## **Proposal Writing 101**



National Science Foundation Directorate for Engineering

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## **Today's Outline**

- Funding Trends
- The Review Process
- Getting Started
- The Proposal
  - Project Summary
  - Project Description
    - Project Rationale
    - Goals, Objectives and Outcomes
    - Evaluation
    - Dissemination
- Final Tips
- Questions



## **Funding Trends**



### 2005 Funding Rate





### **Eng Research Grant Funding Rate**





## **ENG and NSF Funding Rates**

**Research Grants** 





## Number of PIs Submitting to ENG

**Research Grants Only** 





### **Research and Education**

**Increase in Research Collaboration** 





# **The Review Process**



#### NSF Announces Opportunity

#### **NSF Proposal & Award Process & Timeline**



### **NSF Merit Review Criteria**

NSB Approved Criteria include:

- Intellectual Merit
- Broader Impacts of the Proposed Effort



### What is the intellectual merit?

#### **Potential Considerations:**

- Will the proposed activity advance knowledge and understanding within its own field or across different fields?
- How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.)
- To what extent does the proposed activity explore creative and original concepts?
- How well conceived and organized is the proposed activity?
- Is there sufficient access to resources?



### What are the broader impacts?

#### **Potential Considerations:**

- How well does the activity advance discovery and understanding while promoting teaching, training and learning?
- How well does the activity <u>broaden the participation of</u> <u>underrepresented groups</u> (e.g., gender, ethnicity, disability, geographic, etc.)?
- To what extent will it <u>enhance the infrastructure</u> for research and education, such as facilities, instrumentation, networks and partnerships?
- Will the <u>results be disseminated broadly</u> to enhance scientific and technological understanding?
- What are the <u>potential benefits</u> of the proposed activity to society?



## **Getting Started**



### A Good Proposal

A good proposal is a good idea, well expressed, with a clear indication of methods for pursuing the idea, evaluating the findings, making them known to all who need to know, and indicating the broader impacts of the activity.



## **Getting Started**

#### Key Questions

- 1. What do you intend to do?
- 2. Why is the work important?
- 3. What has already been done?
- 4. How are you going to do the work?



## **Getting Started**

### Develop your bright idea

- Survey the literature
- Contact Investigators working on topic
- Prepare a brief concept paper
- Discuss with colleagues/mentors

### Determine possible funding sources

### Prepare to do the project

Develop preliminary data



### **National Science Foundation**





### My NSF http://www.nsf.gov/mynsf/

HOME   FUNDING   AWARD	cience Foundation scoveries begin DS   DISCOVERIES   NEWS   PUBLICATIONS   STATISTICS   ABOUT   FastLane
MyNSFAbout MyNSFAbout MyNSFFrequently Asked QuestionsRSS Frequently Asked Questions	MyNSF, formerly the Custom News Service, allows you to receive notifications about new content posted on the NSF website. Notification can be received via email or RSS.   Current Subscribers   If you are already subscribed, please enter your email address in the box below and select the MyNSF button. This will take you directly to your personal MyNSF Page. You may bookmark that web page.   Email address:   New Users!   Desubscribe, type your email address in the text box below and select the Subscribe subscribe.   Email address:



### **NSF Awards Search**

National Science Foundation WHERE DISCOVERIES BEGIN  SEARCH  SEARCH SEARCH  SEARCH  SEARCH SEARCH SEARCH SEARCH SEARCH SEARCH SEARCH						
Award Search Send Comm	ents					
Awardee Information         Program Information         Search All Free-Text         Search All Fields						
Hint: The text field below 'Search Award For' searches the title, abstract, and award number fields.   Search Award For:   Restrict to Title Only:						
ho Awardee Information						
Principal Investigator						
First Name:						
Last Name: PI Lookup						



#### http://www.nsf.gov/awardsearch/onal Science Foundation

### **Chemical and Transport Systems**

HOME   FUNDING   AWAI	RDS   DISCOVERIES   NE	WS   PUBLICATIONS	STATISTICS   ABO	DUT   FastLane		
National Scier	nce Foundation		SEARC	Н		
Engineering (F	Engineering (ENG)					
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ENG Home   ENG Fundir	ng   ENG Awards	ENG Discoveries	ENG News	About ENG		
Chemical and Transport Systems (CTS)	Chemical and	Transport Syst	ems (CTS)			
CTS Home	The two annual CTS Sub	mission Windows for all Un	solicited Proposals a	re:		
About CTS	February 1 through March 1 and August 15 through September 15 each year, at 5 PM submitter's local time.         Programs and Funding Opportunities         Key: Crosscutting   MNSF-wide					
Funding Opportunities — Awards						
News						
Discoveries	Chemical Reaction Pro	cesses				
Publications — Career Opportunities	<u>Catalysis and Biocatalysis</u> <u>Process and Reaction Engineering</u> <u>Fluid and Particle Processes</u>					
Submission Windows						
Become a Reviewer	Fluid Dynamics and Hydraulics     Particulate and Multiphase Processes					
Award Achievements 	Interfacial, Transport	, and Separation Proces	ses			

## **Information on Funding Opportunities**

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Web:
  www.nsf.gov
Grant Proposal Guide:
   http://www.nsf.gov/pubs/gpg/nsf04_23/
 NSF – Awards:
   http://www.nsf.gov/awardsearch/
Program Officer
 Colleagues
```



## **Getting Started**

Read the program solicitation

- Determine how your ideas match the solicitation and how you can improve the match
- Determine if you are eligible
- Talk with NSF Program Officer
  - Your proposed project
  - Specific program requirements/limitations
  - Current program patterns
- Coordinate with your organization's sponsored projects office



## **Types of Proposal Submission**

No deadlines Deadlines Target dates Submission Windows Preliminary proposals Letters of Intent



## **The Proposal**



### What makes a proposal Competitive?

- Likely high impact
- New and original ideas
- Succinct, focused project plan
- Knowledge of subject area of published, relevant work
- Experience in essential methodology
- Clarity concerning future direction
- Sound scientific rationale
- Realistic amount of work
- Sufficient Detail
- Critical Approach



## **Sections of an NSF Proposal**

- Cover Sheet
- Project Summary
- Table of Contents
- Project Description
- References Cited
- Biographical Sketch(es)
- Budget
- Current & Pending Support
- Facilities, Equipment & Other Resources
- Special Information & Supplementary Documentation



#### **Write Proposal to Answer Questions**

What are you trying to accomplish? What will be the outcomes?

Why do you believe that you have a good idea? Why is the problem important? Why is your approach promising?

How will you manage the project to ensure success? How will you know if you succeed?

How will others find out about your work? How will you interest them? How will you excite them? Goals etc.

Rationale

Evaluation

Dissemination



## **Project Summary**

Pay special attention to Project Summary

- Summarize goals, rationale, methods, and evaluation and dissemination plans
- Address intellectual merit and broader impacts
  - Explicitly and independently
  - 1 Page Limit
  - Three paragraphs with headings:
    - "Summary"
    - "Intellectual Merit"
    - "Broader Impacts"



## **Project Description**

#### Introduction

- Project Rationale
- Goals
- Background/Literature Review
  - Previous work you have done
- Action Plan
- Evaluation
- Management Plan
- Broader Impacts
  - Dissemination
- Prior Results



# **Project Rationale**



## **Project Rationale**

- Rationale is the narrative that provides the context for the project
- What does the knowledge base say about the approach?
  - What have others done that is related?
  - What has worked previously?
  - What have been the problems/challenges?
- Why is this problem important?
  - Is it a global or local problem?
  - What are the potential broader impacts?
  - How will it improve quality of learning?

What is the evidence that the approach will solve the problem?

- Address the defined outcomes?
- Achieve the defined outcomes?
- Improve student learning?



## Goals → Objectives → Outcomes



## An Example: Origin of a CCLI Proposal



## Scenario

Prof X has taught Signal Processing at U of Y for several semesters.

- She has an idea for greatly improving the course by adding "new stuff"
  - "New stuff"
    - Material (e. g., modules, web-based instruction)
    - Activities (e. g., laboratories, projects)
    - Pedagogy (e. g., problem based learning)
- She has done some preliminary evaluation
   She decides to prepare a CCLI proposal



### **CCLI** Program

Vision:

 Excellent STEM education for all undergraduate students.

#### Goal:

 Stimulate, disseminate, and institutionalize innovative developments in STEM education through the production of knowledge and the improvement of practice.



## **Professor X's Initial Proposal Outline**

#### ✤ Goals:

Develop "new stuff" to enhance student learning at U of Y

#### ✤ <u>Rationale:</u>

 Observed shortcomings in educational experience of the students at U of Y and felt that new stuff would improve the situation

#### Project Description:

- Details of "new stuff"
- ✤ <u>Evaluation:</u>
  - Use U of Y's course evaluation forms to show difference

#### Dissemination:

 Describe "new stuff" using conference papers, journal articles, and web site



## **Project Goals and Objectives**

#### **Defining Goals**

Broad, overarching statement of intention or ambition

#### Sample Goal for Prof. X

The project is developing a signal-processing laboratory that is vertically integrated into the curriculum to illustrate theoretical concepts through application-driven exercises.



#### **Defining Objectives**

#### Specific statement of intention

- Measurable
- More focused and specific than a goal
- A goal typically leads to several objectives



## Exercise

#### **Activity**

Write one or more objectives for this sample project goal

#### Sample Goal for Prof. X

The project is developing a signal-processing laboratory that is vertically integrated into the curriculum to illustrate theoretical concepts through application-driven exercises.



## **Sample Objectives**

- Create laboratory exercises that give hands-on experience to enhance conceptual understanding
- Increase student retention rates (in program)
   because interest in topic is increased
- Increase retention of technical material for future courses
- Improve laboratory skills of students
- Improve student confidence or attitude about profession



### **Expected Measurable Outcomes**

#### **Defining Outcomes**

Statement of expected result

Measurable with criteria for success

An objective may lead to one or more outcomes

#### <u>Activity</u>

Write one or more expected measurable outcomes for this objective: Increase student retention rates (in program)



### **Expected Measurable Outcomes**

#### **Objective: Increase student retention rates**

- Increase student graduation rates by \_\_\_\_ percent
- Increase students' transition rates from the first to second year courses from \_\_\_\_ to \_\_\_\_
- Increase the students' "Attitude towards discipline" as measured by surveys and interviews by \_\_\_\_ percent



## **Evaluation**



## **Sample Evaluation Plan**

Assessment of the Student Response Technology (SRT) will be both quantitative and qualitative. First, students will be surveyed at the end of the semester on the content, level of difficulty, and their perceived level of mastery of the concepts of Statics. Second, faculty members teaching the course using SRT will be asked to judge its effectiveness in monitoring student achievement throughout the semester. In addition, faculty members who have been teaching Statics course for several years will be asked to compare students' abilities after using SRT with those in previous years who have not used SRT. Finally, the final grades of students using SRT will be compared with those from previous years who have not used the technology in the classroom.



## **Project Evaluation Plan**

All projects require evaluation

All proposal require an evaluation plan
What aspects should Prof X evaluate?
How should she evaluate them?

What should Prof X include in her evaluation plan?



## **Evaluation Plan Should Include**

#### Formative assessment

- Provides feedback during the design and implementation phases
- Helps monitor progress toward outcomes
- Provide details on tools & experimental design
  - Describe how
    - Students will be "surveyed",
    - Faculty will be "asked",
    - Grades will be "compared"
  - Indicate who will do these tasks
  - Indicate who will analyze and interpret the data
  - Try to measure deeper learning
  - Collect demographic data on student populations



## **Evaluation Tips**

- Get help at the beginning in the proposal writing phase
  - Involve an expert evaluator
  - Consider outside (independent) evaluator
- Consult other sources
  - User Friendly Handbook for Project Evaluation
    - http://www.nsf.gov/pubs/2002/nsf02057/start.htm
  - Existing tools
  - Science education literature



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## Dissemination

#### (Contributing to Knowledge Base & Building Community)



### **Sample Dissemination Plan**

This project will serve as a pilot for other courses at the University of \_\_\_\_\_ and at other colleges and universities throughout the country. The results of our evaluation will be disseminated on the University's web site, which will contain a special page devoted to this NSF-sponsored project. Additional dissemination will occur through presentations at conferences, such as teacher education and science education conferences, regionally and nationally, and through articles published in peer-reviewed journals.



## **Dissemination Plans**

All CCLI projects need to contribute to:

- The STEM education knowledge base
- Building the STEM education community
- How can Prof X's project "contribute to the STEM education knowledge base"?
  - How does she indicate this in the proposal?
- How can Prof X's project "help build the STEM education community"?
  - How does she indicate this in the proposal?



## **Dissemination Plans Tips**

- Be more proactive in promoting website & materials
- Integrate community building , dissemination and evaluation
- Target and involve a specific sub-population
  - Those who teach similar course at other locations
  - Ask them to review various products, data, and experimental approaches
  - Work with them to organize
    - Email exchanges and listserves
    - Informal meeting at a conference or on-campus
    - Faculty development workshops (on-campus and at conferences)
  - Explore beta test sites



## **Dissemination Plan Tips**

- Be specific about how the project will serve as a "pilot"
  - Strategy for evaluating and disseminating
  - Strategy for getting "buy-in" by others
- Be more specific in publication efforts
  - Indicate the specific conferences and journals
    - Include conference travel and journal page charges in budget
    - Include a tentative title & description of paper
  - Explore other venues
    - Science news publication and lay press
    - Professional society and specialty listserve



## **Dissemination Plan Tips**

#### Explore commercialization

- Discuss contacts with software and textbook publishers
- Put material in a form suitable for the National Science Digital Library (NSDL)





#### **Reviewers have**

- Many proposals
  - Ten or more from several areas
- Limited time for your proposal
  - 20 minutes for first read
- Different experiences in review process
  - Veterans to novices
- Different levels of knowledge in proposal area
  - Experts to outsiders
- Discussions of proposals' merits at panel meeting
  - Share expertise and experience



#### Use good style (clarity, organization, etc.)

- Be concise, but complete
- Write simply but professionally
- Avoid jargon and acronyms
- Check grammar and spelling
- Use a readable, "friendly" structure
  - Use sections, heading, short paragraphs, & bullets
    - Avoid dense, compact text
  - Reinforce your ideas
    - Summarize them
    - Highlight them (bolding, italics)
  - Give examples
  - Provide appropriate level of detail



#### Follow the solicitation and GPG

- Adhere to page, font size, and margin limitations
  - Use allotted space but don't pad the proposal
- Follow suggested (or implied) organization
- Use appendices sparingly (check solicitation to see if allowed)
  - Reviewers not required to read them
- Include letters showing commitments from others
  - Avoid form letters



Prepare credible budget

- Consistent with the scope of project
- Clearly explain and justify each item
- Address prior funding when appropriate
  - Emphasize results
- Sell your ideas but don't over promote
- Address review criteria
- Don't make assumptions about audience
  - The reviewers
- Proofread it
  - Also have expert and non-expert read it



Use data to document existing shortcomings

- Describe management plan
  - Provide tasks, team responsibilities, timeline
- Provide clear examples of the approach
- Integrate the evaluation effort early
  - Build assessment tools around defined objectives and expected outcomes
  - Connect with independent evaluation experts
- Identify strategies for dissemination
  - Define a plan to contribute to knowledge base
  - Address broader impacts
  - Collaborate, form partnerships (build community)



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#### Get advice

- NSF program directors
- Experienced colleagues
- Use an "imaginary panel"
  - Variation on guidelines for effective writing
    - Write for a specific reader

#### Use your judgment

 Don't include a poorly developed section because someone told you that it is needed



### **Getting Support in Proposal Writing**

#### NSF Publications

- Program Announcements/ Solicitations
- Grant Proposal Guide
- Web Pages
- Funded Project Abstracts
- Reports, Special Publications
- Targeted Workshops

- Program Officers
  - Incumbent
  - Former "Rotators"
- Mentors on Campus
- Previous Panelists
- Serve As Reviewer
- Sponsored Research Office
- Successful Proposals



# Questions



### **Contact Information**

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