

PERSPECTIVE

Support for Undergraduate Neuroscience at the NSF and NIH

Ellen M. Carpenter¹ & Deborah B. Henken²

¹Program Director, Division of Undergraduate Education, National Science Foundation, Alexandria, VA, 22314; ²Program Director, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD, 20852.

Undergraduate students are a vital component of United States efforts in neuroscience. Neuroscience as a field has grown from the study of anatomy, physiology, chemistry, physics, and psychology into an interdisciplinary field encompassing all of these aspects. Along with its growth as a field of research, neuroscience education has also grown from directed courses in neurobiology at the Marine Biological Laboratory in the 1970s to over 100 institutions currently offering Neuroscience majors to undergraduate students (Ramos et al., 2011; MBL History Archives, 2016). Commensurate with the growth of interest in neuroscience, national funding agencies have developed avenues to support both undergraduate research and education in neuroscience. This article will summarize current opportunities to support undergraduates in neuroscience available at the National Science Foundation and the National Institutes of Health.

THE NATIONAL SCIENCE FOUNDATION

The NSF is the source for approximately 24% of federally supported basic research at U. S. academic institutions, with funding directed to virtually all basic science fields, but not toward biomedical research. In 2017, the NSF budget was \$7.4 billion dollars, split among seven research and education directorates. NSF funding for basic neuroscience research stems primarily from the Directorates for Biological Sciences (BIO), Social, Behavioral, and Economic Sciences (SBE), Math and Physical Sciences (MPS), Engineering (ENG), and Computer, Information Sciences, and Engineering (CISE), while research in neuroscience education is supported by the Education and Human Resources Directorate (EHR). Additional support comes from cross-directorate programs such as the Integrative Strategies for Understanding Neural and Cognitive Systems Program (NCS). Current information about NSF funding opportunities can be found on the web pages for each of the directorates, as well as by browsing the Funding section of the NSF website (<https://www.nsf.gov/funding/index.jsp>).

A recent search of the NSF awards database using the search terms "neuroscience + undergraduate" revealed 1717 awards; as of January 2018, 325 of these awards are active. Undergraduate efforts in neuroscience are supported by a variety of mechanisms, including efforts focused on research and on neuroscience education. NSF efforts include support for undergraduate efforts in individual faculty laboratories, course-based undergraduate research (CUREs), neuroscience education, and research

coordination networks (RCNs) involving undergraduate institutions.

Individual faculty research is most commonly supported by investigator-initiated grants submitted in response to program solicitations or Dear Colleague letters issued by NSF directorates and divisions. Award size and term varies by program. Interested investigators are advised to consult individual program solicitations for guidelines for each of the programs. Investigator-initiated awards can be made to any type of institution, including research-intensive institutions, comprehensive institutions, primarily undergraduate institutions, and community colleges. The inclusion of undergraduate students in faculty research projects is encouraged by the NSF, and Research Experiences for Undergraduate (REU) funding is available to support these efforts. REU funding may come in the form of a supplement to an individual research grant, supporting undergraduate students to work on investigator-initiated projects, or as REU sites, which are independent awards to initiate and conduct projects that engage a number of students in research.

Two funding opportunities, Research in Undergraduate Institutions (RUI) and Research Opportunity Awards (ROA) specifically focus on research at undergraduate institutions. RUI awards support faculty at primarily undergraduate institutions in building capacity for research at their home institution and supporting the integration of research and undergraduate education. ROA awards also support faculty research by allowing faculty from primarily undergraduate institutions to work as visiting scientists at research-intensive organizations, where they collaborate with other NSF-supported investigators. More information about these programs may be found at https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5518

Undergraduate education in neuroscience is supported primarily by the EHR and BIO directorates. EHR has a number of programs that support undergraduate education at a variety of institutional types. These include the Improving Undergraduate STEM Education (IUSE) program, the NSF Scholarships in STEM (S-STEM) program, and the Advanced Technological Education (ATE) program. The IUSE program funds educational research initiatives at both individual and collaborative groups of institutions. IUSE projects may include curriculum redesign efforts, integration of research opportunities (e.g., through CUREs), and faculty professional development activities. IUSE projects are expected to be both evidence-based and knowledge-

generating, and thus often contain a set of research questions focused on improving knowledge about teaching and learning. The S-STEM program provides scholarship support for students with demonstrated financial need and may support students from specific disciplines or departments, such as neuroscience or psychology. S-STEM awards typically develop both academic and support activities to increase the success of students engaged in the program. ATE awards support workforce development at 2-year institutions; training students to engage in neuroscience-related technical activities would be relevant to the mission of ATE. Core research related to the scholarship of teaching and learning is also supported by EHR, through the EHR Core Research (ECR) program. The BIO directorate participates in the support of undergraduate neuroscience education through its sponsorship of the Research Coordinating Networks for Undergraduate Biology Education (RCN:UBE) program. The goal of the RCN:UBE program is to catalyze change in undergraduate biology education by leveraging the power of a collaborative network of institutions. RCN awards do not support primary research but may provide a mechanism for sharing ideas and teaching practices across a network of institutions.

THE NATIONAL INSTITUTES OF HEALTH

The NIH is a component of the Department of Health and Human Services. The mission of the NIH is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability. The NIH supports basic scientific, biomedical and behavioral, and public health research at academic institutions, medical schools, and other research entities. In 2017, the NIH budget was \$33 billion dollars, divided among 27 different Institutes and Centers (ICs). Ten of these Institutes support neuroscience research. Current information about NIH funding opportunities can be found on the web pages for each of the ICs, as well as by browsing the Funding section of the NIH guide website (<https://grants.nih.gov/funding/searchguide/index.html>). It is important to be aware that not all ICs support all funding mechanisms. Be sure to refer to the specific announcement and contact the appropriate Program Officers to confirm that the IC of interest is participating.

The NIH has a wide variety of mechanisms that support neuroscience research and training. In addition to individual Institutes, there are large NIH efforts, two of which are the trans-NIH Blueprint for Neuroscience Research (<https://neuroscienceblueprint.nih.gov/>), which aims to accelerate the pace of discovery in neuroscience research, and the Brain Research through Advancing Innovative Neurotechnologies® (BRAIN) Initiative, (<https://braininitiative.nih.gov/>), which aims at revolutionizing our understanding of the human brain by accelerating the development and application of innovative technologies. Both have training components, which, while not specific to undergraduate education, could support certain aspects. Those efforts, more specific to the education of undergraduates, or the exposure of undergraduates to

research experiences will be discussed next.

Some undergraduate research is supported by individual faculty through investigator-initiated grants which were submitted in response to standing Funding Opportunity Announcements (FOAs), received meritorious scientific scores, and were funded by one of the NIH Institutes. Research supplements to promote diversity in health-related research diversity for eligible undergraduates may be requested: <https://grants.nih.gov/grants/guide/pa-files/PA-18-586.html> for these funded grants.

The Academic Research Enhancement Award Program, (<https://area.nih.gov/>), is implemented through the R15 funding mechanism. It was started in 1985 to fulfill a unique Congressional mandate to support meritorious research, expose undergraduate and graduate students to hands-on research in eligible environments and to strengthen the research environment of schools that have not been major recipients of NIH support. It is distinct from other NIH initiatives that seek to increase diversity, enhance research in specific geographic areas, support individual or institutional training or career development, build research education infrastructure or capacity building. Direct costs are limited to \$300,000 over the project duration. The project period is limited to 3 years, but it is renewable, and can be considered a career sustaining award. Like those mechanisms supported by the NSF, a primary goal is to leverage resources, build capacity for research at their home institution and support the integration of research and the undergraduate experience.

The Research Education Program, (<https://researchtraining.nih.gov/programs/research-education/R25>) is implemented through an R25 mechanism. Many, but not all of the NIH Institutes supporting neuroscience research participate and many publish their own FOAs. The stated purpose of this program is to support research education activities in the mission areas of the NIH that: (a) Complement and/or enhance the training of a workforce to meet the nation's biomedical, behavioral and clinical research needs; (b) Enhance the diversity of the biomedical, behavioral and clinical research workforce; (c) Help recruit individuals with particular specialty or disciplinary backgrounds to research careers in biomedical, behavioral and clinical sciences; or (d) Foster a better understanding of biomedical, behavioral and clinical research and their implications. Some of these R25 programs support summer internships, or short courses tailored to students, including undergraduates. Project period limits vary as do budgets, so carefully reading the appropriate FOA and contacting a Program Officer to discuss your ideas is advised.

SUMMARY

Both the NSF and the NIH have made demonstrable financial commitments to the support and inclusion of undergraduate students in neuroscience research, and to improving the teaching and learning of neuroscience. Together these agencies have helped to advance neuroscience as a vital and dynamic field. Through their contributions to undergraduate research and education,

these agencies are helping to ensure the continued vitality of the field through training the next generation of neuroscientists and educators.

the U. S.: an analysis using data from the National Center for Education Statistics. *J Undergrad Neurosci Educ* 9:A66-A70.

Received July 20, 2018; accepted July 27, 2018.

Address correspondence to: Dr. Ellen M. Carpenter, 2415 Eisenhower Ave., Rm. W11132, Alexandria, VA, 22314. Email: elcarpen@nsf.gov.

REFERENCES

MBL History Archives (2016) Available from: <https://hpsrepository.asu.edu/handle/10776/9>.

Ramos RL, Fokas GJ, Bhambri A, Smith PT, Hallas BH, Brumberg JC (2011) Undergraduate neuroscience education in

Copyright © 2018 Faculty for Undergraduate Neuroscience

www.funjournal.org