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Feature
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News from the Funding Front: Upcoming Opportunities, Proposals Welcomed

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This column has been a welcome opportunity to keep the *CBE—Life Sciences Education* readership aware of national efforts to improve undergraduate education in the life sciences and of ways to become a part of that effort (Woodin *et al.* 2009, 2010, 2012; Wei and Woodin, 2011). Throughout the years of engagement in the Vision and Change initiative, from the summer of 2007 to the present, the three primary agencies involved, the National Science Foundation (NSF), the National Institutes of Health (NIH), and the Howard Hughes Medical Institute (HHMI), have continually maintained a dialogue with participants through formal and informal conversations, workshops, and meetings. Our shared focus has been on how the life sciences community itself can change biology undergraduate education in order to better reflect and respond to the current educational environment, including the

- rapid advances in the discipline,
- new educational technologies and platforms becoming available,
- evidence developed through research on effective practices in undergraduate education, and
- challenges of accomplishing the necessary changes with the resources available.

As the participants have talked and the funding agencies have listened, it has become clear that many life sciences faculty and administrators are unaware of existing funding programs and of the strategies needed for writing an educationally related proposal. In this column, we hope to remedy this problem (in part) by making the life sciences audience aware of two NSF programs particularly relevant to Vision and Change that appear to be underutilized by the biology community. These are:

- Transforming Undergraduate Education in Science, Technology, Engineering, and Mathematics (TUES) program (anticipated Spring of 2013 release), and
- Undergraduate Research Coordination Networks–Undergraduate Biology Education (RCN-UBE) program (next deadline is June 14, 2013).

PROGRAM DESCRIPTIONS

Both TUES and RCN-UBE support the community to catalyze change within undergraduate biology education and, in effect, act synergistically. TUES supports change in the way courses are taught, development of new materials (including new assessment materials to support these approaches), and research into undergraduate education in general. It offers support at both the course and department levels. TUES funds can be used to support course development by funding faculty time and other resources, including some funds for initial purchase of instrumentation essential to the development and implementation of transformative changes in student laboratories and/or lecture classes. TUES funds also may be used for faculty development activities that prepare other faculty to incorporate these new ideas into their own teaching (NSF, 2006). TUES also supports evaluation, webinars, conferences, and a project information portal (American Association for the Advancement of Science [AAAS], 2011). The current (FY2013) program has tracks ranging from small pilot projects with funding caps of $200,000 to large national projects with funding caps of $6 million.

The RCN-UBE program focuses on forming alliances of faculty, professional societies, and institutions active in developing, among other things, learning in emerging technologies in the biology curriculum, strategies and approaches for

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Table 1. Yearly distribution of proposals and awards within the RCN-UBE program

Fiscal year	Awarded[a]	Funding rate
2009	3	23%
2010	12	57%
2011	7	37%
2012	1	20%
2013	5	56%
Total	28	41.8%

[a]Data from NSF report server. www.nsf.gov/awardsearch/.

engaging biology faculty in professional development, incorporating emerging subdisciplines into the biology curriculum, improving assessment of student learning, improving the transition of students from 2-yr to 4-yr institutions, and incorporating authentic research experience into undergraduate laboratory courses (NSF, 2012b). The coordination efforts may include holding workshops, generating websites, or other appropriate means of developing a community of practice. The RCN-UBE program has two tracks, a full proposal track that funds projects up to $500,000 and an incubator track that funds projects up to $50,000. The incubator track accepts proposals that request support for the initial development of networks that will catalyze positive changes in biology undergraduate education. About a half-dozen incubator awards have matured into successful full awards. While the number of proposals submitted to the program has declined, the funding rates have remained high (Table 1). (The average funding rate across the 5 yr of the program is 41.8%; this is nearly double the average NSF funding rate [NSF, 2012a].)

A glance at the recently funded projects within these programs (see the Supplemental Material) should help the reader understand the scope of these two programs and how they relate to one another. Principal investigators do not need to have an ongoing project in one program in order to apply to the other, but may apply to both programs, as appropriate.

FUNDING PATTERNS IN TUES AND RCN-UBE

TUES serves all science, technology, engineering, and mathematics (STEM) disciplines, as well as projects that involve interdisciplinary approaches, research on undergraduate STEM education, assessment of student learning, and evaluation of teaching approaches. Biology proposals are handled by one of the nine teams (biology, chemistry, computer science, engineering, geology, mathematics, physics, interdisciplinary, and research and assessment) within the program. In 2012, 1007 proposals were submitted to the program. Of these, only 97 (10%) focused on biology education (Table 2). Table 2 also shows that 41% of all STEM graduates in the United States are biology majors, and 22% of all U.S. STEM faculty are biology professors. If we compare these data with the results for engineering, which has 24% of all STEM graduates each year and 14% of the STEM faculty, we see a great disparity in the degree to which faculty in these two disciplines seek funding for instructional changes in their classrooms. Fully 28% of the TUES proposals submitted in 2012 were submitted by engineering faculty, while only 10% were submitted by biology faculty.

We chose to compare engineering and biology undergraduate education because both are undergoing major reorganization; engineering due to the pressures from the Accreditation Board for Engineering and Technology, and biology due to the pressures of the Association of American Medical Colleges/Howard Hughes Medical Institute report *Scientific Foundations for Future Physicians* (AAMC/HHMI, 2009), as well as the Vision and Change initiative (AAAS, 2011).

The reasons for these strikingly disproportionate proposal submissions, despite similar demands for change in engineering and biology, are not apparent. It is our hope that articles such as this, along with frequent presentations by NSF staff at professional societies' annual and regional meetings, will encourage the community of life sciences faculty to seek funding from this versatile program, which encourages a range of projects from small pilots to test new ideas through large multi-institutional collaborations designed to disseminate effective practices more broadly (Singer *et al.*, 2012).

Because RCN-UBE is a relatively new program, its impact on undergraduate biology education is only beginning

Table 2. Distribution of TUES type 1 proposals submitted during FY 2012 and the number of majors and faculty members in the United States in the STEM disciplines

Discipline	Awarded[a] (% awarded)	Submitted (% submitted)	Graduates per year (% STEM graduates)	Number of faculty[b] (% STEM faculty)
Biology	18 (10%)	97 (10%)	88,000 (41%)	50,090 (22%)
Computer science	39 (21%)	176 (17%)	38,000 (18%)	33,510 (14%)
Chemistry	22 (12%)	116 (12%)	12,000 (5.5%)	20,830 (9%)
Engineering	48 (26%)	278 (28%)	53,000 (24%)	33,660 (14%)
Geosciences	11 (6%)	40 (4%)	4,400 (2%)	10,660 (5%)
Math	17 (9%)	78 (8%)	16,000 (7%)	53,650 (23%)
Physics and astronomy	12 (6%)	58 (6%)	5,000 (2.3%)	15,710 (7%)
Interdisciplinary	13 (7%)	122 (12%)	N/A	N/A
Research and assessment	5 (3%)	42 (4%)	N/A	N/A
Total	185	1007	216,400	230,000

[a]Data from NSF report server. www.nsf.gov/awardsearch/.

[b]Data from Bureau of Labor Statistics (2012). Estimates do not include self-employed workers. www.bls.gov/oes/current/oes251042.htm.

to emerge. Designed specifically to develop communities of people who are working on similar projects, but who otherwise may be unaware of others with similar interests, it generated a flurry of proposals in the first 3 yr, but this was followed by a dramatic decrease in the number of submissions. We are hopeful that the increase in the number of proposals between 2011 and 2012 represents an appreciation of the value of this program to build and strengthen current or future collaborative efforts, as well as an awareness of the program within the community. It is certainly a program that can serve a crucial role in the development and dissemination of ideas generated to support the Vision and Change initiative call for action.

PROPOSAL WRITING PRIMER

The number of proposals funded within any program depends not only on the number of proposals submitted but also on the quality of the proposals received. The information below provides some advice on proposal preparation.

Writing a proposal for an educational initiative is essentially the same as writing a research proposal. It is important to:

- be sure the proposal is being submitted to the appropriate program;
- clarify the subject matter to be addressed in the instructional materials or practices;
- establish the evidence for the effectiveness of the instructional practices that the project builds on and intends to adds to;
- describe outcomes from any preliminary work you have done to test the potential of the approach;
- present implementation plans succinctly, so panelists can easily understand them and judge their potential for success;
- state the outcomes expected and how they will be determined and documented; and
- indicate the level of support and/or interest either by colleagues within the department or elsewhere.

Resources exist to help with proposal preparation. For example, to determine whether the project is appropriate for a particular program, read the program solicitation carefully; program officers are always available via email or telephone to answer specific questions. The program solicitation provides the names of program officers associated with the program, as well as links to recent awards. We have included an annotated list of selected recent awards in the Supplemental Material. The evidence base for instructional best practices can be found in journals such as this one, as well as in publications such as *Vision and Change in Undergraduate Biology Education: A Call to Action* (AAAS, 2011) and *Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering* (Singer *et al*., 2012). This literature provides information on instructional best practices that inform the project being proposed and ground it in that research base.

In addition to the TUES and RCN-UBE programs within NSF, there are a variety of other funding opportunities for faculty and students in the life sciences, including the following:

1. The HHMI Science Education Alliance helps "bring good ideas in science education to a broader audience by offering educators models of research-based curricula developed to engage college students in true scientific discovery as early as possible in their academic careers" (www.hhmi.org/grants/sea/index.html).
2. The NIH has internship, scholarship, and fellowship programs for undergraduates (www.training.nih.gov/programs).
3. The NIH Institutional Research and Academic Career Development Awards help postdoctoral students develop teaching skills and pedagogical knowledge as they work with established faculty in minority-serving institutions, with the aim of facilitating the progress of postdoctoral candidates toward research and teaching careers in academia (http://grants.nih.gov/grants/guide/pa-files/PAR-12-245.html).
4. The U.S. Department of Agriculture (USDA) offers different pathway opportunities for students and recent graduates to work in agriculture, science, technology, math, environmental, management, business, and many other fields. The USDA offers internships to students and recent graduates to help them to excel in their chosen fields (www.dm.usda.gov/employ/student/index.htm).

The biology staff of the Division of Undergraduate Education has compiled a resource for those seeking information on the NSF programs that support improvement of undergraduate education in biology. This document includes helpful information on proposal preparation, insights into the review process, and post-award management. While the information is useful for faculty in any discipline, the examples and advice given are oriented to the needs of biologists. The document is updated in August of each year and can be obtained electronically by contacting Helen Vasaly (hvasaly@nsf.gov). The program officers and staff members at the NSF are looking forward to receiving your TUES and RCN-UBE proposals. Good luck!

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