NATIONAL SCIENCE FOUNDATION

http://www.nsf.gov

Education Related Programs
Background on Funding

Division of Undergraduate Education

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***Note:** The materials in this handbook do not represent an official NSF document. They have been assembled by a group of Program Directors as an aid to people inquiring about programs available. Given the rapid pace of change there may be new nuances not caught by us. The information here was compiled in August, 2011. For more information contact either Celeste Carter (vccarter@nsf.gov), Mary Lee Ledbetter (msledbet@nsf.gov), or Terry Woodin (twoodin@nsf.gov). Thanks are due to Monique Tulley of University of New Mexico, a participant in the Washington Internships for Native Students (WINS), who helped edit and update the material.

Summary of NSF Undergraduate/Graduate Education Programs

Mission: To promote excellence in undergraduate/graduate science, technology, engineering, and mathematics (STEM) education for all students.

A number of programs at the National Science Foundation support post-baccalaureate education (see Table 1). Programs may be listed more than once to reflect the number of interests they are designed to serve. **A denotes programs found across the NSF in a number of directorates. To find information on a specific program, go to the NSF website, (http://www.nsf.gov), select Education, and then select the Division and Program of interest. Alternatively, go to the disciplinary Directorate of interest to you and go to their education offerings. You will find Program Announcements (Solicitations), listings of current awards, background information, and contact information for Program Solicitation.

Table 1 NSF programs offering funding for projects involving education in Science, Technology, Engineering, and Mathematics (STEM) at the National Science Foundation. (For discipline-specific programs see individual Directorate listings on the NSF web site).

Interests served	Program name	Acronym	Division of NSF
DEVELOPMENT OF NEW MATERIALS			
Can include faculty time, beta testing	Transforming Undergraduate Education in STEM	TUES	DUE
	Advanced Technological Education	ATE	DUE
	Geoscience Education	Geo-Ed	GEO
	Centers for Ocean Science Education Excellence	COSEE	GEO/OCE
	GLOBE program	GLOBE	GEO
	EarthScope: Science, Education, and Related Activities		GEO
	Research in Disabilities Education	RDE	HRD
	Discovery Research K-12	DR-K12	DRL

	Research Coordination Networks – Undergraduate Biology Education	RCN-UBE	BIO/DUE
	Innovations in Engineering Education, Curriculum, and Infrastructure	IEECI	EEC
	Climate Change Education Partnership	CCEP	**
PROGRAM AND CURRICULUM DEVELOPMENT			
Includes developing tools for assessment	Transforming Undergraduate Education in STEM	TUES	DUE
	Advanced Technological Education	ATE	DUE
	STEM Talent Expansion Program	STEP	DUE
	Integrative Graduate Education and Research Training Program	IGERT	DGE
	C I S E Computing Research Infrastructure	CRI	CISE
	Nanoscale Science and Engineering	NSE	**
	Nanotechnology Undergraduate Education in Engineering	NUE	ENG
	Grants for Department Level Reform of Undergraduate Engineering Education	DLR	ENG
	Historically Black Colleges and Universities Undergraduate Program	HBCU-UP	HRD
	Tribal Colleges and Universities Program	TCUP	HRD
	Broadening Participation Research Initiation Grants in Engineering	BRIGE	ENG
	Geoscience Education	Geo-Ed	GEO
	Centers for Ocean Science Education Excellence	COSEE	GEO/OCE
	Opportunities for Enhancing Diversity in the Geosciences	OEDG	GEO
	Advanced Learning Technologies	ALT	OISE
	Education and Interdisciplinary Research	EIR	Phys
	CISE Pathways to Revitalized Undergraduate Computing Education	CPATH	CISE
	Alliances for Broadening Participation	ABP	HRD
	Math and Science Partnerships	MSP	DRL
	Innovative Technology Experiences for Students and Teachers	ITEST	DRL
	Discovery Research K-12	DR-K12	**
	Innovations in Engineering Education, Curriculum, and Infrastructure	IEECI	EEC
	Program for Research and Education with Small Telescopes	PREST	AST
	Science Masters Program	SMP	DGE

	Climate Change Education Partnership	CCEP	**
FACULTY AND TEACHER RECOGNITION AND DEVELOPMENT			
	Transforming Undergraduate Education in STEM	TUES	DUE
	Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers	ADVANCE	HRD
	Faculty Early Career Development	CAREER	**
	Research in Undergraduate Institutions	RUI	**
	Geoscience Education	Geo-Ed	GEO
	Centers for Ocean Science Education Excellence	COSEE	GEO/OCE
	Education and Human Resources Program, Earth Sciences	EHR	GEO/EAR
	Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring	PAESMM	DUE
	CISE Pathways to Revitalized Undergraduate Computing Education	CPATH	CISE
	Alliances for Broadening Participation	ABP	HRD
	Presidential Awards for Excellence in Math and Science Teaching	PAEMST	DRL
	Math and Science Partnerships	MSP	DUE
	Innovative Technology Experiences for Students and Teachers	ITEST	DRL
	Discovery Research K-12	DR-K12	**
	Research Coordination Networks – Undergraduate Biology Education	RCN-UBE	BIO/DUE
	Innovations in Engineering Education, Curriculum, and Infrastructure	IEECI	EEC
	STEM Talent Expansion Program	STEP	DUE
	Climate Change Education Partnership	CCEP	**
	Robert Noyce Teacher Scholarship Program	NOYCE	DUE
STUDENT SUPPORT			
	Information Technology Experiences for Students and Teachers	ITEST	DRL
	Undergraduate Research Centers	URC	CHE
	NSF Scholarships in Science, Technology, Engineering or Mathematics	S-STEM	DUE
	Federal Cyber Service: Scholarships for	SFS	DUE

	Service		
	Research Experiences for Undergraduates	REU	**
	International Research Experiences for Students	IRES	OISE
	Undergraduate Research Collaboratives	URC	CHEM
	Opportunities for Enhancing Diversity in the Geosciences	OEDG	GEO
	Collaboration in Mathematical Geosciences	CMG	GEO
	Developing Global Scientists and Engineers	EHR	DGE
	Graduate Research Fellowship Program	GRFP	DGE
	Integrative Graduate Education and Research Traineeship Program	IGERT	DGE
	East Asia and Pacific Summer Institutes for US Graduate Students	EAPSI	OISE
	Doctoral Dissertation Improvement Grants in the Directorate for Biological Sciences	DDIG	BIO
	Doctoral Dissertation Enhancement Projects	DDEP	OISE
	Discovery Corps Fellowships (postdocs)	DCF	CHE
	Pan American Advanced Studies Institutes Program	PASI	OISE
	Education and Interdisciplinary Research	EIR	Phys
	Computational Science Training for Undergraduates in the Mathematical Sciences	CSUMS	MPS
	Research in Disabilities Education	RDE	HRD
	Historically Black Colleges and Universities Undergraduate Program	HBCU-UP	HRD
	Tribal Colleges and Universities Program	TCUP	HRD
	Ethics Education in Science and Engineering (mostly graduate education)	EESE	**
	Science Masters Program	SMP	DGE
RESEARCH ON STEM EDUCATIONAL ISSUES			
	Geoscience Education	Geo-Ed	GEO
	Discovery Research K-12	DR-K12	DRL
	Research and Evaluation on Education in Science and Engineering	REESE	DRL
	Partnerships for International Research and Education	PIRE	OISE
	Historically Black Colleges and Universities	HBCU-UP	HRD

	Undergraduate Program		
	Education and Interdisciplinary Research	EIR	PHYS
	Engineering Education Programs	EEP	ENG
	Alliances for Broadening Participation	ABP	HRD
	Math and Science Partnerships	MSP	DUE
	Research Coordination Networks – Undergraduate Biology Education	RCN-UBE	BIO/DUE
	Innovations in Engineering Education, Curriculum and Infrastructure	IEECI	EEC
	Science of Learning Centers	SLC	OAD
	Education and Special Programs	ESP	AST
	Climate Change Education Partnerships	CCEP	**
MULTIPURPOSE OVERARCHING CENTERS & INFRASTRUCTURE IMPROVEMENT			
	Advanced Technological Education – Centers	ATE	DUE
	Centers of Research Excellence in Science and Technology	CREST	HRD
	HBCU Research Infrastructure for Science and Engineering	RISE	HRD
	Innovation through Institutional Integration	CREST, ITEST, MSP, Noyce, RDE, TCUP	**
	Alliances for Broadening Participation	ABP	HRD
	Math and Science Partnerships	MSP	DUE
	Research Coordination Networks – Undergraduate Biology Education	RCN-UBE	BIO/DUE
	Innovations in Engineering Education, Curriculum and Infrastructure	IEECI	EEC

WRITING THE PROPOSAL--STEPS TO SUCCESS

Preparing to Write--Do your homework

- Outline for your collaborators and yourself what you want to do.
- Consult the literature and descriptions of funded projects. Know what is being done in your field in ways similar to your proposed project.
- Consult the agency's program solicitations. Read through them to find the most appropriate program.
- If you still need clarification, email or call the appropriate Program Officer. Email is usually the best way to reach them.
- Give yourself time to complete the process a few days before the announced deadline. This can be a time consuming process. Your school may have internal deadlines to permit budget review and gathering needed signatures. It is your responsibility to be sure the proposal is submitted and received on time. **So give yourself and your grants office plenty of lead time.**
- Think about evaluation and potential for education research early in the process. Bring an evaluator in early in the planning. It helps focus the project and the proposal.
- Identifywhether approval is needed for research in human subjects. (http://www.nsf.gov/bfa/dias/policy/hsfaqs.jsp), hazardous chemicals, or use of vertebrate animals when you first submit your proposals. **Be sure the cover page indicates if this decision has been made or is pending.** No award can be made without the necessary Institutional Review Board (IRB) approval.

Writing

- Organize the proposal following proposal guidelines, (see Grants Proposal Guide on nsf.gov)
- **Make it easy for reviewers to find key items in your proposal**. Use aids such as bullets and subheadings. Format with spaces between sections.

- Refer to the literature or data from prior work. When you cite the relevant literature, reviewers can see how what you are doing relates to and builds upon prior work done by others or yourself. If you have done a pilot project, include data from that project.
- Description of Project: Be sure you clearly describe **what you want to do** and **how you will do it** as well as the **problem you want to solve** (goals and objectives) and how **you will know that you have solved it**. If possible give a short, explicit example that illustrates what you mean to do within the overall changes proposed.
- **Evaluation and Assessment:** Be sure you describe how you will follow the progress of your project, determine whether it is successful, and then disseminate outcomes. Consult a skilled evaluator, preferably external to the project itself, at the outset of planning.
- Consider the research potential of the project. Could results from your project add to the knowledge we now have about what works and why in STEM education? If at all possible relate your efforts to current research about what works and why.
- Link budget explanation clearly (by line number if possible) to items on the budget page.
- **Include the following required sections:** References Cited; Current and Pending Support; Facilities, Equipment and Other Resources. If the solicitation suggests additional information or letters of support, provide them in the Supplementary Material. **Do not overlook requirements of particular programs** such as a RUI impact statement, data management plan, postdoctoral mentoring plan, or price quotes from instrument manufacturers.

Final Steps- Little Things Count

- Check your proposal using the proposal guidelines to make sure the proposal is complete.
- Observe page limitations—reviewers are not required to read the appendices.
- **Check spelling, punctuation, and grammar.**
- Avoid abbreviations; be sure to write the complete name for an acronym the first time you use it.
- **Have someone read your draft critically.**
- Check your FastLane submission to be sure your Grants Office has submitted it properly.
- Follow the fate of your proposal on FastLane. NSF emails decisions to you. Once your proposal has been declined or awarded, reviews and panel summaries plus suggestions from the Program Officer are available on FastLane.
- **Include** data management plan and, if necessary postdoctoral mentoring form.

SUGGESTED ACTIONS AFTER YOU RECEIVE WORD OF A DECISION

Potential Awardees

- If a Program Officer calls to negotiate a potential award, negotiate in good faith. Return the requested rewritten budgets and explanations as soon as possible. **Get that IRB (Internal Review Board) approval if asked!!!**

Awardees

- When reporting results, acknowledge the source of funding; including agency, directorate and division.
- As appropriate, **keep NSF informed through annual reports and other NSF-based data collection system** that might have been developed for your program.
- Disseminate results.
- **Help hopeful potential applicants if they call for help.**
- Cooperate with educational researchers who might find your project a useful base for their own research.

Declines

- **Read the reviews carefully.**
- Consult the Program Officer if the reviews and comments seem unclear.
- **If encouraged, submit again paying attention to suggestions from the panelists and NSF Staff.**
- If you rewrite and resubmit a proposal do not specifically refer to any past declined proposals, as the next set of panelists rarely include any of those who reviewed your last proposal.

OTHER TIPS

These features increase interest in strong proposals

CURRENT NSF CONCERNS

- Attention to newly emerging fields, such as climate change, proteomics, nanoscience, cyber infrastructure, and to groups currently in **high demand** in science, mathematics, engineering and/or technology fields, such as pre-service teachers, computer science technicians, and/or those with the ability to apply interdisciplinary approaches to complex problems.
- Attention to opportunities to attract or retain students from groups currently **underrepresented** in science, mathematics, engineering or technology fields and to faculty and institutions serving these students.
- Attention to institutions that appear to be underrepresented in the current NSF portfolio such as community colleges, historically black colleges and universities, Hispanic serving institutions and tribal colleges or institutions in rural or economically depressed areas.

SOME COMMON REASONS FOR A PROPOSAL BEING DECLINED

- **Lack of evidence** that the PI is aware of the relevant literature and is building upon it.
- Diffuse, superficial and unfocused plan.
- **Lack of sufficient detail.**
- Apparent lack of the requisite expertise or experience by the proposers.
- **Lack of a clear plan to document and evaluate activities** and outcomes and to disseminate the results.
- Evaluation plans that are mainly surveys to determine user satisfaction with **no clear mechanism** for documenting changes in: student learning, faculty approaches to presenting material, and/or university and departmental or disciplinary approaches to graduate or undergraduate education.
- Note that proposals whose **summaries do not explicitly address in separate section both NSF-wide review criteria of Intellectual Merit and Broader Impacts** will be returned without review. Useful insight into what constitutes broader impact (from a chemistry viewpoint) is offered at this website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13626&org=CHE&from=home

PROPOSAL PROCESSING

What happens to your proposal once received?

Panel Reviews

- Proposals are assigned to panelists in advance and they write their reviews before arriving on site.
- All proposals are discussed by a panel of 4-6 reviewers. Panelists are your peers, knowledgeable about the discipline or sub-discipline. Typically in biology separate panels consider proposals focused on biochemistry/molecular biology, physiology/anatomy/cell biology and general/ecology. Panelists are involved in and drawn from a diverse set of institutions. Among K-12, industry, government labs, community college, liberal arts institutions, and comprehensive and research 1 university. The reviewers have a variety of backgrounds in reviewing and grants administration experience ranging from first time reviewers to awardees of multiple grants. For education grants all reviewers have demonstrated interest and expertise in education within the sub-discipline.
- Each panelist rates the proposal. A scribe writes a summary of the panel's discussion.

NSF Staff Review-The Program Director

- Reads the reviews and the proposals.
- Decides on potential funding for proposals based on the merits of the individual proposal, funds available and proposal pressure.
- Emails or calls the potential awardees to negotiate needed changes based on program guidelines, reviewers' comments, common practice within the sub-discipline, and characteristics that become obvious on a careful rereading by Program Directors.
- Releases, on FastLane, anonymous copies of available reviews and panel summary.
- May enter suggestions into Fastline for those whose proposals will be declined (Program Officer Comments).

Avoidable Obstacles to Speedy Handling of a Potential Award

- Slow response to requests for additional information.
- Slow response to the need for a revised budget, lack of attention to budget guidelines.
- Overdue Annual or Final Report from you, your co-PIs, or from a PI on a project for which you are a co-PI.
- IRB approval or exemption not in hand.
  *Note: most education research uses human subjects, so IRB approval must be obtained, and informed consent of the subjects (students) given, before the research commences.

INSIGHT INTO THE REVIEW PROCESS (TUES AS AN EXAMPLE)

Introduction

To give you an insight into the review process, we have expand on three emphases listed in the newly revised program solicitation for TUES (Transforming Undergraduate Education in the STEM disciplines) program solicitation (NSF 10-544).

1. Building on prior work and contributing to the STEM education knowledge base.
2. Building a community of STEM education scholars, those who study how students learn in STEM programs.
3. Identifying and using a set of measurable outcomes.

What do these statements mean? What do we hope to see in proposals?

1. Build on Prior Work and Contribute to the Knowledge Base

We hope that PIs will

- read and acknowledge work by others that contributed to their proposed project
- put their work in the context of advances within the educational efforts and scientific advances in their discipline and STEM in general, and
- design the project so others could benefit from their findings.

It would be a nice bonus if the proposed activity

- appears to have the potential to serve as the basis for future research in science education (what works and why).

2. Build a Community of Scholars:

We hope proposals have some indication that the PIs

- consulted with others doing similar work and
- will work with their colleagues both on their campus and elsewhere to continue and expand on what they learn.

It would be a nice bonus if

- the PIs were working with groups within their discipline's professional society to both examine the value of their efforts and to disseminate it to others

3. Identify a set of Measurable Outcomes to be used in Project Management and Evaluation

We hope each project will include:

- a clear set of objectives and
- a mechanism for determining outcomes (both expected and unexpected)

It would be a nice bonus if the PIs indicated how they:

- will determine if they are doing what they had planned to do,
- will use their formative evaluations to improve the project as it evolves, and
- will determine at least the short-term outcomes of what they had done in terms of effects on students, faculty and perhaps (if appropriate) infrastructure.

Summary

NSF and other agencies are interested in projects that have **feet** and **staying power.**

Feet

- If the project is successful how does it get disseminated? How can we create a community of scholars within the discipline (the people who teach and influence graduates and undergraduates), who realize that there is a need to
  A) change what they are doing,
  B) expand their teaching to include new technologies, and
  C) try new ways to deal with students
  It is important to think how to engage others, enlist their support, pick their brains, so the best we create can become better, and adopted by others.

Staying Power

- How are you convincing others, including your department colleagues, of the usefulness of what you are doing and the need to incorporate it as department policy and practice?
- How will successful effeorts be sustained one NSF funding is over?

So we are emphasizing

- Know what others are doing and build on it—It is how we do our research. It should be how we approach our education responsibilities.

- Evaluate and assess—You will learn what the process is accomplishing so you can make needed changes, and convince others thatt is worth doing. Work early with an assessor and/or evaluator-- could be a sociologist, anthropologist, educator etc.—someone who asks you the right questions: What do you really want to do? How will you know if you accomplish it? Will the method of determining your outcomes let you know if things are not working as anticipated?
- Disseminate within your institution, within your professional society, to your friends and friendly skeptics, and to peer-reviewed journals as the project matures and when appropriate. This is the most effective way for your project to be transformative in nature.

RESOURCES TO EXPLORE ONGOING PROJECTS

NSF Resources

- NSF's **Quick Search** tool allows you to perform full-text searches on the award records, including abstracts, in NSF's database http://www.nsf.gov/awardsearch/index.jsp
- NSF's **Fielded Search** tool allows you to restrict your search criteria to specific fields in the database, and to use date and numeric ranges. To restrict your search to programs in a specific division: In the "NSF Organization" field, select that division. To restrict your search to a particular program: In the "NSF Program" fields, select Contains from the drop-down list and enter the appropriate four-digit code for the program http://www.nsf.gov/awardsearch/tab.do?dispatch=4
- NSF's **FastLane Search** tools allow you to perform a variety of searches, producing lists of recent awards and lists of awards by state, program, and institution https://www.fastlane.nsf.gov/a6/A6Start.htm
- NSF's **Budget Internet Information System** provides information about NSF funding trends, including summaries of awards by state, awardee organization, and NSF directorate http://dellweb.bfa.nsf.gov/

BIO Directorate Resources

- Consult the bio general website www.nsf.gov/dir/index.jsp?org=BIO

A Sampling of Sources External to NSF

- Contact your professional organization to find people that may share to your interests.

Journals

- Consult your professional society to find where members publish their educational work
    - Advances in Physiology Education http://advan.physiology.org/
    - American Biology Teacher http://www.nabt.org/websites/institution/index.php?p=26
    - Biochemistry and Molecular Biology Education (BAMBEd) http://www3.interscience.wiley.com/journal/122288004/grouphome/home.html
    - Bioscience http://www.bioscience.org
    - Bioscience Education eJournal http://www.bioscience.heacademy.ac.uk/journal/
    - CBE - Life Sciences Education http://www.lifescied.org/
    - Frontiers in Ecology and the Environment http://www.frontiersinecology.org
    - Journal of College Science Teaching http://www.nsta.org/college/

- Journal of Microbiology & Biology Education (formerly Microbiology Education) http://www.microbelibrary.org/about/index.asp?bid=1076
- Science http://www.sciencemag.org/
  (note particularly Education Forum articles, published within the Commentary Section of Science)
- Teaching Issues and Experiments in Ecology http://tiee.ecoed.net

Websites

- The BEN (Biosciednet) portal to the National Science Education Distributed Learning http://www.biosciednet.org/portal/
- Multimedia Educational Resources for Online Learning and Online Teaching http://www.merlot.org/merlot

ADVICE ON PROPOSAL-WRITING AND PROJECT EVALUATION

Proposal-Writing Aids

- **NSF 98-91: A Guide for Proposal Writing:** a booklet prepared by staff in DUE http://www.nsf.gov/pubs/1998/nsf9891/nsf9891.pdf
- **NSF's A-Z Index of Funding Opportunities:** easy access to information on funding opportunities at NSF http://www.nsf.gov/funding/
- **NSF Grant Proposal Guide:** detailed guidance for preparing and submitting a proposal to NSF http://www.nsf.gov/pubs/policydocs/pappguide/nsf08_1/gpg081print.pdf

Resources for Project Evaluation

- **NSF 02-057: The 2002 User-Friendly Handbook for Project Evaluation**, a basic guide to quantitative and qualitative evaluation methods for educational projects http://www.nsf.gov/pubs/2002/nsf02057/start.htm
- **NSF 97-153: User-Friendly Handbook for Mixed Method Evaluations**, a monograph "initiated to provide more information on qualitative [evaluation] techniques and ... how they can be combined effectively with quantitative measures" http://www.nsf.gov/pubs/1997/nsf97153/start.htm
- **Online Evaluation Resource Library (OERL)** for NSF's Directorate for Education and Human Resources, a collection of evaluation plans, instruments, reports, glossaries of evaluation terminology, and best practices, with guidance for adapting and implementing evaluation resources http://oerl.sri.com/home.html
- **Overview of Evaluation Methods for R&D Programs (2007)** http://www1.eere.energy.gov/ba/pba/pdfs/evaluation_methods_r_and_d.pdf
- **Field-Tested Learning Assessment Guide (FLAG)** for Science, Math, Engineering, and Technology Instructors, a collection of "broadly applicable, self-contained modular classroom assessment techniques and discipline-specific tools for ... instructors interested in new approaches to evaluating student learning, attitudes, and performance." http://www.flaguide.org/
- **AGEP Collecting, Analyzing and Displaying Data** http://www.nsfagep.org/resources/CollectingAnalyzingDisplayingData.pdf
- **American Evaluation Association** http://www.eval.org/resources.asp
- **American Evaluation Association Guiding Principles for Evaluators (2004)** http://www.eval.org/Publications/GuidingPrinciples.asp
- **Research Methods Knowledge Base:** Design a short but comprehensive, on line overview of quantitative designs http://socialresearchmethods.net/kb/design.php

- **Research Methods:** Knowledge Base: Types/Traditions of Qualitative Research: A short but comprehensive on-line overview of qualitative design http://socialresearchmethods.net/tutorial/Mensah/default.htm
- **Evaluating and Improving Undergraduate Education in Science, Technology, Engineering and Mathematics** http://www.nap.edu/catalog.php?record_id=10024
- **Student Assessment of Their Learning Gaines (SALG):** An on-line survey of students concerning their perceptions of their learning gains within a course. Well worth looking at for ideas and possible use. http://www.salgsite.org/
- **W.K. Kellogg Foundation Handbook** http://www.wkkf.org
- **United Way of America:** Measuring Program Outcomes: A Practical Approach http://www.unitedwaystore.com/product/measuring_program_outcomes_a_practical_approach/program_film
- **Using FastLane to Submit Proposals** links to a detailed guide to preparing and submitting proposals via FastLane and links to information about programs requiring submission via grants.gov https://www.fastlane.nsf.gov/fastlane.jsp
- **Human Subjects:** http://www.nsf.gov/bfa/dias/policy/hsfaqs.jsp

Partinent Workshops, Studies, and Reports on Undergraduate Education

- **New Challenges, New Strategies: Building Excellence in Undergraduate STEM Education** Report from a 2008 meeting highlighting CCLI (now TUES) projects and lessons learned from them
- **Recommendations for Action in Support of Undergraduate Science, Technology, Engineering, and Mathematics** and **Recommendations for Urgent Action** Project Kaleidoscope 2002, 2006 reports calling for "collective action" to share ideas and materials so that projects build on, connect to, and enhance the work of others http://www.pkal.org/documents/ReportonReports.pdf and http://www.pkal.org/documents/ReportOnReportsII.cfm.
- **How Students Learn**--An NRC 2005 report on effective teaching mechanisms (emphasizes the importance of teaching subject matter in depth, eliciting and working with students' preexisting knowledge, and helping students develop the skills of self-monitoring and reflection) http://www.nap.edu/books/0309074339/html/
- **Invention and Impact: Building Excellence in Undergraduate Science, Technology, Engineering and Mathematics Education**--A 2004 report from an AAAS organized meeting of CCLI active faculty describing some of the successful efforts supported by the CCLI program and its predecessors (the Course and Curriculum Development (CCD), Instruction and Laboratory Improvement (ILI), and Undergraduate Faculty Enhancement (UFE) programs). http://www.aaas.org/publications/books_reports/CCLI

- **Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future**--Committee on Prospering in the Global Economy of the 21st Century: An Agenda for American Science and Technology, Committee on Science, Engineering, and Public Policy (2007). National Academies Press http://www.nap.edu/catalog.php?record_id=11463
- **Vision and Change in Undergraduate Biology Education**—a Call to Action (2009) http://visionandchange.org/

BIOLOGY REPRESENTATION IN DUE PROGRAMS

STEP: Science, Technology, Engineering, and Mathematics Talent Expansion Program

Purpose: Increase the number of students receiving associate or baccalaureate degrees in established or emerging fields within science, technology, engineering, and mathematics (STEM). Two types of projects are supported, those aimed at implementing strategies that will lead to an increase in the number of students obtaining STEM degrees (Type 1) and those that conduct educational research on degree attainment in STEM (Type 2). A major focus of the Type 1 projects is to make changes in the first-year college experience

Sample BIO STEP Project:
0969607 *Ready! Set! Transfer! Project* The architecture of RST's Science and Mathematics Academies have been adapted from Prince George's Community College's (PGCC) successful STEP program and is enhanced by research-based initiatives. At the core of RST is its emphasis on retention strategies, faculty and peer mentoring and early and continued exposure to research and research-based experiences. The project management team, led by the Deans of Science and Mathematics who are all former community college faculty, is comprehensive, committed, and capable. RST is supported by the District Chancellor and the Vice Chancellor, who is the lead internal evaluator. The external advisory committee includes representatives from PGCC and members of the University of Washington's Undergraduate Research Program, Office for Minority Affairs and Diversity, the Washington NASA Space Grant Consortium, Office of Post Doctoral Affairs and the Graduate School. The internal advisory committees of each college are lead by each of the Vice Presidents for Instruction.

ATE: Advanced Technological Education

Purpose: To promote improvement in technological education at the undergraduate (with a focus on two year colleges) and secondary school levels (7-12) by supporting: curriculum development; professional development of college faculty and secondary school teachers; program development and implementation; and career pathways between secondary schools, two-year colleges, and four-year institutions. The program supports 3 tracks: Projects, Centers, and Targeted Research on Technician Education. The program encourages partnerships between industry, business, government, economic development agencies, workforce development boards, and other educational institutions to assure that community college technician programs serve the needs of the high performance workplace. Community college faculty need to play a leadership role on all projects.

Sample BIO ATE Projects:
1003649 *Serving Industry through Education: Student Mentoring and Research Techniques*
This project will establish undergraduate research as an essential component of a two-year community college education and for training the next generation of technicians for the region's biotechnology industry. The project goal is to broaden student involvement in undergraduate research to better prepare them as future employees of the region's biotechnology industry.

S-STEM: NSF Scholarships in Science, Technology, Engineering or Mathematics

Purpose: This program makes grants to institutions of higher education to support scholarships for academically talented, financially needy students, enabling them to enter the workforce following completion of an associate, baccalaureate, or graduate level degree in science and engineering disciplines. Grantee institutions are responsible for selecting scholarship recipients, reporting demographic information about student scholars, and managing the S-STEM project at the institution.

Sample Project:
1011509 *Science Master's Program: Creation of a New Master's Program in Medical and Industrial Biotechnology.* This proposal seeks to create a new Cornell-wide, STEM-based master's degree in Medical and Industrial Biotechnology (MIB), which will prepare its graduates for careers in business, industry and government by providing them with a strong foundation in both science and engineering through specially tailored courses and laboratory experiences. A hallmark of this master's program will be the integration of education and research via an extensive *hands-on* laboratory that will provide practical experience to trainees in state-of-the-art biotechnology facilities (*e.g*, the new MIB Training Lab, Biofuels Research Lab, fermentation facility, pilot GMP manufacturing facility).

PAESMEM: Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring

Purpose: Most of the best Scientists, Mathematicians, and Engineers have been greatly influenced by one or more mentors over the course of their education and careers. The program is administered by the National Science Foundation on behalf of the White House. The PAESMEM Awards are given in recognition of these mentoring efforts. We seek to identify individuals and organizations with outstanding mentoring efforts or programs designed to enhance the participation of groups (women, minorities, and persons with disabilities) underrepresented in science technology, engineering, and mathematics (STEM). The awardees serve as exemplars to their colleagues and are leaders in the national effort to more fully develop the Nation's human resources in STEM. Awards are given to individuals and organizations.

Sample BIO ATE Projects:
0829244 Individual Award: Dr. Suzzette Chopin is a professor of biomedical sciences, director of the Office of Special Programs and the Office of Research Development and a Texas A&M System Regents Professor at Texas A&M University-Corpus Christi (TAMUCC). Dr. Chopin has been instrumental in the transition of TAMUCC from a two year institution toward Research I status with an increased emphasis on faculty research. She has demonstrated extraordinary mentoring of students and faculty at TAMUCC, a Hispanic Serving Institution. Her mentoring activities have impacted hundreds of students and dozens of faculty members. Her leadership has been a major driver in changing the TAMUCC culture to one that embraces and promotes undergraduate research, mentoring, and outreach to foster diversity in science and provide students with opportunities that would not have existed without her passion, energy and skills.

Education Support from Programs in the NSF BIO Directorate or Jointly from BIO & DUE

RCN-UBE: Research Coordination Networks-Undergraduate Biology Education

Purpose: The Research Coordination Networks (RCN) Program considers proposals that encourage and foster interactions among scientists, educational researchers and practitioners to create new research and education directions or to advance a field. Innovative ideas for implementing novel networking strategies are especially encouraged. Groups are supported to communicate and coordinate their research, training and educational activities across organizational, institutional, and geographical boundaries. The proposed networking activities should have a theme as a focus of its collaboration. The focus could be on a broad research question, a specific group of organisms, or particular technologies or approaches. The RCN-UBE is a new track within the existing RCN program to support networks of groups currently working to enhance undergraduate biology education so that biology and education researchers and practitioners working on items of mutual interest may better exchange ideas, coordinate efforts and disseminate innovative practices. Application of new technologies to enhance pedagogy, increased use of inquiry-based learning, enhancement of curricula with ideas from the frontiers of science, and building research into curricula to motivate the next generation of scientists all may benefit from increased collaboration among those who develop and offer undergraduate biology curricula. Both planning grants of up to $50,000 for one year and full project grants of up to $500,000 for five years are available.

Sample BIO ATE Project:
0956059 RCN-UBE: Rocky Mountain Sustainability and Science Network: Enhancing Undergraduate Student Learning of Biological Concepts, Colorado State University - The Rocky Mountain Sustainability and Science Network (RMSSN) is combining real-world careers and biological education using field experiences to address critical issues for the sustainability and ecological integrity of public lands. The RMSSN has four principal goals: 1) to identify and assess opportunities for students to develop their understanding of sustainability and biological sciences through experiential learning; 2) to build partnerships among federal agencies, non-profits, and academic institutions to address issues of sustainability and student development; 3) to build a model of experiential science learning and design assessment tools which will facilitate the application of the

RMSSN learning model to other experiential learning programs throughout the country; and to 4) establish a diverse next generation of land stewards who excel in the sciences required to address sustainability issues in the rapidly changing and multicultural intermountain west. In addition, the RMSSN strives to increase the representation of the multicultural demographic of the western states through active engagement of minority serving institutions and purposeful outreach.

RIG: Research Initiation Grants

Purpose: To broaden the participation of scientists from groups underrepresented in the biological sciences in the U.S., these activities seek to promote the development and retention of scientists from underrepresented groups and to increase the numbers of such individuals that serve as role models for the scientific workforce of the future. A specific goal is to increase the number of research proposals submitted to NSF by individuals from groups currently underrepresented in the biological sciences as well as from scientists at minority serving institutions so they can become actively and competitively engaged in research as independent investigators and, by so doing, create new research opportunities for students from underrepresented groups.

Sample RIG/Genetics (MCB) **Project:**
1019454 *RIG: Comparative Genomics of Indels in Primate Lineages* The main goal of comparative genomics is to identify functional elements by comparing sequences between different organisms. Current rapid development of next generation technology made it possible to use closely related genomes of high quality where differences can be identified and interpreted in an evolutionary context. Among vertebrates, primate species provide an excellent model group for comparative studies because of their well-established phylogeny, genomic coverage, and annotation currently unmatched in other groups. This proposal aims to address basic scientific questions of identification, verification, impact and evolutionary history of large insertions and deletions (indels), especially those located within known functional elements of mammalian genomes. The main objective of the study is to identify and experimentally validate functional indels with signatures of selection from four pair--wise comparisons of five primate genomes: human-chimpanzee (HuCh), human-gorilla (HuGo), human-macaque (HuMa), and human-orangutan (HuOr).

RUI: Crosscutting/NSF-wide Research in Undergraduate Institutions

Purpose: Supports research by faculty members of predominantly undergraduate institutions through the funding of (1) individual and collaborative research projects, (2) the purchase of shared-use research instrumentation, and (3) Research Opportunity Awards for work with NSF-supported investigators at other institutions. All NSF directorates participate in the RUI activity. RUI proposals are evaluated and funded by the NSF programs in the disciplinary areas of the proposed research. Eligible "predominantly undergraduate" institutions include U.S. two-year, four-year, masters-level, and small doctoral colleges and universities that (1) grant baccalaureate degrees in NSF-supported fields, or provide programs of instruction for students pursuing such degrees with institutional transfers (e.g., two-year schools), (2) have undergraduate enrollment exceeding graduate enrollment, and (3) award an average of no more than 10 Ph.D. or D.Sc. degrees per year in all NSF-supportable disciplines.

Sample BIO/ Division of Environmental Biology (DEB) Project:
0942776 *RUI: Creating and Implementing a Research-Infused Botanical Curriculum: Exploring Plants from Communities to Molecules* The proposed instructional model uses upper-level research students to mentor cohorts of underclassmen during laboratory exercises. Independent research students will also act as research ambassadors, doing outreach activities at local secondary schools and training in-service teachers to implement these exercises with high school students. Rather than using only traditional one-on-one methods for mentoring undergraduate research, this approach provides first-hand course-based research experiences for all biology students. Our model of incorporating undergraduate research projects into our plant-based life science curriculum will provide all biology majors with an opportunity to participate in active research projects. These laboratory activities supplement and deepen traditional instruction about key biological concepts. Students will initially encounter this curriculum as sophomores, which will better prepare all majors for careers or further education in the biological sciences.

CAREER: Crosscutting/NSF-wide Faculty Early Career Development

Purpose: The National Science Foundation's most prestigious awards in support of the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization. Such activities should build a firm foundation for a lifetime of integrated contributions to research and education.

Sample BIO/ Evolutionary Biology CAREER Project:
0952825 CAREER: *Real-time evolution in host-pathogen networks* The foundational role of evolution within biology is at odds with public perception. In part, public skepticism is fueled by misunderstanding of evolutionary principles. In the classroom, this situation reflects a failure to communicate the basic tenets of evolutionary theory, its scientific foundation, and the practical relevance of the field. Here I propose to use the theme of disease evolution and experiments with microbes to illustrate evolutionary theory and highlight its social significance. Specifically, I will: 1) Design and publicly disseminate a series of new real-time evolution modules for undergraduate laboratory courses centered on the theme of host-pathogen evolution. 2) Design a year-long educational sequence in experimental evolution where students pose and test their own evolutionary hypotheses in the context of a wide range of disciplines. The modules will serve as a set of hands-on, inquiry-based experiments that will make important evolutionary principles come alive (e.g., the nature of mutation, the process of adaptation, the role of fitness tradeoffs, etc.).