

Society for Neuroscience
House Appropriations Subcommittee on Commerce, Justice, Science,
and Related Agencies
Request \$7 Billion for FY2010 National Science Foundation Appropriations

Introduction

Mr. Chairman and members of the subcommittee, I am Thomas J. Carew, Ph.D., President of the Society for Neuroscience (SfN) and the Donald Bren Professor and Chair of the Department of Neurobiology and Behavior at the University of California, Irvine. It is my honor to submit this testimony on behalf of SfN in support of the National Science Foundation (NSF).

My research focuses on brain mechanisms underlying memory. Specifically I examine the temporal domains of memory: I wish to understand how some memories last only a few seconds, while others can endure a lifetime. An understanding of the cellular and molecular mechanisms of memory can open the gateway to elucidating the neuronal basis of these diverse forms of memory. To address this fundamental question, my research team at the University of California, Irvine, uses a very simple animal, the marine mollusk *Aplysia*, because its nervous system is composed of very large nerve cells that are relatively few in number. This affords significant advantages for analyzing the synaptic, biophysical, and molecular changes underlying different stages of memory. The fundamental goal of my experiments is to obtain an understanding of the mechanisms by which the nervous system acquires, stores, and retrieves information. I am the recipient of federal support from NSF and the National Institutes of Health for research and for the training of the next generation of scientists.

FY2010 Budget Request

SfN, as a member of the Coalition for the National Science Foundation, **supports a budget of \$7 billion for NSF for FY2010, a 7.9 percent increase above FY2009**. This level matches the Obama Administration's request outlined in the preliminary budget request released last month. SfN and the scientific community applaud this strong support for the agency – it is a crucial step to advance science, build a science-driven new economy, and keep the U.S. competitive in science and technology.

Continued investment in basic research at NSF is essential to laying the groundwork for discoveries that will inspire scientific pursuit and technological innovation for future generations. As reflected in the America COMPETES Act, aggressive investment in technology and scientific research is crucial to ensure America sustains its global leadership and competitiveness. Science is now a truly global enterprise that has the potential to revolutionize the human experience, health, and wellness – the question is whether America will maintain its role leading the next generation of scientific advances.

Congress and the Administration made a bold investment in NSF by providing \$3 billion in the recent economic recovery package. The funds in the recovery package will set the path for a stronger and more competitive economy, create high-wage jobs, and improve the health and life expectancy of many Americans. The \$3 billion provided to NSF will go directly into the hands of the nation's best and brightest researchers at the forefront of promising discoveries, to deserving graduate students at the start of their careers, and to developing advanced scientific

tools and infrastructure that will be broadly available to the research community. With both long-term and short-term investments in basic science, the United States is poised to continue its leadership in science-based innovation.

With FY2010, Congress has an opportunity to ensure the nation seizes the scientific momentum created by the historic recovery investment. SfN urges Congress to support President Obama's call to "return science to its rightful place" and fund future innovation at NSF with \$7 billion in FY2010.

NSF and Neuroscience

SfN supports this increase because NSF research is indispensable to studying how the brain functions, how it controls behavior and health, and how to develop new tools to treat many debilitating diseases and disorders.

The field of neuroscience is deeply interdisciplinary and relies on crucial advances in physics, computer science, mathematics, chemistry, engineering, and basic biology to develop new tools and techniques for studying brain cell activity. For instance, the field of neuroinformatics is driven in part by emerging computational innovation generated by NSF. Also, the physics necessary to create wonders like 11 Tesla functional Magnetic Resonance Imaging or advanced microscopy also emerge from NSF – with these tools, scientists can peer deeper into the brain. Finally, we were deeply honored that NSF-funded neuroscience was at the center of the Nobel Prize for Chemistry last fall. Two of the three winners are neuroscientists and members of SfN, Martin Chalfie and Roger Tsien. These scientists, along with Osamu Shimomura, were recognized for a magnificent contribution to science – the discovery and use of Green Florescent Protein (GFP), which was first observed in jellyfish. NSF support for this basic marine biology research to study nervous systems in crustaceans and other animal models was instrumental in discovering this protein. It has since become one of the most important tools used in contemporary bioscience, since it allows us to directly visualize specific types of nerve cells inside brain. In particular, GFP has become a crucial tool for studying many kinds of cell proteins, particularly brain cells, including nerve cell damage in Alzheimer's disease.

In return, many of these fields are applying neuroscience discoveries to their own fields to create new potential treatments and health interventions. For instance, brain-controlled prosthetics like cochlear implants are technical engineering marvels, making it possible for thousands of individuals who are profoundly deaf or severely hard-of-hearing to understand the speech of others, even over the telephone. By converting the acoustic vibrations of sound into electrical impulses and sending them directly to the brain via the auditory nerve, thereby bypassing receptor cells in the cochlea altogether, the implant provides this neurological "end-run" by stimulating nerve endings that would normally contact the hair cells. Recent discoveries in the neuroscience of hearing, coupled with more advanced technologies, are helping scientists design increasingly sophisticated cochlear implants as well as other types of devices that restore or enhance hearing. The cochlear implant offers a window on the power and potential of the human brain and provides a powerful example of what scientists are learning about the human brain's amazing adaptability and how this knowledge can ultimately be applied to improve quality of life.

Interdisciplinary collaboration is the hallmark of NSF research. For example, NSF-funded biologists and neuroscientists are discovering fundamental mechanisms important to understanding how humans and other animals behave, develop, communicate, learn, and process information. Understanding the neuroscience of animal diversity is necessary as we confront environmental and agricultural changes in the future. Also, NSF-funded physicists, mathematicians, computer scientists, and engineers have done ground-breaking work that enables the analysis of EEG data, the development of brain prosthetic devices, and other technologies that will assist in the rapid diagnosis and treatment of epilepsy and stroke. NSF-funded statisticians are developing new methods for analysis of the large amounts of genome data, on humans and other organisms, and developing better statistical tools for looking at the effects of the environment on human and animal populations. NSF-funded chemists have developed new methods that allows for the extremely accurate measurement of very small amounts of brain hormones.

It is also important to note that NSF is the critical funding source for evolutionary biology and neuroethology, using invertebrate models. This year, we celebrate the 200th birthday of the founder of evolutionary biology, Charles Darwin, and the 50th anniversary of the publication of his seminal work, *On the Origin of Species*. In fact, NSF support for evolutionary research has expanded substantially during the past decade. To help guide this expansion, the agency has hosted workshops, the goals of which are to identify emerging tools, identify and illustrate themes of particular promise, summarize major institutional resources and suggest infrastructure needs that will enable the next generations of advances in understanding evolution.

Indeed, many of the new findings in neuroscience can be traced back to fundamental work in these other fields that has contributed to new technologies of all kinds. This allows us to carry out new kinds of experiments not imaginable even 5-10 years ago. These discoveries have great potential to improve the lives of Americans and almost certainly would not have been made without the strong commitment to interdisciplinary research at NSF.

Commitment to Furthering Science Education and Training

Another key aspect of NSF is its support for science education and training. Through NSF grants and cooperative agreements with colleges, universities, K-12 school systems, and other research organizations throughout the United States, neuroscientists can continue to conduct the basic research that advances scientific knowledge and leads to tomorrow's treatments and cures.

SfN recognizes the leadership role that NSF plays in driving innovation in science education and is committed to furthering the study of learning, memory and perception by uniting education and neuroscience in the emerging field of "neuroeducation." Bringing together scientists and education practitioners, SfN is helping to contribute to the development of tools and strategies with the potential to ultimately improve education. As president of the Society, I am personally stressing the importance this issue by encouraging conversations between basic and applied researchers and underscoring how exciting progress in the field of neurobiology of learning and memory may inform the work of teachers and they role they can play in shaping the direction of future research. NSF's continued support for education and research that contributes to informing educational practice is essential to this burgeoning area.

Finally, I must emphasize that NSF is a leading force in the development of the next generation of scientists through its support of training. In fact, NSF often provides the initial grant mechanism supporting early career scientists before they transition to their first NIH grant. Future scientific progress relies upon the kinds of quantitative and interdisciplinary training that NSF fosters. NSF programs such as the Integrative Graduate Education and Research Traineeship Program (IGERT) are producing a cohort of scientists who have learned to work cooperatively, and have learned to learn across disciplinary boundaries, ensuring that the workforce is provided highly trained scientists who are unafraid of the challenges of the future.

About the Society for Neuroscience

The Society for Neuroscience is a nonprofit membership organization of basic scientists and physicians who study the brain and nervous system. Recognizing the field's tremendous potential, the Society was formed in 1969 with less than 500 members. Today, as we celebrate 40 years of advancing science and improving health, SfN's membership numbers more than 38,000, and it is the world's largest organization of scientists devoted to the study of the brain. Neuroscience advances the understanding of human thought, emotion, and behavior. Our member neuroscientists work to understand animal and human nervous systems, how they develop and learn, and how they interact with their environment. Our membership includes investigators from backgrounds as diverse as physics, chemistry, engineering, mathematics, biology, biochemistry, and psychology, brought together to understand all aspects of brain function, from molecules and genes to cognition.

SfN is devoted to education about the latest advances in brain research and to raising awareness of the need to make neuroscience research a funding priority. Many SfN members are committed to developing educational innovations that take advantage of new neuroscience research. This has given rise to an exciting new breed of neuroscientists who wish to combine their research careers in neuroscience with a commitment to enhancing K-12 education in the nation.

Conclusion

With passage of the American Recovery and Reinvestment Act, Congress and the Administration have entrusted the U.S. scientific enterprise, led by NSF and other agencies, to help reinvigorate the American economy. With sustainable, reliable, and robust increases, NSF will be able to seize the momentum created by the additional funds and build a science-driven economy. Providing \$7 billion for NSF in FY2010 helps ensure the agency is able to continue to fund high-quality, interdisciplinary and basic research, even after the recovery funds are expended. The nation cannot afford to lose the collaborations among scientists, engineers, physicists and biologists that have resulted in such tremendous advances, contributing to improved health. Further, NSF's support for education and training cannot continue without stable funding, as a severe decrease would leave the next generation of researchers with few options, perhaps forcing them to leave science altogether.

The scope of the challenge of understanding the human mind requires a bold approach and the ability to undertake high-risk, high-reward, interdisciplinary projects. NSF is a strong supporter of the kind of research that allows neuroscientists and our colleagues to push the boundaries to ensure groundbreaking, life-enhancing discoveries. By laying the groundwork for revolutionary

advances in neuroscience with interdisciplinary research, NSF is poised to keep the U.S. internationally competitive in the 21st century and beyond.

We urge the subcommittee to support and approve \$7 billion for NSF in FY2010. Thank you for the opportunity to submit this testimony.

Sincerely,

Thomas J. Carew
President, Society for Neuroscience
Bren Professor and Chair
Department of Neurobiology and Behavior
University of California, Irvine