

Feature

From Faculty for Undergraduate Neuroscience: Encouraging Innovation in Undergraduate Neuroscience Education by Supporting Student Research and Faculty Development

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INTRODUCTION

The organization Faculty for Undergraduate Neuroscience (FUN; www.funfaculty.org) was established in 1991 by a group of neuroscientists dedicated to innovation and excellence in undergraduate neuroscience education and research (Ramirez and Normansell, 2003). The founders experienced a need for a community of neuroscience educators because no formal division existed within the Society for Neuroscience (SfN; www.sfn.org) to support undergraduates or the faculty who focus on undergraduate neuroscience education.

An educator's ability to incorporate current research and techniques in crowded undergraduate curricula becomes even more critical as our understanding of how nervous systems develop, function, adapt, and malfunction continues to expand. Teaching faculty must meet the significant challenges of communicating a broad and fast-paced discipline to a growing undergraduate audience. Moreover, as research experiences for undergraduates are increasingly encouraged and expected, providing undergraduates with meaningful research experiences is an additional, ongoing challenge for educators in the face of smaller budgets for research and education. To help undergraduate neuroscience faculty meet these challenges, FUN has emerged as a professional organization dedicated to the support and development of undergraduate neuroscience educators.

The need for an organization that specifically supports excellence in undergraduate neuroscience has grown as an increasing number of interdisciplinary undergraduate neuroscience programs are formalized at colleges and universities. As evidence of the growing interest, FUN's membership has been increasing steadily and currently includes more than 500 individuals at more than 300 colleges and

universities. FUN's members represent a broad range of scientific disciplines, including biology, psychology, chemistry, computer science, and philosophy; they work and teach at a variety of institutions, ranging from private, small liberal arts colleges to regional, state, and research universities.

PHILOSOPHY AND GOALS

The principle guiding FUN's goals and activities is that students learn neuroscience best by actively engaging in research using modern techniques from multiple disciplines. By fostering research experiences throughout the undergraduate curriculum, FUN members continually demonstrate that thoughtful and engaged research mentoring allows undergraduates to make important and novel contributions to our understanding of the nervous system. Moreover, FUN recognizes that the development of tomorrow's scientists must be facilitated by talented and dedicated educators who sustain research programs that actively mentor undergraduate research experiences. In addition to cultivating tomorrow's neuroscientists, public understanding of the sciences is also critical to advancements in both basic and applied research. Consequently, FUN is also committed to the view that scientists must communicate both the methods of scientific inquiry and the necessity of addressing scientific questions from multiple perspectives to nonscientists. Current research in undergraduate science pedagogy supports both the view that future advances in science will require increasingly interdisciplinary approaches and that students learn science best via active, inquiry-driven approaches (McNeal and D'Avanzo, 1997; National Research Council, 1997, 1999, 2000a,b, 2003).

As a professional organization of and for neuroscientists dedicated to undergraduate education, FUN's goals include 1) enhancing undergraduate participation in research and in

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the presentation of research at the SfN meeting, 2) disseminating innovations in undergraduate neuroscience education, 3) recognizing excellence in undergraduate neuroscience education, and 4) developing national and regional networks that enhance undergraduate neuroscience education and research and faculty development. FUN provides a variety of networks, programs, and mechanisms to help meet its goals of advancing undergraduate education in the neurosciences through collaborative support of both faculty and their undergraduates.

SUPPORTING UNDERGRADUATE PARTICIPATION AT THE ANNUAL SOCIETY FOR NEUROSCIENCE MEETING

FUN strongly supports undergraduate participation at SfN's annual meeting because of the numerous benefits undergraduates experience by attending the premier international scientific conference in their discipline. Undergraduates find that attending the SfN meeting gives them an important view of the depth and breadth of the neurosciences and provides them with opportunities to meet neuroscientists, discuss their research, and learn firsthand about how neuroscience research is accomplished and communicated. Moreover, undergraduates find the SfN meeting an important avenue to investigate areas of research beyond their current experiences and to identify potential graduate programs of interest. The SfN recently created a new membership category for undergraduate students that welcomes young neuroscientists into this scientific community at the start of their careers.

Unfortunately, even for the most ambitious and successful undergraduate researchers, the timing of abstract submission and considerable expense of the annual SfN meeting present significant barriers for participation. To reduce these barriers, FUN supports undergraduate attendance at the SfN meeting via travel awards, by opportunities to earn stipends by staffing the FUN booth, and by creating an opportunity for all undergraduates to present a research poster.

To support those exceptional undergraduates who have submitted SfN abstracts, FUN annually provides competitive travel awards (up to \$500/student) to undergraduates mentored by current FUN members. Since 1992, FUN has provided more than 70 travel awards to undergraduates presenting abstracts at the SfN meeting, many of whom have continued their interest in neuroscience beyond their undergraduate education. The ambitious young neuroscientists who receive FUN travel awards are publicly recognized with their faculty mentors in a ceremony at the annual FUN social held in conjunction with the SfN annual meeting. Generous gifts from several foundations, corporations, and both graduate and undergraduate programs have allowed the establishment of several named travel awards. Other FUN travel awards are funded by member dues and by sales of T-shirts and brain-related novelties at the FUN booth. The FUN booth is not only an important mechanism to raise travel award funds but also a means to recruit and renew members. Stipends are provided to offset the travel expenses of undergraduates who staff the FUN booth at the SfN meeting.

As summer undergraduate research programs continue to expand and strengthen, many undergraduates produce the bulk of their data over the summer. These research students may have enough data to tell an interesting story at the fall SfN meeting, but they did not have sufficient data to submit an abstract by SfN's May deadline. Often, these students are seniors who by the next SfN meeting will have graduated and no longer be eligible for travel support from their undergraduate institutions to accompany their research mentors to the SfN meeting. To give such undergraduate researchers opportunities to present their research in conjunction with the SfN meeting, FUN hosts undergraduate poster presenters at the FUN social, a special evening event associated with the SfN meeting (Figure 1). This FUN social is held annually at or near the convention center where the SfN meeting is taking place. The FUN social draws increasingly bigger crowds of students and faculty each year with an estimated attendance of more than 300 in 2005. To allow participation by as many students as possible, the deadline for submitting abstracts to the FUN social is just a few weeks before the poster session. With more than 80 poster presentations in 2005, the FUN social is a substantial scientific session that demonstrates the tremendous potential of undergraduate research. Moreover, the FUN social is an opportunity for graduate programs to recruit applicants from a motivated and productive pool of young neuroscientists as they present their research.

SUPPORTING UNDERGRADUATE RESEARCH IN NEUROSCIENCE AND HELPING FACULTY DEVELOP STRONG RESEARCH PROGRAMS WITH UNDERGRADUATES

Since 2004 FUN has been deeply involved in a national program, Support Of Mentors And their Students (SOMAS) in the neurosciences (www.somasprogram.org), designed to enhance the mentoring skills of junior faculty training undergraduates at predominantly undergraduate institutions and to promote research experiences for undergraduates during the summer. The SOMAS program annually awards six \$10,000 grants to junior faculty who are launching their research and teaching careers at predominantly undergraduate institutions. The SOMAS program is particularly interested in receiving applications from junior faculty who have little experience in grant writing or who are from institutions that serve underrepresented minorities and women. The grants provide funds for student and faculty summer stipends, for a supply budget, for student summer housing, and for travel to the joint annual meetings of the SfN and FUN. To enhance the mentoring and grant-writing skills of the faculty as well as to promote the competitiveness of the undergraduates for entry into graduate school, the SOMAS faculty and their students are required to attend the Professional Survival Skills and Ethics Workshop (www.survival.pitt.edu/index.asp) that occurs in conjunction with the SfN meeting. In addition to the intensive summer research experience provided by their faculty mentors, the students also gain experience in writing a research report (in the style of a *Journal of Neuroscience* article) and in presenting their findings at the annual FUN poster session. In its first year, the SOMAS program received more than 60 applications, which



Figure 1. FUN Annual Social. Every year FUN hosts an evening gathering in conjunction with the SfN annual meeting. At the 2005 event, more than 300 people attended to view more than 80 posters presented by undergraduates. In addition to highlighting undergraduate research, the social also provides valuable networking opportunities for faculty who teach neuroscience. A short program at the social publicly recognizes the talented undergraduate researchers who were selected to receive FUN travel awards as well as outstanding faculty who received FUN’s annual Educator Awards.

were reviewed by the SOMAS Scientific Advisory Board and the Grant Review Committee, made up of faculty from predominantly undergraduate institutions across the United States. The inaugural awards were made to junior neuroscience faculty at institutions from Maine, Maryland, Massachusetts, Pennsylvania, South Carolina, and Texas.

Among FUN’s many initiatives to enhance the research capacity of faculty working with undergraduate neuroscience students, one of the most significant efforts was a successful campaign to increase the cap on Academic Research Enhancement Awards (AREA) at the National Institutes of Health (NIH) from \$100,000 to \$150,000 in direct costs. FUN spearheaded a collaboration involving the Council on Undergraduate Research (www.cur.org) and the SfN to persuade the NIH that increasing the cap would significantly enhance the ability of undergraduate faculty in the biomedical sciences to increase their research productivity, to promote the education of undergraduates by engaging them in substantive scientific research that is appropriately funded, and to improve the education of America’s scientific workforce by providing recent graduates from colleges and universities opportunities to work as technicians in laboratories supported by the AREA grants. In January 2003, the NIH announced that the cap on the AREA grants would be increased to \$150,000. The impact of this increase extended well beyond the neuroscience community as the AREA grants support research across the biomedical sciences.

SUPPORTING CURRICULAR DEVELOPMENT AND COMMUNICATION ACROSS PROGRAMS AND INSTITUTIONS

FUN has partnered for many years with Project Kaleidoscope (PKAL; www.pkal.org) to sponsor four workshops devoted to helping faculty develop and sustain neuroscience programs at undergraduate colleges and universities. PKAL is an alliance of faculty, administrators, and others committed to building and maintaining strong undergraduate learning environments across the sciences, mathematics, engineering, and other technical fields.

At the time of the initial planning for the first workshop at Davidson College in 1995, it was clear that the driving force in undergraduate neuroscience education was an interdisciplinary, research-based curriculum (Ramirez, 1997). At that workshop, participants created four blueprints (neuroscience as a free-standing major, as a minor, or embedded within biology or psychology) that have since been widely used to guide faculty in developing undergraduate neuroscience curricula for their own institutions (Ramirez *et al.*, 1998). Workshops held at Oberlin College in 1998 and Trinity College in 2001 both explored cutting-edge laboratory exercises to stimulate further development of investigative, discovery-based laboratory experiences. Planning for regional meetings emphasizing undergraduate neuroscience research was also a focus of these workshops, providing support and direction for such networks.

At the 2005 PKAL/FUN workshop at Macalester College, the participants revisited the blueprints that had served as curricular models in neuroscience since 1995 to address the directions that neuroscience is headed in the coming decade. These discussions established the need for a fifth blueprint

in the form of *neuroscience studies*, which focuses not only on scientific coursework but also on exploring the intersection of neuroscience with other liberal arts disciplines within the humanities and social sciences. Moreover, each of the original blueprints had evolved toward a wider range of course offerings and greater interdisciplinarity. Among the elements of the curriculum that those at the workshop viewed as important additions to contemporary programs of undergraduate neuroscience education were courses in bioinformatics and related informatics fields. As in previous workshops, the participants also explored new laboratory experiences emphasizing discovery-based learning and discussed regional networks. Finally, participants examined issues focusing on the development of leadership skills to ensure that undergraduate education in neuroscience remains vibrant well into the future.

RECOGNIZING AND DISSEMINATING INNOVATIONS IN UNDERGRADUATE NEUROSCIENCE EDUCATION

Neuroscience is an ever-widening interdisciplinary effort that is changing rapidly in the ways research is conducted and the ways in which it is taught. Many peer-reviewed journals exist to communicate research results, but few mechanisms exist to communicate and recognize innovations in neuroscience education. Several FUN members have authored textbooks, laboratory manuals, and innovative new media, but many more talented educators have modified materials and developed unique methods to stimulate student learning in their own lectures and laboratories. The communication of such effective innovations is often not appropriate for texts and laboratory manuals that are published infrequently. To provide a scholarly forum for the dissemination and discussion of a variety of innovations and best practices in undergraduate neuroscience education, FUN established a professional journal in 2002. *Journal of Undergraduate Neuroscience Education (JUNE; www.funjournal.org)* publishes peer-reviewed articles describing laboratory exercises, curricular issues, and resources. The journal is intended for a wide audience of undergraduate educators who teach within varied disciplines and institutional environments. *JUNE* was intentionally established as an online publication with full content immediately and freely accessible to all. *JUNE* regularly publishes tested examples of creative and effective neuroscience pedagogy that can be adapted by readers. Not only does the publication of such peer-reviewed pedagogical reports facilitate timely dissemination of effective teaching strategies, publication of pedagogical innovations also provides important recognition for the significant intellectual and scholarly activity inherent in the development and assessment of such teaching strategies. *JUNE* submissions and readership have increased steadily during *JUNE*'s first four volumes, indicating that there is a large community of educators who have innovations to contribute and that there is a large audience interest in discussing and implementing new materials. With journals dedicated to advancing undergraduate education such as *JUNE* and *CBE—Life Sciences Education (CBE-LSE)*, professional scientific organizations are facilitating important forums for the scholarly discussion of undergraduate science

pedagogy. As educational methods evolve, it is expected that scientific training will be enhanced, nurturing creative and bright young minds who will advance our understanding of the natural and physical world.

SUPPORTING NETWORKS THAT ENHANCE UNDERGRADUATE RESEARCH AND PROMOTE FACULTY DEVELOPMENT

FUN encourages the establishment of formal and informal regional and national networks in several ways. FUN faculty form important contacts as a result of networking opportunities with peers from other institutions throughout the nation. To facilitate discussion, FUN runs an active listserv. Contributions to the FUN listserv have covered a wide range of topics, including comments on the practicalities of various laboratory instruments; finding roommates to reduce housing expenses at a meeting; identifying strengths and weaknesses of a specific textbook; announcing jobs, grants, and workshops; and calls for political actions related to research and education. Moreover, many FUN members are very active in initiating and maintaining distinct regional conferences, such as the well-established Northeast Under/graduate Organization for Neuroscience (NEURON, www.albany.edu/neuron; Frye and Edinger, 2004). NEURON hosts a regional one-day neuroscience meeting to showcase undergraduate research posters in a welcoming atmosphere and helps sustain regional educator networks. FUN members are emulating the successful NEURON model and are establishing similar networks and conferences for undergraduates and faculty, such as the Symposium for Young Neuroscientists and Professors of the Southeast (www.cofc.edu/synapse; Talley, 2003).

RECOGNITION OF EXCELLENCE AND DEDICATION IN UNDERGRADUATE NEUROSCIENCE EDUCATION

Recognition of the neuroscientists who fuel FUN and who lead innovation in undergraduate education is important because it publicly rewards outstanding accomplishments and sustains the esprit de corps of an organization fueled entirely by energetic and devoted volunteers. To this end, FUN has created a series of awards to recognize members who have excelled in both service to FUN and innovation in undergraduate education. The annual Educator Award recognizes accomplishment that promotes neuroscience education and research at the undergraduate level; it is announced at the FUN social. Recipients of FUN's Educator of the Year award have developed new forums for communicating laboratory exercises, established a strong model for regional undergraduate neuroscience conferences, and provided innovative research opportunities for undergraduates. The Career Award recognizes a lifetime record of effort or a singular contribution that substantively aids the greater neuroscience community in a way that reflects the mission of FUN to promote neuroscience education and research at the undergraduate level. FUN Career Awardees have received their awards for the founding of the organization, for a career spent consulting with and inspiring other faculty to

develop neuroscience curricula, and for exceptional service to both FUN and the undergraduate neuroscience community. FUN's professional journal *JUNE* also names annual Editor's Choice awards recognizing the best articles published in each volume.

FUN IN THE FUTURE

FUN's successes are a modest example of what is anticipated in the future. FUN's commitment to continuation of the undergraduate travel awards, educator and career award programs, and to free access to *JUNE* will not wane. The accomplishments of FUN members and their students will continue to enhance FUN's mission because their achievements provide the impetus for FUN's cause. Among the charges that FUN is willing and able to assume in the coming years is a responsibility to provide its constituents with guidelines and support for assessment and revision of their curricular programs. The first generation of FUN members has much to contribute to ensure that the goals of the next generation of neuroscience educators and students are accomplished. FUN can serve a more active role in this endeavor in liaison with SfN and the Association of Neuroscience Departments and Programs (www.andp.org). In the coming years, the FUN membership will serve as a valuable resource for others who are developing, assessing, and reconfiguring their undergraduate neuroscience curriculum. FUN, at its core, is a group of accomplished educators who are inspired by their discipline and the potential inherent in their students to make future contributions in the neurosciences.

CONCLUSIONS

In the 15 years since its inception, FUN has grown into a dynamic organization making a significant impact on the quality of undergraduate neuroscience education. Through the participation of both faculty and students, FUN provides a unique support system to enhance and encourage undergraduate research experiences in neuroscience. The growth of the organization to include more than 500 members from around the world is indicative of the critical role FUN fulfills. FUN strives to serve this diverse and geographically diffuse group by relying heavily on Internet-based communications that are freely accessible to all. Whether through the organizational Web page, the listserve, or the eJournal *JUNE*, FUN has been able to reach out to faculty involved in undergraduate education across the country and around the world. The result is a membership with a passion for improving undergraduate curricula and a broad range of ideas and expertise to bring to this effort. FUN hopes to expand this outreach by creating networking mechanisms to help increase communication among faculty who are often working in relative isolation from other neuroscientists (Hardwick, 2005). As the undergraduates originally supported by FUN in its infancy embark on their own scientific careers, it will be interesting to see how their perspectives influence the future of organizations like FUN. The next decade will

bring new changes and new challenges. FUN looks forward to finding innovative ways to continue its mission to improve and support undergraduate neuroscience education.

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