts to encourage dialogue between the educational and scientific communities.

**Media and high quality public information** has been a core SfN emphasis for many years. In FY2008, the Society saw wide annual meeting coverage, and increasing media attention to work appearing in *The Journal of Neuroscience*. A new publication, *Research & Discoveries*, focuses on the role of basic research in advancing science and creating the platform on which new health discoveries are made. *Research & Discoveries* joins a group of well-respected and widely read publications, including *Brain Facts*, *Brain Briefings*, and *Brain Research Success Stories*, all of which are available on the Society's Web site.

Numerous activities and ongoing development and expansion of resources position SfN to meet the evolving needs of teachers and members with dynamic and accurate educational tools. In addition, these initiatives build on SfN's efforts to reach out to the public and improve public understanding of neuroscience.

**LEARN MORE:**  
[www.sfn.org/public\\_education](http://www.sfn.org/public_education)  
[www.sfn.org/newsroom](http://www.sfn.org/newsroom)

# Science Advocacy:

## *Influencing public policy, protecting researchers*

SfN and the broader scientific community continue to grapple with maintaining a healthy funding stream for research in the face of significant budgetary constraints, and to address a growing trend of violent and illegal acts by animal rights activists. In preparation for a new administration and U.S. Congress in 2009, the Society is strengthening its efforts to engage members in advocating for biomedical research. Expanding government advocacy efforts are focused on both U.S. activity, and on discovering ways to be a resource for broader global efforts to advocate for science funding. In the U.S. and worldwide, researchers are threatened by extremists who harass and terrorize rather than engage in reasonable discourse — including a deeply troubling firebombing of a researcher's home, endangering young children. SfN is actively working to engage with universities and other institutions to protect researchers and research from growing violence and threat.

### Government and Public Affairs

The last five years of near-flat **National Institutes of Health (NIH)** and **National Science Foundation (NSF)** budgets have created an increasingly precarious environment in which grants are being squeezed and trainees and established researchers are unsure about their futures. In the final FY2008 budget, NIH and the NSF received minimal increases although Congressional supporters were able to include some additional funding in the FY2008 supplemental bill. Nonetheless, there is resulting widespread concern over the impact of eroding research funds on the scientific enterprise. Given the unfortunate fiscal climate in the United States and abroad, these challenges will likely continue with the next



Newt Gingrich, former Speaker of the U.S. House of Representatives and founder of the Center for Health Transformation, spoke at Neuroscience 2007 about the need for increased government investment in basic biomedical research.

administration and Congress. In this environment, the SfN Government and Public Affairs (GPA) Committee seeks to harness the membership's considerable breadth, influence, and expertise to help build a long-term, sustainable climate that supports increased, stable federal research funding, in collaboration with key strategic partners across the scientific and business communities.

Member involvement is essential to the success of SfN's U.S. advocacy efforts because science, like politics, is both local and national. Members of Congress need to know and understand how science and research funding affects their constituents,

## Educating and Engaging the Public

their districts, and their states. In addition to legislative e-mail alerts to all members, GPA is enhancing targeted member engagement in advocacy through the Capitol Hill Day, SfN chapters, and the new SfN Advocacy Network.

The 2008 **Capitol Hill Day**, held on April 22, brought more than two dozen SfN members to visit nearly 50 offices and discuss the serious impact that declining research funding has on their research and home institutions. Because engaging **SfN chapters** in advocacy is a major part of SfN's expanding efforts, for the first time chapter leaders from Michigan, Pennsylvania, California, Georgia, and Maryland received advocacy training and participated in Capitol Hill Day. They returned to their home states to share with colleagues the importance of local and national advocacy in advancing neuroscience priorities. Back

*Several SfN members have already met with their members of Congress and staff in their districts, even providing lab tours.*



The 2008 SfN Capitol Hill Day brought more than 20 SfN members to visit nearly 50 offices to discuss the serious impact flat research funding can have on public health, the economy, and the research enterprise.

home, several SfN members have already met with their members of Congress and staff in their districts, even providing lab tours. These experiences are invaluable to forming personal, impactful relationships with congressional offices.

The new **SfN Advocacy Network**, launched in July 2008, consists of SfN members committed to developing substantive communications and relationships with their members of Congress and staff. As part of the network, participants receive regular legislative updates and are called upon to contact specific members on important votes. This effort is just one step towards building a strong grassroots foundation to support increased advocacy activities.

To complement the member engagement strategy, SfN continued **partnerships with scientific and patient organizations** as part of coalitions focused

on NIH and NSF funding. Coalition leaders in the science community urged Congress to provide a 6.5 percent increase for NIH in FY2009, which would restore funding to at least the biomedical research inflation rate, plus three percent, which is the average increase provided to NIH for nearly 40 years. As part of the **Coalition for the National Science Foundation**, SfN supports a 20 percent increase for NSF in FY2009. While this is a considerable increase, it matches the level recommended in the America COMPETES Act, signed into law by the president, and has the support of 150 members of the U.S. House of Representatives. Despite support for increases from bipartisan leadership on Capitol Hill, the politics of the presidential election make it difficult to predict what will happen with 2009 federal funding.

[www.sfn.org/gpa](http://www.sfn.org/gpa)

Vital research using animals is being targeted by increasingly violent activists. Responsible animal research is essential for new treatments for neurological and psychiatric disorders.

## Animals in Research

Eleven SfN members reported being attacked by animal rights activists in 2007, the most in a single year. The trends are particularly troubling as attacks have become increasingly violent and personal: in summer 2008, the firebombing of a researcher's home in Santa Cruz, California forced his family, including two young children, to flee their home down a two-story fire ladder. To help address this disturbing trend, SfN's Committee on Animals in Research (CAR) has established a leadership role to assist the research community in protecting itself.

Guided by CAR, SfN released **Best Practices for Protecting Researchers and Research** in February. With recommendations in the areas of administration, security, and public affairs, *Best Practices* builds on safety and security plans created at top U.S. research institutions and offers a template to better protect scientists. SfN members are meeting with university administrations to discuss the dramatic increase in animal rights activity, and institutions have expressed enthusiasm for the document's recommendations. Perhaps most importantly, *Best Practices* encourages institutional leaders to speak out publicly in support of researchers and enhance their sense of safety and well-being. Additionally, in partnership with others in the animal research community, SfN is also working to encourage swift and active investigation and prosecution of animal rights terrorism under federal law.

**Media coverage and other visibility** surrounding *Best Practices*' release included *Newsweek.com*, the *Chicago Tribune*, the *Los Angeles Times*, *The Washington Times*, *Associated Press*, *Science*, and many scientific and medical periodicals. CAR chair Jeffrey Kordower also spoke about *Best Practices* and animal rights extremism at the 2008 American Academy of Neurology annual meeting, urging collaboration between scientists and clinicians.

CAR also participated in the SfN Capitol Hill Day, renewed support for an **International Brain Research Organization** program that helps facilitate workshops on laboratory animal welfare in developing countries, and continues to highlight the impor-



tance of responsible animal research to life-enhancing neuroscience research.

In the coming months, activities promoting *Best Practices* to institutions and partner organizations will continue, as will our efforts to inform SfN members on how best to manage attacks, and the Society's abiding work to advance public understanding of the benefits of responsible animal research.

[www.sfn.org/animals](http://www.sfn.org/animals)

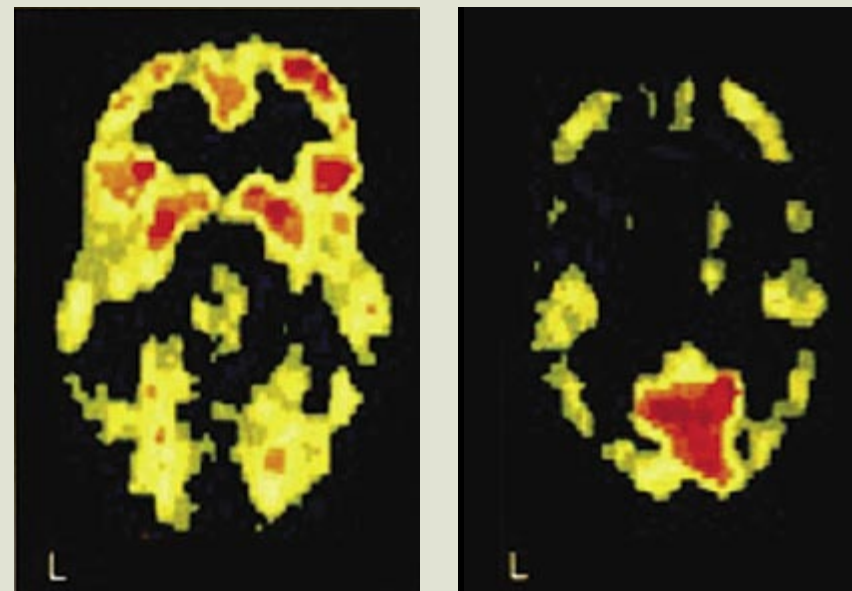


# Neurolaw: Neuroscience in the courtroom

Neuroscience's influence is reaching beyond the research lab and clinic into the courtroom and beyond, regularly generating news headlines such as "Neuroscience sparks criminal responsibility dilemma" and "The brain on the stand." It is increasingly clear that neuroscience efforts to explore links between brain and behavior will continue to influence U.S. legal proceedings, with implications for criminal sentencing and for the legal system writ large, in a specialty now referred to as "neurolaw."

While the law generally holds people personally responsible for their actions, accommodations are sometimes granted to explain misconduct, such as self-defense, extreme provocation, or insanity. Arguments seeking to explain behavior based on brain activity (or the lack of it) are now common in a variety of U.S. jurisdictions, in both civil and criminal contexts, and for a range of purposes. For example, does the presence of a tumor or other neurological malady affect an individual's actions, to the point of criminal behavior? Can a person with frontal lobe damage, which is associated with loss of self-control, claim that it incited a criminal act? The questions are complex and wide-ranging, and measuring the impact of neuroscience evidence is a question very much in play.

These issues have multiplied since the early 1990s, with the



Brain scans of a normal subject (left) and a murderer (right), illustrating the lack of activation in the prefrontal cortex (top of figure), associated with self-control, in the murderer. Warm colors (red, yellow) indicate areas of high brain activation; cold colors (blue, black) indicate low activation.

arrival of advances in imaging technology — particularly functional magnetic resonance imaging, or fMRI. fMRI measures activity in the brain, creating computer generated images of brain regions that are activated while an individual thinks or performs a task. For many years, neuroscientists have studied the function of various brain structures; now they have the technology to observe functional differences in these structures. Altered or diminished function in brain regions involved

in decision-making or aggression may have very real consequences for behavior.

This possibility has generated keen interest from legal circles, and created active discussion and further research within the scientific community. Do these findings tell scientists definitive information about brain activity that warrants submission in a court of law? Do we know enough about the functioning of brain regions to draw definitive conclusions

about motivation from images of electrical activity? Should juries rely on this information to determine guilt or innocence, accountability or forgiveness? In both legal and scientific circles, some experts believe yes, and some believe no. Thus the answers are diverse and complex — far more so than is often portrayed in popular culture outlets.

Even prior to the advent of fMRI, there were earlier uses of neuroimaging evidence in legal proceedings. In the 1981 trial of John Hinckley, Jr., President Ronald Reagan's would-be assassin, the court allowed the defense to admit a CT scan of Hinckley's brain. The evidence was meant to bolster the defense's claim that his brain had atrophied, which they contended was clear evidence of organic brain disease, thus contributing to Hinckley's violent act.

Recent examples of the intersection of neuroscience and the law are numerous. In the 2005 nomination hearing of John Roberts as Chief Justice of the United States, Sen. Joseph Biden (D-Del.) posed a rhetorical question about an issue the Supreme Court might face: "Can brain scans be used to determine whether a person is inclined toward criminality or violent behavior?" His question illustrates the degree to which neuroscience, especially neuroimaging, has entered into the legal system.

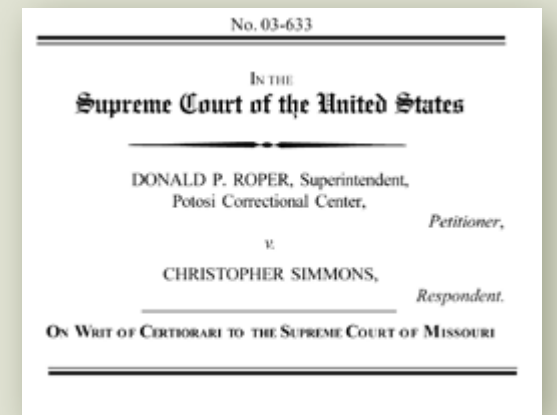
Potential new legal precedent was also set in a high-profile 2005 Supreme Court case, *Roper v. Simmons*, which overturned the juvenile death penalty. Two submitted briefs cited neuroimaging studies, showing key differences between the adolescent and adult

brain: "These neurological, physiological, and psychological deficits are exactly the characteristics that this Court has identified as warranting a categorical exemption [of juveniles] from the death penalty" (American Medical Association et al. *amicus* brief).

On the scientific side, while the technological advances of brain imaging are significant, neurolaw is challenging scientists to ask and explore new questions. For example, scientists are examining questions about the variability in brain physiology and how to define "normalcy." There is clearly natural variation among individuals, but understanding and interpreting the meaning of those differences is a major challenge.

In sum, neuroimaging evidence is increasingly being used in the courts to evaluate human behavior. Whether in a civil context, such as a personal injury case, or a criminal context, such as at sentencing when a jury evaluates mitigating and aggravating factors, neuroscience evidence introduces findings about behavior and responsibility. And it raises big and small questions for society and the legal community: how will it change the way we think about human nature and human action, including criminal and individual responsibility, scientific findings about behavior, or intentionality?

Scientists and legal experts are working collaboratively to explore these questions and broaden the field. Several projects — from the Law and Neuroscience project of the MacArthur Foundation to the Baylor College of Medicine Initiative on Law, Brains, and Behavior — draw on expertise from the



In a high-profile 2005 case, *Roper v. Simmons*, two submitted briefs cited neuroimaging studies that reported key differences between the adolescent and adult brain.

scientific and legal communities to wrestle with the facts, and consequences, of their interpretation. Notably, neuroethics is also among the "Topics of Council Concern" for The President's Council on Bioethics, where several panel sessions have been convened and resulted in a 2004 paper, "An Overview of the Impact of Neuroscience Evidence in Criminal Law." Efforts to address the questions raised by neuroscience in the legal context also span published articles to conferences for judges, such as the Judicial Seminars on Emerging Issues in Neuroscience sponsored by a collaboration that includes the American Association for the Advancement of Sciences, the American Bar Association, and the Dana Foundation.

When it comes to the brain on the stand, the jury is still out, but active research and dialogue will influence science, policy, and law, in decades to come.



# Neurobiology of Aggression and Violence

When most people think of aggression, they think of road rage, physical fights, and violent crime. However, not all aggression is bad. Aggression is adaptive, helping people and animals alike guard their homes from intruders and protect their children from threats. Problems arise when aggression is taken too far, escalating abnormally and becoming violent. Neuroscientists are working to identify brain regions, neurotransmitters, and genes that are involved in escalated aggression and violence. This research may one day help identify individuals at risk of developing dangerous behaviors and new treatments to prevent such episodes in at-risk individuals.

Although previous studies implicated the brain chemical serotonin in all types of aggression, new research suggests that it may only be involved in escalated aggression and violence. New studies also question whether changes in the serotonin system are the cause or effect of escalated aggression: Research now suggests that unchecked aggressive behavior can eventually change the brain in ways that alter serotonin levels and, perhaps, increase violent behavior.

Researchers modeled pathological aggression in wild mice and rats by permitting them to physically dominate other rodents repeatedly. With such positive reinforcement,



Like humans and many other animals, fruit flies battle each other for control over territories and mates. Scientists are studying factors that influence levels of aggression.

the animals' initially normal aggressiveness gradually became transformed into a more violent form — similar to the kind seen in violent people.

Researchers found that levels of serotonin decreased in animals perpetrating repeated victorious episodes of aggression but not as a result of performing normal, functional acts of aggression. These findings are consistent with studies in humans showing that serotonin deficiency is associated with escalated rather than more functional forms of aggression. The results suggest that regulation of the serotonin system may be beneficial for people with anger problems. In animal studies, exposure to serotonin receptor agonists, drugs

that increase serotonin activity, suppressed aggressive behavior, including its escalated form. Genetic studies in the fruit fly *Drosophila melanogaster* have identified other brain compounds important in aggression. Researchers selectively bred *Drosophila* for highly aggressive behaviors. By comparing gene expression in docile and highly aggressive *Drosophila*, they have identified new candidate genes and cellular mechanisms involved in aggression.

Fruit flies bred for aggression showed altered expression of genes involved in pheromone-based communication. Male fruit flies

use pheromones to identify and locate food and other males and to attract females. Highly aggressive *Drosophila* showed increased expression of an enzyme important in processing hormones and pheromones and decreased expression of a protein important in pheromone sensation. These data suggest that abnormally aggressive fruit flies may have difficulty identifying the territories of other males, resulting in more frequent or more violent "turf wars."

In humans, new imaging technologies have helped neuroscientists identify brain regions associated with inappropriate aggressive behavior. Damage to certain regions of the brain, most notably the prefrontal cortex, can result in violent behavior.

However, new research also implicates brain circuits involved in moral judgments in violent behavior. The researchers found that people with antisocial, violent, or psychopathic tendencies tended to have overlapping damage in brain structures involved in making moral judgments. In normal, healthy individuals, moral decision-making activates the dorsal and ventral prefrontal cortex, the amygdala (important in emotions, fear, and stress), and the angular gyrus (involved in language and cognition). Antisocial individuals tended to show more damage in these brain regions than did control subjects.

Some adolescents respond to even mild perceived threats with inappropriate aggression. Recent research shows that teenage boys with this reactive type of aggression show abnormal brain activity relative to their peers. In response

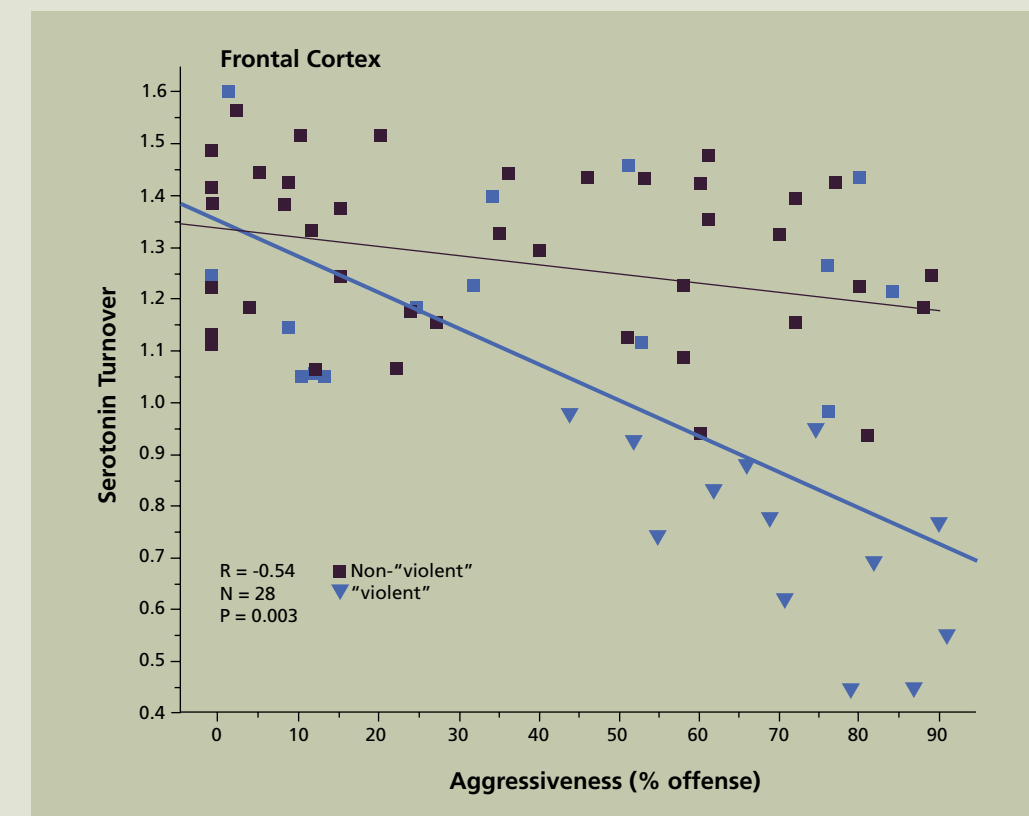
to fear-inducing images, these boys showed more activity in the amygdala and less activity in the frontal cortex, which is involved in impulse control, than other teenagers.

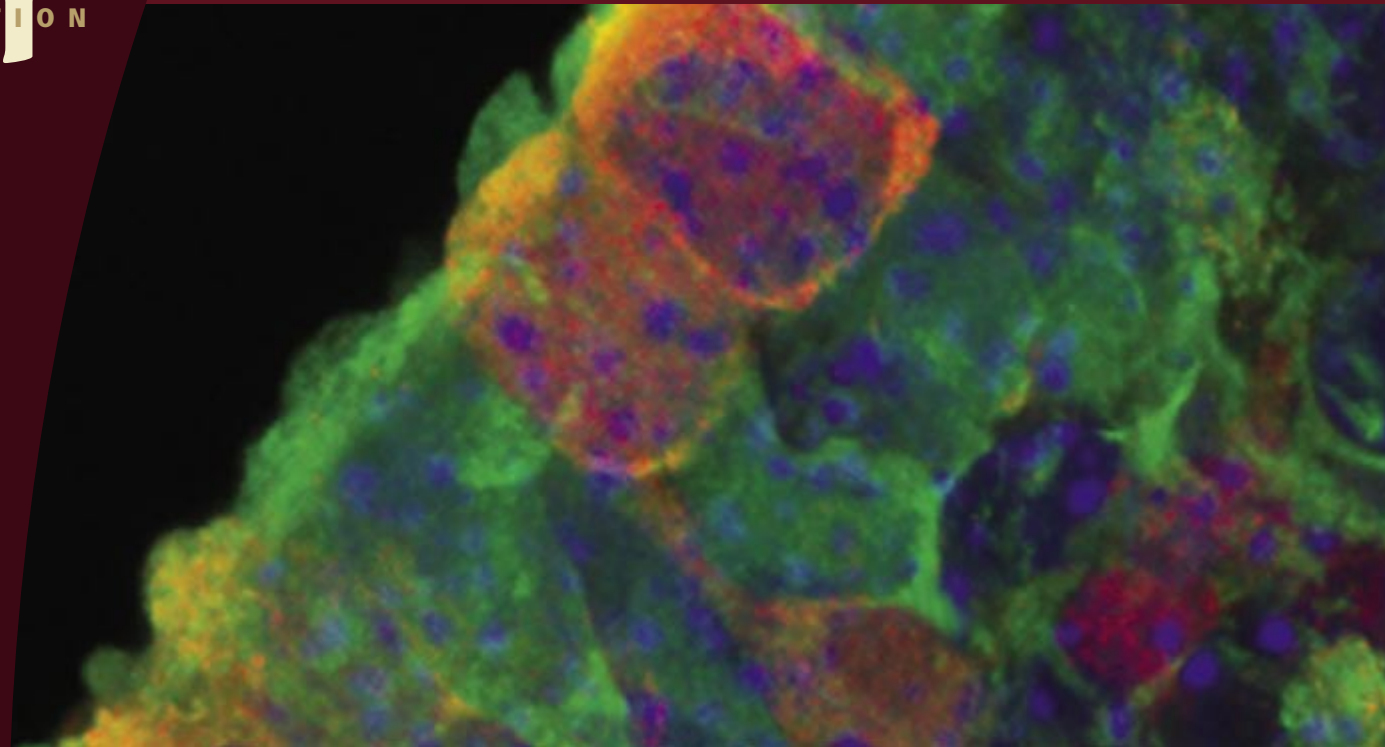
Violence is harmful not only to society, but also to the health of both victim and aggressor. Being the recipient of an aggressive social encounter can cause changes in the brain that lead to depression, anxiety, and susceptibility to immune-related illnesses. Surprisingly, recent animal research shows that aggressors may suffer from many of these same effects. Aggressive encounters increased circulating levels of stress hormones in both dominant and submissive mice, suggesting that aggression affected both groups similarly. Chronic

exposure to social stress increased sensitivity to bacterial infection in both groups, but more so in dominant than in submissive mice.

Unlike most behaviors, individual acts of escalated aggression and violence have the potential to impact society as a whole. Research from fruit flies to humans is helping to decipher the biological causes of these abnormal behaviors. This research promises to reveal new avenues of treatment and prevention in the years to come.

Animals that show escalated aggression (blue triangles) have less serotonin in the brain than animals that show normal aggression (squares). Serotonin levels appear to decrease with increasing aggressive behavior (blue line).





# Sustaining the Mission in a Time of Economic Uncertainty

The Society for Neuroscience continues to maintain a stable fiscal position despite funding constraints affecting our members, the weak economy, and the continuing growth of programmatic activities that combine to challenge the balance between revenues and expenses.

## Financial Highlights

SfN continues to be attentive to its financial controls and systems to ensure they adhere to current best practices for nonprofit financial management; this strong management is helping to maintain a pattern of responsible stewardship of Society resources. Gelman, Rosenberg & Freedman audited the Society's financial operations for the fiscal year beginning July 1, 2007 and ending June 30, 2008. The auditor's opinion letter and the audited financial statements are included later in this section.

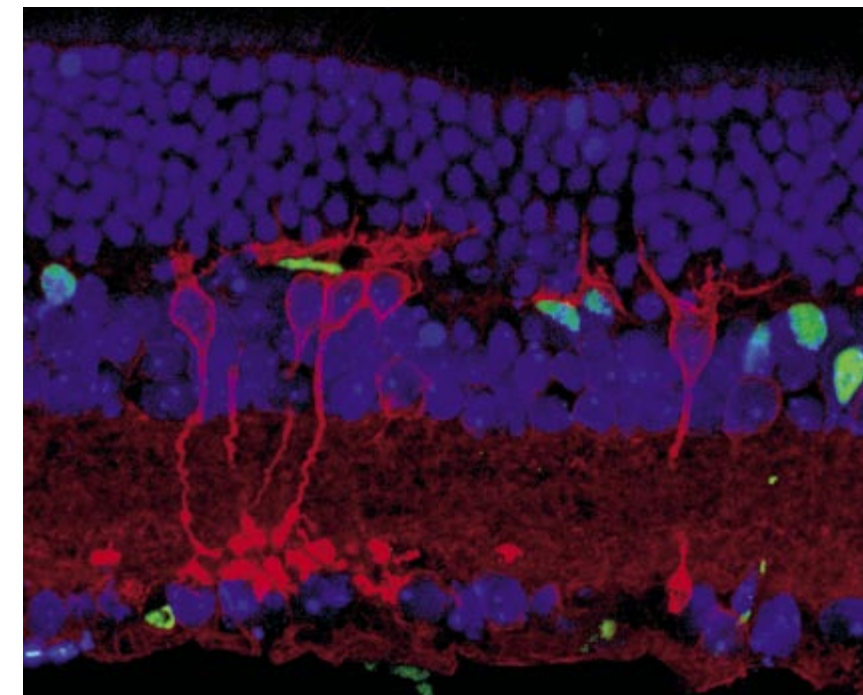
SfN's membership continues to be the organization's greatest strength. The 2007 total of 38,677 members represents a 5.5 percent increase over the 2006 membership total and a three percent increase over the previous membership record of 37,562 in 2005. Preliminary membership figures have remained strong and stable in 2008.

With a vibrant and diverse membership comes a responsibility to continue to provide compelling membership value. SfN's two flagship endeavors, the annual meeting and *The Journal of Neuroscience*, continue to grow in size, scope, and complexity; with this comes additional costs as well as additional benefits. The results of the 2007 Membership Survey told us that members were interested in becoming more involved in SfN activities and that there is an interest and an appetite for more activities, specifically in the areas of professional development, advocacy and public education, already areas of programmatic growth. As we stand poised to further expand the size and scope of these important activities, prudent financial management requires that we consider the revenues that will be needed.

At the end of fiscal year 2008, the Society's investment reserves were valued at a total of \$29.2 million, which represents a \$2.2 million loss from the previous year, largely a result of the overall

downturn in the market during this time. The Society's flexible and sector-based investment strategy is guided by the Investment Committee, which includes outside investment experts who provide pro bono advice. The strategy is prudently allowing for the ups and downs of the economic cycle. Maintaining a healthy reserve fund helps protect SfN from the volatile economic climate that was experienced over the last year and that continues to challenge the nonprofit community as a whole.

Leasing and tenant space construction in SfN's



A scientific cover image from *The Journal of Neuroscience*. *The Journal* is a stable source of revenue for the Society.



Sustaining the Mission in a Time of Economic Uncertainty

headquarters building in Washington, DC continued this year. As of the end of August 2008, nine tenants have signed leases, resulting in a 93 percent commitment of the space in the building. In a very competitive DC rental market, the lease-up of the building has been somewhat slower than originally anticipated, but target rental rates have been achieved or exceeded. SfN's leasing team continues to market the available space with the goal of full occupancy in early 2009. As leasing and construction of office space has continued, significant upfront costs have been incurred as planned, with revenues for rent, parking, and operating expenses increasing along with occupancy.

As capital outlays decline and revenues continue to grow, the building will begin generating a positive cash flow in 2009. Projected significant cash flows for the building in future years will help better position the Society to manage expanding programs while maintaining existing ones, and to maintain reasonable costs to members over the long-term for annual dues, annual meeting fees, and *The Journal of Neuroscience*.

The Society has continued to build strong relationships with public, private, and corporate organizations, with an eye to strengthened collaborations, both now and in the future. SfN saw continued growth in the area of private grants and sponsorships, increasing by eleven and forty-one percent respectively from 2007 to 2008. A \$100,000 grant from Astellas USA Foundation supports the Research Awards for Innovation in Neuroscience (RAIN), which were first given at Neuroscience 2007; this awards program was renewed for 2008. In August 2008, the Society received its second \$650,000 grant to provide long-term funding for an SfN award. The Jacob P. Waletzky Award, which has

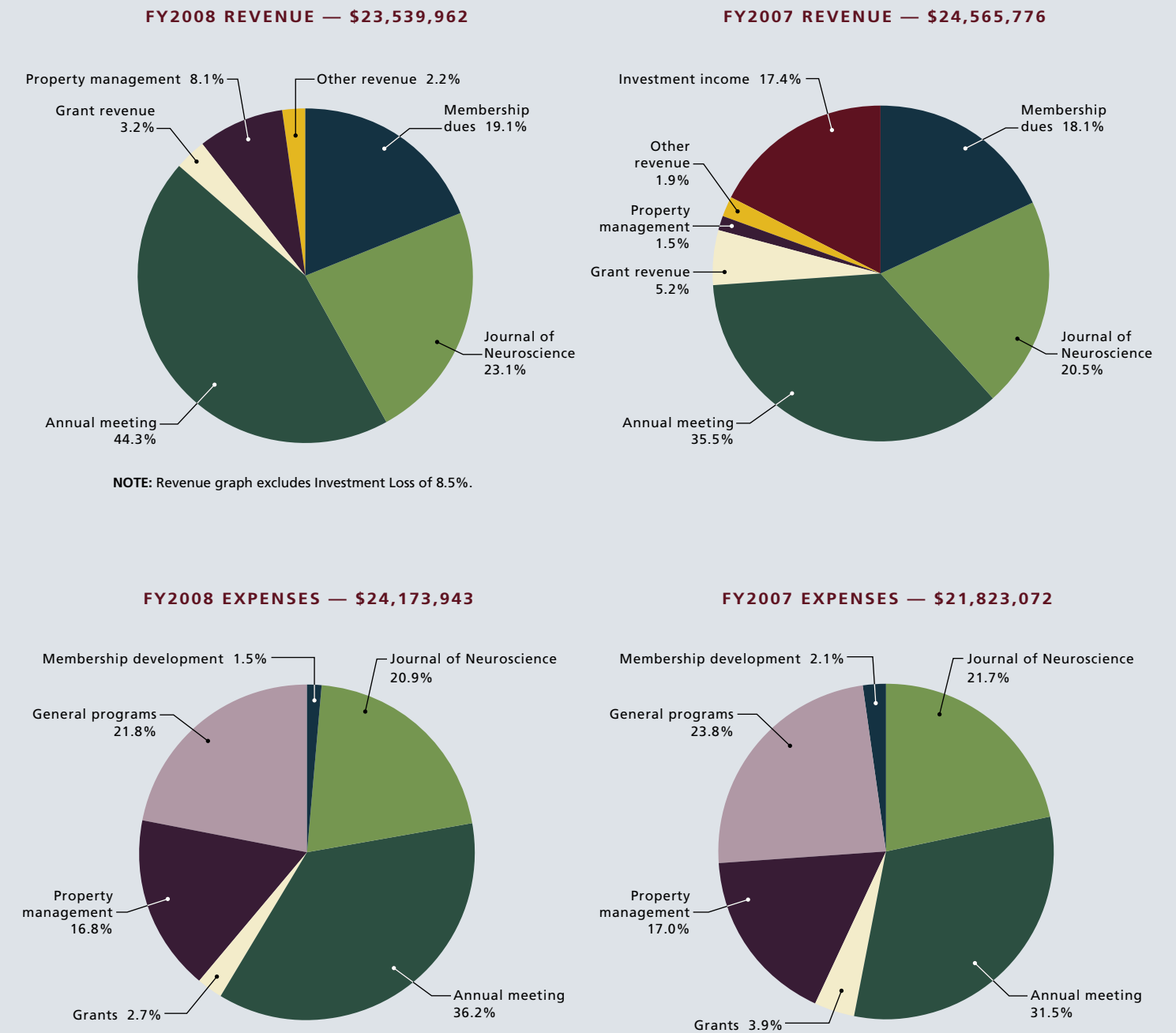
been funded by The Waletzky Family and Rockefeller Philanthropy Advisors since 2003, will continue to be given at the annual meeting each year.

*The Journal of Neuroscience* and its business model remain stable, including revenues from subscriptions, multi-site and global licenses, and author submission, publication, and reprint fees. *The Journal* continues to generate a surplus of over \$1 million each year.

The annual meeting, which consistently draws significant attendance, continues to serve as a major revenue stream for the Society. Neuroscience 2007 had the second highest attendance of any meeting and annual meeting related revenues, such as registration fees, exhibitor fees, and other annual meeting fees, such as those for abstract submission, accounted for more than forty percent of the Society's revenue in fiscal year 2008.

While SfN's revenues and reserves remain strong, the pressures of the expanding membership programs, reduced NIH funding for our members and an economy that continues to drive up costs resulted in a 10.3 percent growth in expenses. This was offset by an increase of 11.7 percent in revenues from 2007, primarily due to increased meeting attendance. The trend over the last few years has shown a gradual convergence of revenues and expenses and the coming years will challenge SfN to closely manage that balance between expansion of program and moderate growth of revenues, which are driven largely by member, subscriber, and vendor related fees. The goals of enhancing member value and supporting the scientific mission will continue to guide this process and drive the financial and programmatic decisions that are made in the coming years.

CURRENT AND PAST FISCAL YEAR REVENUE AND EXPENDITURES BY ACTIVITY





GELMAN, ROSENBERG & FREEDMAN  
CERTIFIED PUBLIC ACCOUNTANTS

INDEPENDENT AUDITORS' REPORT

To the Council  
Society for Neuroscience and 1121 Properties, LLC  
Washington, D.C.

We have audited the accompanying consolidated statement of financial position of the Society for Neuroscience and 1121 Properties, LLC (collectively the Society), as of June 30, 2008, and the related consolidated statements of activities and change in net assets and cash flows for the year then ended. These consolidated financial statements are the responsibility of the Society for Neuroscience's management. Our responsibility is to express an opinion on these consolidated financial statements based on our audit. The prior year summarized comparative information has been derived from the Society's 2007 consolidated financial statements and, in our report dated September 4, 2007, we expressed an unqualified opinion on those statements.

We conducted our audit in accordance with auditing standards generally accepted in the United States of America. 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 consolidated financial position of the Society for Neuroscience and 1121 Properties, LLC, as of June 30, 2008, and their consolidated change in net assets and their consolidated cash flows for the year then ended in conformity with accounting principles generally accepted in the United States of America.

*Gelman Rosenberg & Freedman*

September 18, 2008

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CONSOLIDATED STATEMENT OF FINANCIAL POSITION (as of June 30, 2008)

ASSETS	2008	2007
<b>Current Assets</b>		
Cash and cash equivalents	\$458,917	\$641,102
Accounts receivable, net of allowance for doubtful accounts	375,547	536,576
Prepaid expenses	800,159	1,489,031
<b>Total current assets</b>	<b>1,634,623</b>	<b>2,666,709</b>
<b>Non-current Assets</b>		
Investments (Note 2)	29,135,763	32,048,816
Property, furniture, equipment and improvements, net of accumulated depreciation and amortization of \$3,506,767 for 2008 (Notes 6, 8 and 9)	34,530,879	34,301,555
Deferred rent receivable (Note 5)	377,435	-
Deposits	3,892	3,892
<b>Total non-current assets</b>	<b>64,047,969</b>	<b>66,354,263</b>
<b>Total assets</b>	<b>\$65,682,592</b>	<b>\$69,020,972</b>
<b>LIABILITIES AND NET ASSETS</b>		
<b>Current Liabilities</b>		
Current portion of note payable (Note 8)	\$483,333	\$425,000
Line of credit (Note 11)	1,764,960	1,030,556
Accounts payable and accrued liabilities	1,204,677	2,427,405
Deferred revenue	5,612,885	5,214,992
<b>Total current liabilities</b>	<b>9,065,855</b>	<b>9,097,953</b>
<b>Non-Current Liabilities</b>		
Note payable, net of current portion (Note 8)	19,091,667	19,575,000
Bonds payable (Note 9)	12,000,000	12,000,000
Tenant deposits	17,584	17,584
Interest rate swap obligation (Note 10)	1,695,549	-
<b>Total non-current liabilities</b>	<b>32,804,800</b>	<b>31,592,584</b>
<b>Total liabilities</b>	<b>41,870,655</b>	<b>40,690,537</b>
<b>Net Assets</b>		
Unrestricted	23,040,876	27,647,259
Temporarily restricted (Note 3)	771,061	683,176
<b>Total net assets</b>	<b>23,811,937</b>	<b>28,330,435</b>
<b>Total Liabilities And Net Assets</b>	<b>\$65,682,592</b>	<b>\$69,020,972</b>

See accompanying notes to consolidated financial statements.

**CONSOLIDATED STATEMENT OF ACTIVITIES** (as of June 30, 2008)

	2008			2007
	Unrestricted	Temporarily Restricted	Total	Total
<b>REVENUE</b>				
Membership dues	\$4,503,035	\$ -	\$4,503,035	\$4,434,616
Journal of Neuroscience	5,439,166	-	5,439,166	5,034,765
Annual meeting	10,432,138	-	10,432,138	8,715,166
Grant revenue	560,869	182,464	743,333	1,282,465
Investment income (Note 2)	(2,188,968)	-	(2,188,968)	4,275,891
Property management revenue (Note 5)	1,908,649	-	1,908,649	367,714
Other revenue	513,641	-	513,641	455,159
Net assets released from donor restrictions (Note 4)	94,579	(94,579)	-	-
<b>Total revenue</b>	<b>21,263,109</b>	<b>87,885</b>	<b>21,350,994</b>	<b>24,565,776</b>
<b>EXPENSES</b>				
<b>Program Services:</b>				
Journal of Neuroscience	5,058,933	-	5,058,933	4,732,576
Annual Meeting	8,749,466	-	8,749,466	6,865,356
Grants	651,696	-	651,696	854,812
General Programs	5,278,659	-	5,278,659	5,209,862
<b>Total program services</b>	<b>19,738,754</b>	<b>-</b>	<b>19,738,754</b>	<b>17,662,606</b>
<b>Supporting Services:</b>				
Membership Development	368,997	-	368,997	451,918
Property Management Expenses	4,066,192	-	4,066,192	3,708,548
<b>Total supporting services</b>	<b>4,435,189</b>	<b>-</b>	<b>4,435,189</b>	<b>4,160,466</b>
<b>Total expenses</b>	<b>24,173,943</b>	<b>-</b>	<b>24,173,943</b>	<b>21,823,072</b>
Change in net assets before other item	(2,910,834)	87,885	(2,822,949)	2,742,704
<b>OTHER ITEM</b>				
Unrealized loss on interest rate swap (Note 10)	(1,695,549)	-	(1,695,549)	-
Change in net assets	(4,606,383)	87,885	(4,518,498)	2,742,704
<b>Net assets at beginning of year</b>	<b>27,647,259</b>	<b>683,176</b>	<b>28,330,435</b>	<b>25,587,731</b>
<b>Net assets at end of year</b>	<b>\$23,040,876</b>	<b>\$771,061</b>	<b>\$23,811,937</b>	<b>\$28,330,435</b>

See accompanying notes to consolidated financial statements.

**CONSOLIDATED STATEMENT OF CASH FLOWS** (as of June 30, 2008)

	2008	2007
<b>CASH FLOWS FROM OPERATING ACTIVITIES</b>		
Change in net assets	\$(4,518,498)	\$2,742,704
Adjustments to reconcile change in net assets to net cash provided by operating activities:		
Depreciation and amortization	1,435,844	1,246,750
Net depreciation (appreciation) of investments	3,151,817	(3,505,410)
Unrealized loss on interest rate swap	1,695,549	-
(Increase) decrease in:		
Accounts receivable	161,029	(21,331)
Deferred rent receivable	(377,435)	-
Prepaid expenses	688,872	335,505
Increase (decrease) in:		
Accounts payable and accrued liabilities	(1,222,728)	226,339
Deferred revenue	397,893	127,875
<b>Net cash provided by operating activities</b>	<b>1,412,343</b>	<b>1,152,432</b>
<b>CASH FLOWS FROM INVESTING ACTIVITIES</b>		
Sales and maturities (purchases) of investments, net	(238,764)	(1,152,114)
Purchase of property, furniture and equipment	(1,665,168)	(2,288,909)
<b>Net cash used by investing activities</b>	<b>(1,903,932)</b>	<b>(3,441,023)</b>
<b>CASH FLOWS FROM FINANCING ACTIVITIES</b>		
Proceeds from line of credit	2,051,477	1,030,556
Payments on the line of credit	(1,317,073)	-
Payments on notes payable	(425,000)	-
<b>Net cash provided by financing activities</b>	<b>309,404</b>	<b>1,030,556</b>
Net decrease in cash and cash equivalents	(182,185)	(1,258,035)
Cash and cash equivalents at beginning of year	641,102	1,899,137
<b>CASH AND CASH EQUIVALENTS AT END OF YEAR</b>	<b>\$458,917</b>	<b>\$641,102</b>

**SUPPLEMENTAL INFORMATION:**

Interest Paid	\$1,676,374	\$1,676,741
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See accompanying notes to consolidated financial statements.

## NOTES TO FINANCIAL STATEMENTS

### 1. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES AND GENERAL INFORMATION

#### Organization

The Society for Neuroscience is a nonprofit organization, incorporated in the District of Columbia. The primary purposes of the Society for Neuroscience are to advance the understanding of the nervous systems, including the part they play in determining behavior, by bringing together scientists of various backgrounds and by facilitating the integration of research directed at all levels of biological organization; to promote education in the field of neuroscience; to inform the general public on the results and implications of current research in this area.

The 1121 Properties, LLC (the LLC) is a limited liability company, incorporated in the District of Columbia on July 7, 2005. The primary purpose of the Company is to engage in the business of performing services as directed by the Society for Neuroscience for leasing and maintaining the leases of offices and other retail space in the premises known as 1121 14th St., NW, Washington, D.C. 20005.

The accompanying consolidated financial statements reflect the activity of the Society for Neuroscience and the LLC (collectively the Society) as of June 30, 2008. The financial statements of the two organizations have been consolidated because they are under common control. All intercompany transactions have been eliminated during consolidation.

#### Basis of presentation

The accompanying consolidated financial statements are presented on the accrual basis of accounting, and in accordance with Statement of Financial Accounting Standards No. 117, "Financial Statements of Not-for-Profit Organizations".

The consolidated 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 organization's consolidated financial statements for the year ended June 30, 2007, from which the summarized information was derived.

#### Cash and cash equivalents

The Society considers all cash and other highly liquid investments with initial maturities of three months or less to be cash equivalents.

At times during the year, the Society maintains cash balances at financial institutions in excess of the Federal Deposit Insurance Corporation (FDIC) limits. Management believes the risk in these situations to be minimal.

#### Investments

The Society for Neuroscience invests in shares held in individual securities or investment funds which include bonds, stocks, money market funds held for investment purposes, and limited partnerships. Investment fund managers trade in various domestic and foreign financial markets, which carry a certain amount of risk of loss. Investments are stated at fair value based on quoted market prices at the reporting date or in absence of such quoted market price a reasonable estimate of fair value as approved by management. Realized and unrealized gains and losses are included in investment income in the Consolidated Statement of Activities and Change in Net Assets.

The fair value of financial instruments is determined by reference to various market data and other valuation techniques as appropriate. Credit risk from financial instruments relate to the possibility that invested assets within a particular industry segment may experience loss due to market conditions. The Society has diversified its financial instruments to help ensure that no one industry segment represents a significant concentration of risk.

Although management uses its best judgment at estimating fair value of the underlying assets for its investments, there are inherent limitations in any valuation technique. Therefore, the value is not necessarily

indicative of the amount that could be realized in a current transaction. Future events will also affect the estimates of fair value, and the effect of such events on the estimates of fair value could be material.

#### Property, furniture, equipment and improvements

Property, furniture, equipment and improvements are stated at cost. Property, furniture, equipment and improvements are depreciated on a straight-line basis over the estimated useful lives of the related assets, generally three to ten years. The building and building costs are recorded at cost and are depreciated over thirty-nine years. Expenditures for major repairs and improvements with useful lives greater than one year and in excess of \$1,500 are capitalized, and expenditures of lesser amounts for minor and maintenance costs are expensed when incurred.

#### Income taxes

The Society for Neuroscience is exempt from federal income taxes under Section 501(c)(3) of the Internal Revenue Code. Accordingly, no provision for income taxes has been made in the accompanying consolidated financial statements. The Society for Neuroscience is not a private foundation.

For the purpose of corporate tax reporting for the LLC, all financial transactions are reported under the Society's filing status.

#### Net asset classification

The net assets of the Society are reported in two self-balancing groups as follows:

■ **Unrestricted net assets** include unrestricted revenue and contributions received without donor-imposed restrictions. These net assets are available for the operation of the Society and include both internally designated and undesignated resources.

■ **Temporarily restricted net assets** include revenue and contributions subject to donor-imposed stipulations that will be met by the actions of the Society and/or the passage of time. When a restriction expires, temporarily restricted net assets are reclassified to unrestricted net assets and reported in the Consolidated Statement of Activities and Change in Net Assets as net assets released from restrictions.

#### Revenue recognition

Membership dues and journal subscription revenues are recorded as revenue in the year to which the revenue is related. Contributions and grants are recorded as revenue in the year notification is received from the donor. Contributions and grants are recognized as unrestricted support only to the extent of actual expenses incurred in compliance with the donor-imposed restrictions and satisfaction of time restrictions.

Contracts and grants received from departments or agencies of the United States Government are considered to be exchange transactions (as opposed to contributions) and are not recorded as revenue until related costs are incurred.

Rental income is recognized on a straight line basis. The leases call for rent abatement and/or annual rental payment escalations. The difference between rental income received and rental income recognized on the straight line basis is recorded as deferred rents receivable on the accompanying Consolidated Statement of Financial Position. Deferred revenue is recognized for rental payments received in advance of the period earned.

#### Use of estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities at the date of the financial statements and the reported amounts of revenue and expenses during the reporting period. Accordingly, actual results could differ from those estimates.

## NOTES TO FINANCIAL STATEMENTS

### Functional allocation of expenses

The costs of providing the various programs and other activities have been summarized on a functional basis in the Consolidated Statement of Activities and Change in Net Assets. Accordingly, certain costs have been allocated among the programs and supporting services benefited.

### Reclassification

Certain amounts in the prior year's consolidated financial statements have been reclassified to conform to the current year's presentation.

### Recent pronouncements

In June 2006, FASB issued Interpretation No. 48, Accounting for Uncertainty in Income Taxes (FIN 48). FIN 48 prescribes a "more likely than not" threshold for financial statement recognition and measurement of a tax position taken or expected to be taken in a tax return. This interpretation also provides guidance on other topics related to accounting for income tax assets liabilities, interest and penalties associated with tax position and income taxes in interim periods as well as income tax disclosures. FIN 48 is effective for non-profit organizations for periods beginning after December 15, 2007. Society for Neuroscience is currently evaluating the potential financial statement impact of adopting FIN 48, if any.

### 2. INVESTMENTS

Investments consisted of the following at June 30, 2008:

	Cost	Market Value
U.S. Government obligations	\$2,047,743	\$2,133,708
Fixed Income	8,950,220	9,468,382
Equities	16,059,664	16,054,308
Cash	1,479,365	1,479,365
<b>Total long term investments</b>	<b>\$28,536,992</b>	<b>\$29,135,763</b>

Alternative investments are comprised of the following at June 30, 2008:

Investment Type	Amount	Liquidity
Cayman Islands Exempted Company	\$1,069,757	Quarterly with 90 days prior notice

As of June 30, 2008, the Society has no uncalled commitments. Included in investment income are the following:

Interest and dividends	\$962,849
Net depreciation of investments	(3,151,817)
<b>Total investment income</b>	<b>\$(2,188,968)</b>

The investment management fee expense was \$200,357 for the year ended June 30, 2008.

Included in equities are alternative investments with an estimated market value of \$1,069,757. The sale of these investments is subject to certain conditions. At August 31, 2008, the market value of long-term investments was \$29,442,787.

The Society has resolved to use available funds and future earnings thereon to establish a strategic reserve pool that represents at least one year of expense budget. Based upon the intent of the Society, assets of the strategic reserve pool are classified as long term.

### 3. TEMPORARILY RESTRICTED NET ASSETS

Temporarily restricted net assets consisted of the following at June 30, 2008:

Julius Axelrod Prize	\$586,197
Grass Traveling Scientist Program	38,400
History of Neuroscience Video Series	60,000
Ricardo Miledi Neuroscience Training Program	86,464
	<b>\$771,061</b>

### 4. NET ASSETS RELEASED FROM RESTRICTIONS

The following temporarily restricted net assets were released from donor restrictions by incurring expenses which satisfied the restricted purposes specified by the donors:

Julius Axelrod Prize	\$63,803
Grass Traveling Scientist Program	30,776
	<b>\$94,579</b>

### 5. LEASE COMMITMENTS

The LLC currently has a total of nine tenants leasing office space within its premises. The period of the leases range from August 14, 2006 to July 31, 2018. Rental income from these leases is included in the accompanying Consolidated Statement of Activities and Change in Net Assets in property management revenue. For the year ended June 30, 2008, total rental income totaled \$1,368,016.

The following is a schedule of future minimum rental payments to be received by the LLC:

Year Ended June 30,	Tenants
2009	\$2,140,533
2010	2,340,610
2011	2,281,046
2012	2,029,183
2013	1,785,276
Thereafter	7,967,657
	<b>\$18,544,305</b>

### 6. PROPERTY, FURNITURE, EQUIPMENT AND IMPROVEMENTS

At June 30, 2008, property, furniture, equipment and improvements consisted of the following:

Land	\$7,150,400
Building	22,923,608
Building Improvements	4,716,568
Furniture	1,112,895
Computer equipment	974,989
Other	1,159,186
	38,037,646
Accumulated depreciation and amortization	(3,506,767)
<b>Total</b>	<b>\$34,530,879</b>

Depreciation expense was \$1,435,844 for the year ended June 30, 2008.

### 7. DEFINED CONTRIBUTION PENSION PLAN

The Society maintains a defined contribution plan for employees meeting certain eligibility requirements. Eligible employees may contribute a percentage of their salary subject to the maximum contribution as per the applicable IRS regulation. The Society contributes 4% to 16% of a participating employee's salary depending upon the percentage of contribution made by the employees. The Society's contributions to the plan for the year ended June 30, 2008 totaled \$594,304.

## NOTES TO FINANCIAL STATEMENTS

### 8. NOTE PAYABLE

On February 1, 2006, the Society entered into an agreement to purchase the property at 1121 14th Street, NW, Washington D.C. The purchase was financed through a \$20,000,000 note payable from Bank of America, N.A. The note calls for interest only payments until the building reaches stabilization of tenant income or once a period of eighteen months has elapsed since the closing. As of August 1, 2007, the latter criteria were met. The Society entered into a swap agreement to artificially fix the interest rate. See Note 10.

Future minimum principal payments are as follows:

Year Ended June 30,	
2009	\$483,333
2010	512,500
2011	537,500
2012	563,333
2013	592,500
Thereafter	16,885,834
	19,575,000
Less: Current Portion	(483,333)
<b>Non-Current Portion</b>	<b>\$19,091,667</b>

### 9. BONDS PAYABLE

On February 1, 2006, the District of Columbia agreed to issue its Variable Rate Revenue Bonds (Society for Neuroscience Issue) Series 2006 in the aggregate principal amount of \$12,000,000, for the benefit of the Society through Bank of America, N.A., in order to finance a portion of the costs of acquiring, constructing, and furnishing the office building, including parking garage, located at 1121 14th Street, NW, Washington D.C. The Society agreed to pay the principal or purchase price of and interest on the bonds. The bonds carry a fluctuating rate of interest per annum that approximates the BMA index (a national index of seven-day floating tax-exempt rates). As of June 30, 2008, the interest rate was 4.0%. Principal payments shall begin February 1, 2030.

### 10. INTEREST SWAP AGREEMENT

To minimize the effect of changes in the variable rate, the Society entered into an interest rate swap contract with a commercial bank for both the note and bonds payable which it pays interest at a blended fixed rate of 5.2%. The interest rate swap contract is considered a derivative financial instrument, because it derives its value from the interest rate paid on the DC Bonds. The fair value of the interest rate swap contract has been included as a liability in the amount of \$1,695,549 on the Consolidated Statement of Financial Position as of June 30, 2008. The unrealized loss on the interest rate swap is shown as an Other item on the Consolidated Statement of Activities and Change in Net Assets. The liability amounts represent an estimate of what the Society would have to pay if the agreement was cancelled as of June 30, 2008.

The recorded amount of the liability or asset representing the fair value of the swap contract will vary from year to year as (1) the variable rate received changes in relation to the fixed rate paid, (2) the principal amount is paid down, which reduces the corresponding amount of the swap contract and (3) the remaining time until maturity of the swap contract which terminates in 2030 for the note payable and 2037 for the bond payable.

### 11. LINE OF CREDIT

The Society has a line of credit with Citigroup Global Market, Inc. in the amount of \$5,000,000, with a fixed interest rate based on the applicable floating rate, LIBOR plus 50 basis points (3.22% at June 30, 2008). As of June 30, 2008, the line of credit had borrowings in the amount of \$1,764,960. The line of credit is collateralized by investments held by Citigroup.

### 12. REVOLVING CREDIT NOTE

The Society has a revolving credit note with Bank of America, N.A. in the amount of \$1,000,000, with an interest rate per annum equal to the applicable floating daily rate of the British Bankers Association (BBA), LIBOR plus 75 basis points. As of June 30, 2008, the revolving credit note had no borrowings.

## Photography Credits

**Cover:** Migratory neurons in the moth *Manduca sexta* are controlled by evolutionarily conserved families of guidance molecules. During innervation of the gut, the leading processes of growing neurons (yellow) are directed along specific muscle bands by the adhesion receptor fasciclin II (green; related to vertebrate NCAM) but are prevented from crossing the midline by a specific Eph receptor (MsEph; in blue). An unusual form of "reverse signaling" via a membrane-attached Ephrin ligand (GPI-MsEphrin, the binding partner for the MsEph receptor) restricts the neurons from the midline. Because this type of Ephrins is also widely expressed at sites of neuronal growth and injury in higher organisms, these results provide new insight into a novel molecular mechanism that may help control the development and repair of the mammalian brain.

Confocal image of the leading processes extended by migratory neurons within the developing enteric nervous system of *Manduca sexta*. The neurons and their processes (yellow) coexpress the GPI-linked ephrin ligand MsEphrin (red) and the homophilic adhesion receptor fasciclin II (green). The neurons travel selectively along visceral muscle bands on the gut that also express fasciclin II (green) while avoiding the adjacent midline muscles expressing the Eph receptor MsEph (blue). Manipulations that interfere with endogenous MsEphrin-MsEph interactions in cultured embryos cause the neurons to cross the midline inappropriately. The image was acquired at the Live Cell Imaging Facility in the Center for Research on Occupational and Environmental Toxicology at Oregon Health & Science University with the assistance of Dr. Stefanie Kaech-Petri.

Courtesy, with permission: T. M. Coate et al.; *The Journal of Neuroscience* 2008, 28(15):3846-3860.

**Inside Cover:** This image shows adult cortical astrocytes stained for GFAP (yellow) and aquaporin 4 (pink); neurons were stained for MAP2 (blue), and all cells by DAPI (green). GFAP is localized to astrocytic somata and processes, whereas aquaporin 4 localized selectively to perivascular astrocytic endfeet.

Image by Nancy Oberheim and Takahiro Takano, from *The Journal of Neuroscience* 2007, 27(45): 12255-12266. Courtesy, with permission: Maiken Nedergaard and Steve Goldman, Univ. of Rochester.

**Page 2:** An artistically stylized high-magnification confocal image of ciliary neurotrophic factor (CNTF)-expressing astrocytes in the subventricular zone of the adult mouse brain. The nigrostriatal pathway regulates adult CNS neurogenesis through D2 dopamine receptors, and this neurogenesis is mediated entirely by CNTF. Astrocyte GFAP staining is shown in green, and CNTF expression is shown in red. Note the almost exclusive overlap (yellow).

Courtesy, with permission: P. Yang et al.; *The Journal of Neuroscience* 2008, 28(9):2231-2241.

**Page 5:** Astrocytes in the stratum radiatum of mouse hippocampus just below CA1 pyramidal cells express a large number of Cx43 gap junctions (yellow puncta). Astrocytes have been labeled using antibodies to GFAP (blue), and nuclei were stained with DAPI (purple).

Illustration credit: Xiaoning Han and Takahiro Takano. Courtesy, with permission: J. H.-C. Lin et al.; *The Journal of Neuroscience* 2008, 28(3):681-695.

**Page 6:** Detail of a pyloric dilator neuron in the stomatogastric ganglion of a juvenile lobster, *Homarus americanus*. The neuron was filled with Alexa 568 hydrazide. The image is a low-transparency volume rendering from a confocal image stack generated in using AMIRA software (TGS, San Diego, CA).

Courtesy, with permission: D. Bucher et al.; *The Journal of Neuroscience* 2005, 25(7):1611-1619.

**Page 8:** Octopamine actions on the STNS. Octopamine ( $10^{-4}$  M) was bath-applied to the entire STNS. Extracellular recordings from the *lvn* and *pdn* and intracellular recordings from the PD and PY neurons before, during, and after 5 min octopamine application. Octopamine induced a reversible increase in the pyloric rhythm cycle frequency associated with strong depolarization of the PD membrane potential and slight depolarization of the PY membrane potential.

Courtesy, with permission: J.-M. Goillard et al.; *The Journal of Neuroscience* 2004, 24(32):7063-7073.

**Page 10:** A representative example of the multiphenotype progeny derived from in vitro clonal expansion of a single multipotential neural stem cell isolated from embryonic rat telencephalon. The cells were fluorescently labeled using lineage-selective markers including cholera toxin B subunit (green), anti-9-O-acetylated GD3 (orange), anti-vimentin (red), and anti-GFAP (pink), and the cell nuclei were counterstained using DAPI (blue). The progeny include vimentin+ neural stem cells and radial glia, GFAP+ astrocytes, cholera toxin+ neurons, and 9-O-acetylated GD3+ neuroglial neuronal progenitors.

Courtesy, with permission: D. Maric et al.; *The Journal of Neuroscience* 2007, 27(8):1836-1852.

**Page 13:** Illustration of a serially reconstructed GABAergic synapse on a hippocampal pyramidal cell that is labeled for neuronal nitric oxide synthase (nNOS; black particles on the postsynaptic side of the synapse). The image is a three-dimensional rendering, but the serial-section surfaces are taken from real electron micrographs of nNOS-labeled sections.

Courtesy, with permission: E. Szabadits et al.; *The Journal of Neuroscience* 2007, 27(30):8101-8111.

**Page 17:** Neural wiring reconstructed from rabbit retina tissue using serial block-face scanning electron microscopy and automated tracing algorithms. Each individually colored object denotes a putatively distinct physical wire identified by an algorithm.

Courtesy, with permission: This data was produced and is property of the lab of Winfried Denk at the Max Planck Institute for Medical Research in Heidelberg,

Germany, along with his internal collaborators Kevin Briggman and Moritz Helmstaedter, and external collaborators in the lab of Sebastian Seung at MIT in Cambridge, MA, USA along with his collaborators Viren Jain, Joseph Murray, and Srinivas Turaga.

**Page 18:** Courtesy, with permission: David Van Essen and Jason Hill.

**Page 19:** Courtesy, with permission: Jeff Neil and Terrie Inder.

**Page 20:** Rapid retraction of presynaptic motor axon terminals after postsynaptic protein synthesis inhibition. A cell-impermeant protein synthesis inhibitor is injected along with a fluorescent dextran near the neuromuscular junction of a muscle fiber in a living adult mouse. Three days later, the motor axon (yellow-green) innervating the injected muscle fiber (magenta) has become thin and has retracted from postsynaptic acetylcholine receptors (red), whereas surrounding motor axons (cyan) show normal caliber and full occupation of receptor sites.

Courtesy, with permission: C. M. McCann et al.; *The Journal of Neuroscience* 2007, 27(22):6064-6067.

**Page 24:** *In vivo* intracortical imaging of astrocytic calcium dynamics during spreading depression using two-photon microscopy (160  $\mu$ m below the cortical surface of a rat). Astrocytes were loaded with SR-101 (red) and the calcium indicator Fluo-4-AM (green). The vascular compartment was loaded with FITC dextran (green). The projected shadows of major surface vessels are clearly seen.

Courtesy, with permission: J. Chuquet et al.; *The Journal of Neuroscience* 2007, 27(15):4036-4044.

**Page 24:** Courtesy, with permission: Tuncay Erdogan.

**Page 27:** Courtesy, with permission: Institute of Neurobiology-UNAM, photograph by Laura Carballo.

**Page 30:** Courtesy, with permission: Erica J. Crespi and Robert J. Denver.

**Page 31:** The rufous-collared sparrow (*Zonotrichia capensis*) breeds seasonally on the equator in Ecuador. Local populations breed asynchronously, associated with variations in local climate and independent of photoperiod. Males only sing during the breeding season and thus display associated asynchronous changes in structure of the neural song control system between two populations in close proximity.

Courtesy, with permission: I. T. Moore et al.; *The Journal of Neuroscience* 2004, 24(45):10182-10185.

**Page 32:** The hippocampal neuroepithelium of embryonic day 14.5 embryos was electroporated in utero with pCAG-RFP plasmid. Confocal images of the hippocampus were acquired 2 months later (on postnatal day 60). Transfected pyramidal neurons (red) were found in the CA3 and CA1 regions of this hippocampus. Cell nuclei were labeled with Hoechst dye (blue).

Courtesy, with permission: I. Navarro-Quiroga et al.; *The Journal of Neuroscience* 2007, 27(19): 5007-5011.

**Page 38:** Brain scans (positron emission tomography, or PET) of a normal subject (left) and a murderer (right), illustrating the lack of activation in the prefrontal cortex (top of figure), associated with self-control, in the murderer. Warm colors (red, yellow) indicate areas of high brain activation; cold colors (blue, black) indicate low activation.

Courtesy, with permission: Adrian Raine.

**Page 39:** From the cover page of the brief of the American Medical Association et al. as Amici Curiae Supporting Respondent, *Roper v. Simmons*, 543 U.S. 551 (2005) (No. 03-633).

**Page 40:** Courtesy, with permission: Kravitz laboratory, Harvard Medical School.

**Page 41:** Negative correlation ( $R = -0.54$ ) between frontal cortex 5-HT turnover and excessive or violent forms of offensive aggression in trained wild-type rats ( $N = 28$ ,  $P = 0.003$ ).

Courtesy, with permission: Sietse F. de Boer.

**Page 42:** Newly emerging *plp*-activated neural progenitor cells at the third ventricle in the prethalamus of an E13.5 *plp-shble-lacZ* mouse embryo.  $\beta$ -Galactosidase antibody (in red) marks the activated progenitors; blbp (brain lipid-binding protein) antibody (in green) identifies these progenitors as radial glial cells; nuclear marker Hoechst (in blue).

Courtesy, with permission: D. Delaunay et al.; *The Journal of Neuroscience* 2008, 28(10): 2551-2562.

**Page 43:** Extensive degeneration of the retina in a retinal-specific, Dicer conditional knock-out. Nuclei are stained blue by a fluorescent DNA-binding molecule. All the retinal layers are thinner than normal. Rod bipolar cells, labeled red by PKC  $\alpha$  antibodies, are significantly reduced in number and display only rare and disorganized dendrites.

Courtesy, with permission: D. Damiani et al.; *The Journal of Neuroscience* 2008, 28(19):4878-4887.

**Page 52:** Rendered images of neurons labeled by the juxtacellular method in the central lateral nucleus (red) and parafascicular nucleus (blue) of the intralaminar thalamus. Example dendrites are also shown at higher resolution. The distinct dendritic architectures of these thalamic neurons are mirrored by fundamentally different firing properties *in vivo*.

Courtesy, with permission: C. J. Lacey et al.; *The Journal of Neuroscience* 2007, 27(16):4374-4384.

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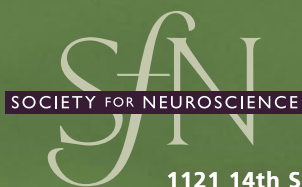
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