New Faculty Guide to Competing for Research Funding

What all new faculty need to know about finding funding and writing research proposals

By Mike Cronan and Lucy Deckard

August 2012 edition
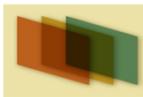
Academic Research Funding Strategies, LLC

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Competing for Research Funding

*What all new faculty need to know about finding funding
and writing research proposals*

BY MIKE CRONAN AND LUCY DECKARD

*Strategies to help new faculty get off to a successful
start in identifying and competing for grants to support
their research*

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About the Authors

This book was published by *Academic Research Funding Strategies, LLC*, a consulting firm that specializes in helping faculty and universities compete more successfully for research funding. We also publish a monthly newsletter, *Research Development & Grant Writing News*, which addresses in greater depth the subjects touched on in this book. The newsletter also includes information on recently-announced funding opportunities, strategic changes at the agencies, and other time-limited information. For more information about the newsletter and how to subscribe, please see our website.

The Authors

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He developed, staffed, and directed two highly successful proposal development offices at Texas A&M, one in the Texas Engineering Experiment Station (Office of Research Development & Grant Writing, 1994-2004), a state-wide engineering research agency with divisions at 14 universities, and the second for the Vice President for Research (Office of Proposal Development, 2004-09), working across all academic disciplines in 11 colleges.

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Introduction

The following sections cover the core questions most often raised by new faculty starting a university research career. While federal agencies, foundations, and other funders of research differ significantly in their research mission and objectives, in agency culture and protocols, and in guidelines for submitting unsolicited proposals, the core knowledge base and writing expertise you need to acquire comprise an *accumulation of generic strategies* leading to more success in grant writing, regardless of academic discipline or research agency.

For example, regardless of whether you are submitting a proposal to the Defense Advanced Research Projects Agency (DARPA) or the National Endowment for the Humanities (NEH), your core competitive strategies will be similar:

- You must make a compelling case for the significance of your research, including its impact on the field and the value it brings to the agency's mission.
- You must understand the mission and culture of the agency sufficiently to explain how your research fits within the context (e.g., goals, objectives, outcomes, etc.) of the agency's research priorities as defined in the funding opportunity.
- You must write a research narrative that fully responds to the program guidelines.
- You must understand how your proposal will be reviewed.
- You must describe for reviewers:
    - what you will do,
    - why it is important to do it,
    - the significance and impact of your research on the field and agency mission,
    - why you are the right person to do the research,
    - why you have the capacity, expertise, and experience to perform it, and
    - that you have the institutional infrastructure to support your efforts when required.

These, and other topics addressed here, offer generic strategies for success, although they will be made more robust and nuanced by the specifics you come to understand about specific agencies, your discipline, and more detailed requirements unique to particular agencies or their programs.

Developing a Strategic Plan for Funding Your Research

The first few months as a new faculty member can be overwhelming, but setting aside some time to start developing a strategic plan for funding your research will help you in the long run. New faculty members face a tremendous number of demands on their time. In addition to learning your way around campus, setting up your office, getting to know your colleagues, and preparing to teach, set aside some time to develop a strategic plan for what you will do over the next few years to position yourself to secure funding for your research. Creating a plan to guide you will make finding and competing for funding less overwhelming and will help you use your time more efficiently. In fact, many of the things you'll need to do can be accomplished in parallel with your other activities. For example, when you meet with your Department Chair, ask about departmental expectations regarding funding, and as you meet your departmental colleagues, keep an eye out for potential grant mentors and collaborators.

Below is a list of steps you need to take as part of developing your strategic plan. Subsequent chapters will explore many of these topics in more detail.

- **Develop your research agenda**: What research topics do you plan to pursue over the next five years? (You probably had to do this as part of your search for a faculty position, but you should revisit your plan periodically as your field evolves and as you determine the strengths of your institution and identify potential collaborators.)
- **Develop your education agenda**: What are your interests related to education in your discipline? (This is particularly important if you plan to pursue funding from NSF.)
- **Determine the expectations for research funding in your department**: How is funding counted in the promotion and tenure process in your department? Are you expected to win external funding early in your career, or are publications more important? When should you start pursuing external funding?
- **Find research grant mentors**: These may be well-funded faculty in your department, colleagues from other departments, former dissertation advisors, staff in your research development office, or colleagues from other institutions.
- **Find out who is likely to fund your research, and get to know those funders**: Just as you need to network within your research community, you also need to get to know and understand your funding community – understand the mission, culture, and procedures of agencies and foundations likely to fund your research, and get to know the program officers, reviewers, and researchers who are well-funded in your research area.
- **Develop a process for identifying specific funding opportunities that you may want to pursue now or in the future**: Many grant programs are recurring and have relatively predictable due dates. Others, particularly those in highly active areas, may appear suddenly. Creating a process for identifying opportunities

early will give you time to plan the opportunities to pursue and avoid last-minute proposals.

- **Identify potential collaborators if appropriate**: If you're in a field that encourages collaboration, then collaborating with other researchers can help you move into new fields of research and compete more successfully for grant funding. It's important, however, to determine how your department and institution view collaboration and how joint projects and publications will be handled during the promotion and tenure review.
- **Identify research development resources at your institution**: Most universities have research offices, and many have research development offices that provide a range of services that may include websites with updated funding opportunity lists, proposal workshops for new faculty, personal consultations, and even assistance with editing your proposal. Sponsored Projects (or similarly named) offices will often help you with your budget and with routing, uploading, and submitting your proposal. Seek out the resources available at your institution and the procedures required to use them.
- **Do your homework and determine what you must to do to be competitive**: Writing a proposal takes a lot of time and effort, so you'll want to make sure your proposal is as competitive as possible. Do you need more preliminary data? Have you read all of the relevant literature? Do you understand the program to which you're applying? Have you talked to the Program Officer? Have you talked to other researchers who have been funded through that program? Develop your proposal-writing skills. If your institution offers proposal-writing workshops, take advantage of them. Ask your funding mentors to show you examples of successful and unsuccessful proposals.
- **Schedule your proposal writing**: What grant do you plan to submit first and when is it due? What grant will you submit after that? How long will it take to produce the proposal? When should you start working on that first grant? Put those dates on your calendar, and set aside time for proposal writing. If you wait for your calendar to be clear, it will never happen!
- **Plan to be declined**: It's a fact of life for anyone who submits proposals that they will be declined more often than they'll be funded. Successful researchers learn from their reviews and continue to submit proposals. Build into your plan the expectation that you will need to revise and resubmit your proposal before it is funded.

We'll discuss these steps in the rest of this book. We'll also give an overview of the actual writing process and the sections that appear in a typical research proposal. Our intention is to give you a high-level overview of the process for finding and competing for research funding without overwhelming you. Other resources, including our monthly newsletter, *Research Development and Grant Writing News*, and agency- and discipline-specific books on funding, explore these subjects in considerably more detail, discussing particular programs and agencies.

Developing Your Research Agenda

As you search for research funding, it's important to have a clear idea of where you want to go with your research. Having a clear, focused idea of your research direction will enable you to select the grants that will help you develop a clear line of scholarship. Publications will, in turn, help you establish the credentials that proposal reviewers seek. The detailed steps to follow in developing a research agenda vary considerably by discipline, but take these considerations into account as you consider funding options:

- Is your research agenda sufficiently separated from that of your graduate advisor so that you will be able to establish an independent career?
- Is your research agenda in an area that you are passionate about and would enthusiastically spend the next few years working on?
- Do you have a strong publication record that will support your chosen research area or a closely related area, or do you have a plan to establish a strong record soon? If the area is very new, will your previous publications demonstrate your qualifications to pursue this research area?
- Is your research agenda in an exciting, vigorous, high-impact area of scholarship (rather than in an already well-researched area in which progress is now incremental)?
- Is your research agenda in an area currently funded or likely to be funded by agencies or foundations?
- Have you reviewed the strategic investment plans, research roadmaps, reports, and workshop results of the agencies you are targeting for funding?

This is not an argument for planning your future research based solely on any of these considerations whose importance will vary by discipline. For example, you may be passionate about an area of poorly funded scholarship, but if you have a strategy for conducting that research without external funding, and if your department values publications over funding, that could be a good choice for you. However, it is wise for any early career researcher to know the answers to the above questions before deciding on a particular research agenda.

Moving to a New Research Area

At this point in your career, you may have two or three research interests that move in somewhat different directions: continuation of the research that you did for your dissertation or postdoc, a relatively newer and more innovative offshoot of that research, and perhaps some research on a different but related topic that you plan to conduct in collaboration with other faculty. You'll typically have the strongest track record in terms of data and publications in the research related to your dissertation topic. On the other hand, the newer research directions may be more exciting and

innovative. Many researchers maintain more than one track of research and pursue funding in each.

In the case of the newer research area, you'll want to start developing a track record in that area by generating preliminary data and publishing your findings. If you feel well qualified to conduct research on a topic, but an aspect of the research lies somewhat outside your expertise (an increasingly common occurrence as disciplinary lines become blurred in new areas of research), recruit a collaborator who can contribute that expertise. If you are faculty at a Predominantly Undergraduate Institution, and you identify an NSF-funded potential collaborator, you can participate in a [Faculty Opportunity Award Supplement](#), whereby NSF provides funding enabling you to work with that faculty member during the summer. If the field is very new and you cannot find a collaborator, look for connections between the new research area and your prior research, and build on those connections. Reviewers look closely at your publications, so you'll need to make a convincing case that some of your prior publications, even if they are in a somewhat different field, are germane to the current research topic. And, of course, you'll want to publish in the area as soon as possible.

Establishing Long-Range Research Goals

Your research proposal will be more compelling if you can place the proposed research project in the context of your larger research agenda. What do you want to accomplish in this field over the next ten years? How will this particular project (which may be two-, three-, or five-years long) help you advance toward those long-term goals? Funders look for significance and impact, so tying a proposed two-year project (in which only a limited number of experiments can be accomplished) to your larger goals will allow you to make a stronger argument for the impact of your research.

Creating a long-range research plan will also help you make strategic decisions about pursuing some funding opportunities over others. While it's important to be flexible and move with the changes in your field, you'll want to avoid the trap of letting funding dictate your research. Jumping from topic to topic based on funding opportunities that happen to be available can result in a disjointed research record, and such proposals tend not to be successful anyway. Creating a well-thought-out, long-term research agenda will position you to use research funding as a tool to help accomplish your goals rather than as a wild card determining those goals.

Developing Your Education Agenda

NSF and, increasingly, other funding agencies, require education, outreach, and diversity components in research proposals. Establishing a long-term education agenda that fits your interests can make those components stronger and the projects, once funded, more rewarding.

New faculty are not surprised that they need to develop a long-term research agenda; however, it can be a surprise that they should also develop an education agenda. (This is much more than the teaching philosophy you may have developed as part of your application for a faculty position, although they may have some elements in common.) NSF and, increasingly, other federal funding agencies want to know how your project will improve the education of students at various levels (not just graduate students), increase the diversity of graduates (particularly those in science, technology, engineering, and math) and benefit society as a whole. In the rest of this chapter, we'll focus on NSF, since they generally have the most stringent criteria in this area.

Selecting Issues to Address

When developing your education agenda, first consider those issues related to education and outreach in your field that interest you. Is there an educational issue or need that you feel strongly about? Perhaps you are a scientist and have a child in elementary school and would like to help improve the quality of science instruction in elementary school. Perhaps you want to encourage more women to pursue careers in physics. It could be that you want to help improve understanding of your subject in the community. Maybe you've been teaching a sophomore class in your field and have noticed that the students aren't grasping an important concept. Any of these issues could inspire a variety of educational activities appropriate for an NSF grant.

Next, consider the needs and mission of your institution. Does your university serve a large number of minority students, students who are the first in their families to attend college, students from rural areas, working students, or another special demographic? What are your institution's future priorities and plans? Perhaps they have identified e-learning as a big priority, or they are pushing to become a Tier One institution and increase their research activity, or perhaps they've identified increasing diversity of the student body as a major concern. Think about what educational needs you could address in support of these priorities.

Researching the Issue

Next, read the educational literature to find out what others have done in this area. Two very helpful resources include the NSF MSPnet ([Math and Science Partnership Network](#)) and **ERIC** ([Education Resources Information Center](#)), which is a searchable database of education research articles. If, for example, your goal is to encourage more girls to pursue careers in physics, you might look for articles discussing the factors that

affect girls' interest in science. You might also look to see what others have done in this area and how successful those efforts have been. Your discipline may also have an education journal; for example, the [American Society for Engineering Education](#) has a peer-reviewed journal, conferences, and resources on their website. If you find some interesting approaches, it's fine to propose to implement those approaches at your campus. NSF doesn't expect their PIs to reinvent the wheel; implementing approaches that have been successful elsewhere and assessing the results will contribute to the body of knowledge in education.

Look for available campus resources on which you can draw. If your education topic relates to an institution-wide priority (for example, increasing diversity of engineering students, improving e-learning, providing more opportunities for students to become globally engaged, or improving students' communication skills), you should be able to locate ongoing activities to which you can connect. There may also be experts with whom you can collaborate. Even if your chosen topic is not a campus-wide priority (for example, you might be concerned with a discipline-specific issue such as deficiencies in how a particular scientific concept in your field is taught), there may be experts in education, psychology, or other departments, or in a university office such as a Center for Teaching Excellence or a Writing Center who might be able to advise you. Talk to colleagues, but be aware that, particularly if you're at a large institution, they may not be aware of resources outside of your college. A university's research office and its website can also lead you to education and outreach resources across your campus.

Building a Track Record

Just as reviewers will look for your track record in research to assess your expertise, they will look at your education and outreach track record. It's one thing to say that you plan to implement an innovative teaching approach; it's another to say that you have already implemented that approach on a pilot basis and discuss the results. Of course, as a new faculty member, you have limited time and resources, but there are often small tasks you can take on that support your education agenda and will help you to develop a track record. If one of your priorities is to recruit more minority students into science, volunteering to judge a science fair in a local school district with high minority enrollment would not require a large time commitment but would help you build relationships with the schools and provide experience that you can mention in your proposals. If you have an idea for a new teaching approach, try it out in one of your classes and note the results.

You can also build a track record by participating in education projects that might be funded (or are being proposed) in your department, such as NSF Research Experiences for Undergraduates (REU), Research Experiences for Teachers ([RET](#)), and Transforming Undergraduate Education in STEM ([TUES](#)). At this point in your career, you shouldn't take on a project role that entails administrative responsibilities (such as PI of an REU), but you should consider acting as a research mentor for an [REU](#), which will not require a lot of time in meetings and will provide valuable experience that you can mention in your next proposal.

Finding Research Funding: an Overview

This topic area will be addressed by focusing on the following four subtopics related to finding funding for your research:

- Funding from Federal Agencies,
- Funding from Foundations,
- Funding in the Humanities, and
- Funding for Less Well-Supported Research Areas.

These subtopic areas share characteristics as the following definitions and discussion of common terms should clarify:

- There are two major research funding paths open to new faculty: one involves responding to an agency-published research solicitation, and the other involves following agency-specific guidelines for the submission of unsolicited or investigator-initiated research proposals. *New faculty should explore and understand both of these funding mechanisms*.
- Funding announcements, or solicitations, may be referred to differently by various agencies, including Request for Proposals (RFP), Funding Opportunity Announcement (FOA), Program Announcement (PA), or Broad Agency Announcement (BAA), among others*. We will refer to those here as the RFP*. RFPs contain the key information you will need to submit a proposal, and their role will be addressed in a subsequent section.
- Most university research is funded by federal agencies, but an important research role is also played by foundations, industry, state agencies, and private sources, among others.
- In the humanities and humanities-related social sciences, research funding for scholarly work often comes from libraries, collections, associations, museums, and related institutions, all addressed more fully below.

   While the universe of research and educational grant opportunities from federal, state, and local agencies, foundations, professional associations, and industry is very large, it shrinks quickly when you cull out the agencies, programs, and solicitations *without relevance to your research interests*. Once you define your disciplinary area of expertise and your research interests within that area, *your funding universe will become very small, very quickly*, perhaps amounting to only a few agencies, a few program areas within any particular agency, and fewer solicitations within that program area. This also applies to foundations and the above-mentioned humanities funders.

   As a new faculty member, it is important that you learn how to identify research and educational funding opportunities immediately upon their announcement. This will gain you valuable time for preparing your proposal. This added time may give you a decisive advantage in the competition for these awards. It allows you to assess the

requirements for responding to a solicitation, to make a measured decision about whether or not to pursue it, and to undertake your response with sufficient time remaining for developing and writing a competitive submittal .

As a new faculty member, most funding opportunities that will fit your research expertise and interests will likely come from a subset of the over 24 federal agencies that post upcoming solicitations to **Grants.gov**, or perhaps a few foundations that fund research specific to your discipline, e.g., social science, education, humanities. Your funding focus will likely remain on research grants specific to your discipline. However, in some disciplines, you may also explore educational grants, or hybrid grants that integrate research and educational objectives. These are the three most common grant categories pursued by university faculty. Determining where your search for funding will begin is a function of your research goals and performance expectations, likely related to third-year review and promotion and tenure. Your objective is to map these criteria to possible sources of research support through published solicitations from federal funding agencies.

Keep in mind, however, that significant funding opportunities for your research may also come from writing unsolicited proposals, a topic that will be addressed herein as a specific topic in a subsequent section. For example, roughly 50 percent of NSF and 80 percent of NIH research funding is awarded through the unsolicited proposal process, e.g., **NIH Parent Announcements** for unsolicited or investigator-initiated proposals. Other funding opportunities may come from foundation funding, another topic addressed separately below.

When first identifying research funding, note the part of the research spectrum (basic, applied, applications, contract, etc.) that best defines your expertise, capacities, and interests. This will likely be significantly influenced by departmental expectations defined in the hiring process, as well as advice on research from an assigned or requested faculty mentor(s) or a department head or chair. ***Does the department favor certain types of grants over others?***

For example, departments frequently encourage new faculty in the technical disciplines to focus first on research grants rather than educational grants such as undergraduate research, curriculum development, or K-12 partnerships, whereas education, social, and behavioral sciences departments may have tenure expectations advanced by these educational grants, particularly in those areas where education is a research area, e.g., cognition and student learning. Hybrid grants that integrate research and education vary significantly by agency, but a sufficient number of them will have a primary focus on research along with an educational component.   So you can use multiple determining factors and criteria such as those mentioned above first to filter your search parameters for finding funding opportunities and second to narrow your search to funding opportunities that best fit your career expectations as a new faculty member.

Another important distinction to make when identifying potential federal funding agencies is ***to note how and whether each agency restricts the definition of various general research areas to one that is unique to that agency's mission***. For example,

several federal agencies support research in biochemistry , including NSF and NIH, but the NSF objectives are not (like those at NIH) conjoined to human diseases or medical outcomes. Moreover, many of the major umbrella research topic areas funded across many federal agencies, e.g., climate change, water, sustainability, energy, critical infrastructures, homeland security, materials, smart grid, etc., are often uniquely and tightly aligned with their research investment priorities as driven by one or more agency strategic plans or research roadmaps. Your capacity to note these distinctions is an important part of your overall funding strategy.

As an individual researcher, you have the most nuanced understanding of the particular research solicitations or unsolicited opportunities most relevant to your career objectives. Therefore, it is helpful to recognize that you can do the best job of identifying funding of possible interest to you by "packing your own funding chute." Develop your own search and organizational protocols for finding and categorizing research funding opportunities. This is very easily done.

Who Funds What? A Quick Guide

Funding Agency and Funding Links	What They Fund	Comments
National Science Foundation (NSF)	Research in science, mathematics, engineering, social science, and education. STEM education initiatives. Fellowships, instrumentation.	Largest funder of academic research. Tend to fund basic research. Will not fund human disease-related research or research in the humanities.
National Institutes of Health (NIH) **RFAs** **PAs**	Basic and applied research related to human health, including social science research. Fellowships, instrumentation, training grants.	Part of Department of Health and Human Services. Research must have implications for enhancement of health, lengthening life, and reduction of the burdens of illness and disability.
Department of Education **IES** **OPE**	Research on education from pre-school through higher education, adult education	Main research programs funded through Institute for Education Research(IES) and Office of Postsecondary Education (OPE).
Congressionally Directed Medical Research Program (CDMRP)	Disease-related research. Diseases of focus selected each year by Congress.	Includes grant categories for high-risk research and new investigators.
Agency for International Development (USAID)	Applied research and development to evaluate new products, tools, approaches and interventions focusing on health concerns in developing countries (includes behavioral research).	**Collaborative Research Support Programs** partners with Land Grant Universities to strengthen agriculture in developing countries.
U.S. Department of Agriculture National Institute of Food and Agriculture (NIFA) Agriculture and Food Research Initiative (AFRI)	Funds a wide range of food and agriculture research, including biotechnology, genomics, pest management, biofuels, childhood obesity and more. Funds fellowships.	Most research funding through AFRI. Also teams with other agencies (NSF, DoD) for some grant programs.
Economic Development Agency (EDA)	Funds projects to stimulate job creation, economic development, and innovation (institutional projects)	Part of Department of Commerce. Funds collaborations between university and industry (entrepreneurship and small business development)
National Institute for Standards and Technology (NIST)	Funds research related to materials, manufacturing, information technology, measurement, and standards	Part of Department of Commerce. Most of research is intramural, but they do funds some extramural research, particularly in collaboration with NIST researchers.
Department of Defense - **AFOSR** - **ONR**	Fund basic and applied research related to the mission of each service. In addition to physics,	Research offices are AFOSR (Air Force), ARO (Army), ONR (Navy), DARPA (high-risk, high-payoff research for all

Funding Agency and Funding Links	What They Fund	Comments
- **ARO** - **DARPA** - **NSA**	materials, mathematics, computer science, etc., they may fund some life science and psychology (e.g., human cognitive and behavioral modeling)	services), NSA.
Agency for Healthcare Research and Quality (AHRQ)	Funds research to improve quality, safety, efficiency and effectiveness of health care.	Part of Department of Health and Human Services. Current funding priorities include health issues of minorities, health information technology, health care system redesign, and more.
Substance Abuse and Mental Health Services Administration (SAMSA)	Implementation grants for mental health and substance abuse services	
Administration for Children and Families (ACF)	Funds research to promote the economic and social well-being of families, children, individuals, and communities. Funds fellowships.	Most of the grants are implementation rather than research grants. Be sure to look for grants related to research.
Centers for Disease Control (CDC) - **National Institute for Occupational Safety and Health**	NIOSH funds research to identify occupational populations at risk, develop methods for measuring exposures to hazards and detecting adverse health effects, determine the prevalence and incidence of occupational hazards, understand the etiology of occupational diseases and injuries, and reduce or eliminate exposures to hazards.	Part of Department of Health and Human Services. Procedures are similar to NIH
Environmental Protection Agency (EPA)	Funds research to improve EPA's scientific basis for making decisions on environmental issues	STAR grants, fellowships, research, small business grants
National Aeronautics and Space Administration (NASA)	Funds research related to NASA's space mission (also funds some STEM education programs)	Description of programs released annually in large ROSES solicitation.
Department of Energy – Office of Science	Funds basic research related to energy, including advanced computing, biological and environmental research, basic energy sciences, high energy physics, nuclear physics, and more.	Offer new investigator-type grants in the various program areas.
Department of Energy – National Energy Technology Laboratory (NETL)	Funds research related to energy, including solid state lighting, smart grid, electric vehicles, clean coal, and other technologies	
Department of Energy -	Funds research related to clean	

Funding Agency and Funding Links	What They Fund	Comments
Energy Efficiency and Renewable Energy (EERE)	energy technologies, including solar, wind, water, biomass, geothermal, and hydrogen & fuel cells.	
National Oceanic and Atmospheric Administration (NOAA) - **Office of Education**	Fund research on the structure and behavior of the ocean, atmosphere, and related ecosystems. Also fund education and scholarships related to their mission.	Part of the Department of Commerce
National Endowment for the Arts (NEA)	Funds fellowships and projects in the arts (including theater, arts education, dance, literature, folk arts, music, and more)	
National Endowment for the Humanities (NEH)	Funds fellowships, humanities initiatives, collections and education in the humanities	
Institute for Museum and Library Services (IMLS)	Funds activities including professional development, conservation, collections management, informal learning, community engagement, and more.	
Nuclear Regulatory Commission (NRC)	Funds education, minority serving institutions, research on nuclear materials safety, and other nuclear-related issues.	
Housing and Urban Development (HUD) - **Office of University Programs**	Funds some research on housing and urban issues and policy analysis. Mainly funds dissertation research.	Most grants are not research related, but they do fund some research out of the Office of Policy Development and Research (PD&R)
Department of Justice - **National Institute of Justice**	Funds physical and social science research, development, and evaluation projects about criminal justice. Also funds fellowships.	
Department of State - **Fulbright Program**	Most grants fund cultural exchanges, fellowships	Funds opportunities for faculty to conduct research abroad.
Department of Transportation - **Research and Innovative Technology Administration** (RITA)	Funds research to bring advanced technologies to the transportation system. Funds university transportation centers.	
Department of the Interior **Bureau of Indian Affairs** **Bureau of Land Management**	Each of these bureaus funds projects specific to its mission. Overall agency goals focus on resource protection, resource use, recreation, and serving	

Funding Agency and Funding Links	What They Fund	Comments
Bureau of Ocean Energy Management, Regulation and Enforcement **Bureau of Reclamation** **National Park Service** **Office of Surface Mining, Reclamation and Enforcement** **U.S. Fish and Wildlife Service** **U.S. Geological Survey**	communities.	
Robert Wood Johnson Foundation	Funds projects to improve the health and health care of all Americans.	
Bill and Melinda Gates Foundation	Funds research related to global health, poverty and development and education.	Many of the grants are for implementation rather than research. Be sure to look for opportunities that target research.

Funding from Federal Agencies

To begin with, all federal research agencies post new funding solicitations to **Grants.gov**. Grants.gov offers both **RSS feeds and email alerts** that notify you daily of new grant opportunities based on advanced search criteria you select when you subscribe to the alerts (e.g., agency or agencies, funding opportunity number, funding instrument type, eligibility, or subagency). It is also important to subscribe to the "**modified opportunities alert**" that notifies you of any modifications to open solicitations. *This is particularly important for solicitations that stay open for an entire fiscal year*, e.g., broad agency announcements (BAAs) from the defense agencies that may change research priority areas during the open period, or make other modifications that impact how you write the project narrative. Finally, all of these electronic alerts can be saved in a folder to give you a chronological record of funding directions and recurring open periods on solicitations published annually.

   In some cases, solicitations by federal agencies may also be published to **FedConnect** and **Federal Register**. This will be *in addition to and not a replacement* for publication in **Grants.gov**. For example, the Department of Energy may publish the entire downloadable solicitation in **FedConnect** and the Department of Education will publish in **Federal Register**, but in both cases a hot link to these sites will be provided in the **Grants.gov** announcement.

   Moreover, many of the federal research agencies will also have agency-specific RSS and email alert systems for notification of funding opportunities posted to the agency website, e.g., **NSF** and **NIH**. In other cases, it is helpful to bookmark agency sites that continuously update funding information, e.g., **EPA**, **DARPA**, **DOE**, **ONR**, **DoED**, **NIST**, etc.. This is particularly helpful for the federal mission agencies, e.g., DOD, EPA, NOAA, DARPA, etc., where large, multiple research program areas within a single agency function with significant autonomy. Also, remember that Google is your friend. A simple Google search on **"RSS feeds at 'agency name'"** or some modification of this search string specific to your research domain or program office within an agency will likely retrieve the information you need.

   These agency websites are a robust complement to Grants.gov and an excellent source of funding information and related funding resources. Another advantage to subscribing to agency-specific electronic alerts is that you can also receive information such as agency reports, agency presentations, strategic plans and roadmaps, research alerts, and changing research investment priorities, etc. that can help clarify the agency's mission and culture, thereby aiding you to write a proposal that clearly describes the significance and impact of your research on the mission of the agency. *This is a key competitive factor in writing a successful proposal.*

Funding from Foundations

Funding from foundations typically represents a much smaller part of a university research portfolio than does funding from federal agencies. Foundation funding is most often of interest to a much smaller subset of faculty. In most cases, the application process differs significantly from those directed to federal agency solicitations. Some colleges, e.g., education, and some disciplines, e.g., social and behavioral sciences, may locate more opportunities in foundation funding specific to their research domain, e.g., **Spencer Foundation**, than other colleges and disciplinary departments. Regardless, in most cases, foundation funding will be at significantly lower levels than funding from federal agencies. Moreover, foundations have specific protocols for seeking research and education funding, in some cases including published solicitations with defined eligibility guidelines specific to preselected university applicants, or ongoing programs in specific disciplines. For example, the **Camille and Henry Dreyfus Foundation** funds chemical sciences and chemical engineering.,

It is particularly important when seeking foundation funding to understand the mission and agenda of the foundation. For example, the **Russell Sage Foundation** and the **Social Science Research Council** are devoted to research in the social sciences, whereas the **Howard Hughes Medical Institute** funds biomedical research grants for individuals and science education grants for institutions. The **W. M. Keck Foundation** focuses on science, engineering, and medical research and undergraduate education. The Robert Wood Johnson Foundation funds grants in seven program areas related to health and health care. However, many smaller foundations will often restrict eligibility based on mission and agenda-specific factors. Geographic restrictions on eligible applicants, for example, is one of the more common restrictions for this funding group.

Finding funding from foundations is always tightly linked with becoming knowledgeable about a foundation's mission and agenda. This can be accomplished in several ways, including exploring the foundation website, reading the foundation's annual report on funded projects, reading publications of disciplinary colleagues and scholars whose research has been funded by the foundation, talking to colleagues who have been funded by the foundation or may have served as a reviewer for the foundation, and exploring links at the **Foundation Center**. *It is always helpful to talk to a program officer at a foundation to get a deeper and more nuanced understanding of its mission-specific agenda and application process.* Foundations can range from the very large (**Gates**, **Ford**, **Rockefeller**) to the very small. Understanding the mission and agenda of small foundations can sometimes be more challenging, but one good starting point is the **990 Finder** at the Foundation Center website. The 990-PF is the information return U.S. private foundations file with the Internal Revenue Service. This public document provides fiscal data for the foundation, names of trustees and officers, application information, and a complete grants list.

Funding in the Humanities

Research funding of interest to university faculty in the humanities is most often focused on *scholarly research*. In most cases, funding for scholarly research differs from the research funding sought by faculty in the technical disciplines and the social and behavioral sciences. It differs as well from the funding sought by institutions with a humanities mission focus, such as museums or other cultural institutions, and programs that seek funding to promote the humanities to a wide public audience or advance it through teacher training. Funding from the National Endowment for the Humanities (NEH) or the U.S. Department of Education (DoED), for example, often has this objective. Moreover, depending on the institution, the research interests of faculty in the humanities may not be as well understood, and hence not as well promoted or supported by university research offices more familiar with supporting faculty research in the technical disciplines.

Funding for scholarly research in the humanities is distributed widely across a vast number of museums, libraries, collections, centers, archives, associations, endowed programs, and institutes, to name only a few sources. Moreover, compared to the technical disciplines, the dollar amounts for scholarly research in the humanities are small and often do not allow for charging indirect costs. In many cases, depending on institutional protocols, funding to faculty in the humanities goes directly to the faculty member rather than the institution.   How this works on your campus is something to discuss with your sponsored projects office or similar research support office, often under the office of vice president for research.

The largest federal funder of the humanities is NEH, but supporting faculty scholarly research is only one part of how that agency supports the humanities. Other federal agencies fund humanities-related activities, *as opposed to scholarly research*, including U.S. Department of Education and the Department of Interior Heritage Programs.   The Department of State funds scholarly research through the **Fulbright Program**.

There are several good starting places for finding funding for scholarly work in the humanities, including **Humanities Funding and Research** by the **Humanities Resource Center Online**. Many universities and humanities centers at universities have excellent web sites that offer exhaustive listings of opportunities for research funding in the humanities. For example, the following websites provide a good starting point that will quickly become a cascade of opportunities as you follow embedded links: **Fellowship and Grant Opportunities for Faculty Humanities and Social Sciences**; **Humanities Funding Sources A-to-Z**; **Duke University Funding Alerts; Humanities Funding Listed by Johns Hopkins University**; and **ASU Institute for Humanities Research**.

Funding for Less Well-Supported Research Areas

Locating funding for your research can be a frustrating search if your discipline or research topic area is not well supported, or not supported at all, by any federal agency. Most federal agencies fund either basic research or mission-driven research specific to that agency. Given this predetermined funding landscape, and the mission-specific opportunities it offers in terms of funding solicitations, it is not uncommon for some faculty to come to the challenging realization that their research interests and expertise do not map to any open funding solicitations at any of the federal agencies. However, they are still faced with institutional expectations for research along their academic career path, particularly at third-year review and in the tenure and promotion process. Fortunately, many avenues, in addition to federal agency solicitations, lead to funding for your research interests. For example, consider the following as some possible routes to follow for funding success.

Explore Research Collaborations

As a synthesis of research capacities, collaborations hold the potential for research funding opportunities that might not otherwise be funded as discrete topic areas by individual researchers on single-PI grants. However, true research partnerships regardless of size come about from taking the time to establish the groundwork for collaboration through networking at conferences, working with and engaging mentors and colleagues, publishing jointly, and making a keen assessment of the "value-added" characteristics that research collaborations bring to any given initiative. Moreover, collaborations require creative and integrative thinking about the synergy that occurs at the intersection of your research with the research of potential partners. So take the time to create your own personalized "partnership roadmap," including identifying the possible benefits your research expertise might bring to that of your colleagues, on your campus or on other campuses.

Find a Place for Your Research on Large Proposals

Many center-level proposals require multiple research strands. In some cases, these proposals may require programmatic components outside the core technical or scientific domains that enable the center to meet the goals and objectives of the funding agency. For example, topics such as public outreach and societal benefits, or ethics, public policy, communications, public or stakeholder surveys, workforce planning, community and cultural impacts, evaluation and assessment, and the like, may be required by the sponsor to complement the technical research core of the center. Regardless, in many cases, center-level proposals require the inclusion of programmatic components that represent unique and highly specialized research expertise from faculty in other disciplines in order to fully respond to the agency research objectives and thus be competitive for funding.

Research deans and department heads in various colleges and university-level professional staff in various VPR offices can serve as a possible source of information about the types of center-level proposals being developed or planned on your campus, or in partnership with other universities.

Review Websites of Researchers in Your Disciplinary Area to Find Funding References

University websites exist for almost every conceivable disciplinary area and research topic with a home at an academic institution. These range from comprehensive websites of centers and institutes to websites by interdisciplinary and affinity groups, to the personal websites of individual faculty. Surfing the websites of faculty whose research is in your topic area can have great benefit in terms of a deeper and more nuanced understanding of possible ways you can find funding for your research. In some cases, websites of research groups in an area that mirrors your own research domain may identify sources of research funding by project area, agency, foundation, and industry.

Review Journal Articles for References to Funding

Journals and publications in your academic field and specialty area may include authors' acknowledgements of support from a funding agency or agencies that made the research possible. Look to those acknowledgements as a potential funding source for your own research.

Find Funding from Business and Industry

Identify business, industry, or consulting firms that provide client services that would benefit from your research expertise or specific research topic area (remember Google is your friend here). Perhaps you will identify a consulting firm that advises township clients on wetlands or ecosystem restoration processes or policies required as part of plans for growing communities and annexing former rural areas. As in all examples here, the key is to know how to describe your research, identify a potential funder that would benefit from your research, and pursue discussions that focus on the added value your research brings to their particular enterprise.

Find Foundation Funding

Funding from foundations holds many advantages for those whose research topic areas and expertise do not map well to federal agency funding. It is typically the first alternative option researchers think of when they are unable to find federal agency funding. The process of seeking foundation funding resembles that of seeking federal funding in several key respects. Your primary goal is to map your research and programmatic interests, capacities, and ideas to the research and programmatic interests and mission of the foundation. ***Therefore, be sure to research and understand the mission, culture, and investment agenda of the foundation, and learn the role of***

the program officer at the foundation during the application and review process. Importantly, opportunities for funding at foundations exist at many scales, *including national, regional, state, and local foundations.* Foundations will have domains of interest and a mission agenda driving their investments. Your job is to explore those mission and agenda domains in your search for foundations that fund programmatic areas to which you bring competitive expertise and *offer an idea of interest to the foundation.* Do not overlook small regional or state foundations in your search.

Find Funding from NGOs, Associations, and Professional Groups

Another avenue to explore begins with mapping your research interests, expertise, and particularly an idea you have to the agenda of local, regional, or national associations and professional groups, special interest groups, nongovernmental organizations, advocacy groups, community groups, and the like. The goal is to find an organization with a mission and agenda that could benefit from your research. This may seem like a very open-ended challenge made more troublesome by the vagueness of a starting point. However, the stepwise process is generic to any research funding search: (1) define your research, (2) map it to the interests, mission, and agenda of a possible funder; and (3) start discussions or meet with the potential funder to explore how your research expertise can bring value-added benefits to its mission.

Municipal, County, and State Governments

Municipal, township, county, and state government agencies and offices often have mission or operational objectives that can benefit from research, particularly applied or applications-based research, that can help that agency better serve the public. Keep in mind that successful public-serving agencies must function as problem solvers, *and good research is one ingredient of successful problem solving in a host of areas.* For example, councils of government at both the regional and local levels along the coastal Gulf of Mexico may have an interest in the disaster preparedness protocols established by an assistant professor of political science as part of her doctoral dissertation. Similarly, coastal communities along Lake Michigan may need surveys and analysis of the impact of wind farms on coastal ecosystems and flyways that attract tourists to the area. While these examples abound, the *key task for you is to creatively envision the role your research could potentially play in helping government agencies serve the public by helping the agency to better solve problems*.

Community Partnerships

Many community organizations have mission objectives that could potentially benefit from a research perspective, particularly in the applied and applications-based social and behavioral sciences and community health. Community organizations often have agendas specific to local or regional needs, and may have a focus on a range of issues, including health disparities, educational attainment, environmental issues, healthy communities, domestic violence, and the like. Learn about local and regional

community organizations to discover how your research interests and expertise may contribute to the ability of a specific organization to offer better services.

Faculty at PUIs: What to Do When You Need Equipment

Predominantly Undergraduate Institutions (PUIs) usually don't have the same level of research infrastructure as research-intensive institutions, and this can present a special challenge to faculty in science who conduct laboratory research requiring expensive laboratory equipment. If you find yourself in this situation, you can use several strategies to address this challenge.

 If the equipment you need is not very expensive (e.g., $50K or less), and it is clearly required to conduct a proposed project, you may be able request funding for the instrument as part of the project budget. Discuss this possibility with the program officer before submitting the proposal.

 If the equipment is needed by a number of faculty at your institution or at other institutions in your region, you should consider teaming to submit a proposal for an instrumentation grant. There are a number of such grants, the most widely known of which is the NSF Major Research Instrumentation (MRI) program. These grants fund research instruments up to $4 million and generally require multiple users, preferably from multiple departments and institutions. Many of these grants (particularly those for under $100K) have been awarded to PUIs, so if you have the right elements in place, you can be competitive for these grants. Other grants that fund instrumentation are listed at the end of this chapter. NSF also funds shared-use instrumentation through the Research in Undergraduate Institutions (RUI) program. To be competitive for most of these grants, the instrument should have multiple users, many of which have strong research records (and in some cases, such as the NIH Shared Instrumentation grants, explicit requirements concern the source of funding for the instrument users' research).

 If you are the only researcher in your institution who will need the instrument in question and you'll need the instrument on an intermittent basis, you should consider looking to other universities that have the instrument and determine whether they would be willing to allow you access. This may not be as difficult as it might first appear. It's quite possible that the instrument was purchased on a grant such as the MRI, and as part of the proposal the PI committed to sharing access to the instrument. If this is the case, their proposal included a management plan, which probably described procedures for allowing outside researchers use of the instrument (usually for a reasonable use fee to cover consumables and technician time), and they may have committed to encourage use by faculty from PUIs and minority-serving institutions. You can search for such an instrument by looking through NSF's awards for MRIs as well as by networking with fellow researchers.

 A related strategy is to find a colleague with access to the desired instrument who has a current NSF research grant. Propose a collaboration in which they submit a proposal for a Research Opportunity Award (ROA) supplement to their original NSF research grant. These FOA supplements fund faculty from PUIs to visit the NSF-funded researchers' lab, usually during the summer, to conduct research. Not only can the ROA

grant help you gain access to the needed instrument for a summer but it can also help you develop a collaboration that can continue beyond the life of the original grant. Also keep in mind that data generated using your collaborator's instrument can be used as part of an MRI proposal if you later decide to pursue a grant to fund an instrument at your institution.

If you need more regular access to the instrument, traveling to someone else's lab may not be practical. In that case, you might investigate whether it's possible to get a used instrument as a donation or at a reduced price. If the instrument you need is frequently used in industry labs, you may find a company that is planning to upgrade to a newer instrument and would be happy to take the tax write-off by donating their used instrument to a university. Often, connections can be made with these companies through research colleagues or through alumni who work at the company. (If you decide to pursue this approach, be sure to check with your university's development office to determine the procedures you need to follow when requesting such a donation.) Used instruments might also be available for sale through the vendor or other venues (you can even find some instruments on e-bay, although caution would be advisable). Note also that DOE has a program that makes used equipment from their labs available to schools and universities [(LEDP)](#).

You should keep in mind, however, that the cost of purchasing a lab instrument is only one portion of the expense involved. You also have to find a place to put it that meets space, power, water, and other requirements. In addition, significant operation costs (e.g. consumable materials such as liquid nitrogen) as well as maintenance expenses often apply. This is why it's important to enlist the support of your department head and possibly your dean. Make your case to them that having this instrument will benefit not only your research, but the institution and its mission. Will you involve students in your research? Will you incorporate the instrument or the data generated by the instrument in the curriculum? Will having the instrument help position you to publish and compete for research funding? All of these things will strengthen your case and perhaps convince your department head and dean to commit funds and space to support the instrument you need.

Grants that Fund Instrumentation

(Note that not all of these programs stage competitions every year. Program activity can vary markedly depending on agency funding priorities. If it's not clear when the next competition will be held, contact the funding agency to find out.)

Program: [Major Research Instrumentation Award (MRI)](#)
Funding Agency: National Science Foundation (NSF)
Amt: $100K - $4M; < $100K OK for non-PhD granting
3 proposals per institution (max 2 acquisition)
Cost Share: 30% except for non-PhD granting and some disciplines
Support the acquisition, through purchase, upgrade, or development, of major state-of-the-art instrumentation for research, research training, and integrated research/education activities at institutions. Proposals will be considered for instrumentation used for any NSF-supported field of science, mathematics, and engineering. Two types: acquisition and development.

Instrument Development for Biological Research (IDBR)
Funding Agency: NSF Directorate of Biological Sciences
Amt: not specified
No limit on number of proposals
No cost share required
Accepts two types of proposals: A) Innovation proposals for the development of novel instrumentation that provides new research capabilities, or that significantly improves current technologies by at least an order of magnitude in fundamental aspects (such as accuracy, precision, resolution, throughput, flexibility, breadth of application, cost of construction, operation costs, or user-friendliness); and B) Bridging Proposals for transforming, 'one of a kind' prototypes or high-end instruments into devices that are broadly available and utilizable without loss of capacity.

Earth Sciences: Instrumentation and Facilities (EAR/IF)
Funding Agency:NSF Directorate for Geo-sciences, Division of Earth Sciences
No limit on number of proposals
No cost share required
 The Instrumentation and Facilities Program in the Division of Earth Sciences (EAR/IF) supports meritorious requests for infrastructure that promotes research and education in areas supported by the Division (see http://www.nsf.gov/div/index.jsp?div=EAR). EAR/IF will consider proposals for: 1) Acquisition or Upgrade of Research Equipment that will advance laboratory and field investigations, and student research training opportunities in the Earth sciences. The maximum request is $1M. The maximum request for upgrade of research group computing facilities is $75,000; 2) Development of New Instrumentation, Analytical Techniques or Software that will extend current research and research training capabilities in the Earth sciences. The maximum request is $1M; 3) Support of National or Regional Multi-User Facilities that will make complex and expensive instruments or systems of instruments broadly available to the Earth sciences research and student communities; 4) **Support for Early Career Investigators** to facilitate expedient operation of **new research infrastructure** proposed by the next generation of leaders in the Earth Sciences. This opportunity allows for submission of a proposal for Acquisition or Upgrade of Research Equipment that includes budget line items associated with support of a new full-time technician who will be dedicated to manage the instrument(s) being requested. Any request for technical support under this opportunity is limited to three years duration. Maximum request is $1M.
Planned research uses of requested instruments, software, and facilities must include basic research on Earth processes SUPPORTED BY THE DIVISION OF EARTH SCIENCES.

Chemistry Research Instrumentation and Facilities (CRIF) – *currently suspended*
 Funding Agency: NSF Directorate for MPS, Division of Chemistry
Maximum: TBD
No limit on number of proposals
Cost share: none
provides funds to research institutions and consortia thereof for the purchase of multi-user instruments and for the establishment and support of multi-user research facilities in the chemical sciences.

Archaeometry Awards
Funding Agency: NSF Directorate of Social, Behavioral and Economic Sciences, Archaeology
Funding: $50K - $400K approx
The Archaeology Program recognizes three broad classes of archaeometric proposals: (1) proposals to support laboratories which provide archaeometric services; (2) proposals to develop and refine archaeometric techniques; and (3) proposals to apply existing analytic techniques to specific bodies of archaeological materials. "Laboratory support" and "technique development" projects are included within the Archaeometry competition. "Technique application" proposals are best evaluated in a more strictly archaeological context and therefore should be submitted to the "senior" research competition.

Astronomical Sciences Advanced Technologies and Instrumentation (ATI)
Funding Agency: NSF MPS Directorate, Division of Astronomical Sciences

the development and construction of state-of-the-art detectors and instruments for the visible, infrared, and radio regions of the spectrum. These include, and are not limited to, the application of new hardware and software technology and innovative techniques in astronomical research, interferometric imaging and adaptive optics.

Shared Instrumentation Grant (SIG)
Funding Agency: NIH
$100K - $600K
No limit on number of proposals
No cost share required
Funds applications from groups of NIH-supported investigators to purchase or upgrade a single item of expensive, specialized, commercially available instrumentation or an integrated system. Types of instruments supported include confocal and electron microscopes, biomedical imagers, mass spectrometers, DNA sequencers, biosensors, cell-sorters, X-ray diffraction systems, and NMR spectrometers among others. A major user group of three or more investigators must be identified. **A minimum of three major users must be Principal Investigators on NIH peer-reviewed research grants** at the time of the application and award.

Defense University Research Instrumentation Program (DURIP)
Funding Agency: DoD agencies
Amt: 50K - $1M
No limit on number of proposals
No cost share required
DURIP is a multi-agency DoD program within the University Research Initiative designed to improve the capabilities of U.S. institutions of higher education to conduct research and to educate scientists and engineers in areas important to national defense by providing funds for the acquisition of research equipment. [Note: To be competitive, applicants should currently be funded by DoD and the instrument requested should support those funded projects.]

High End Instrumentation Grant
Funding Agency: NIH
Amt: $750K - $2M
No limit on number of proposals
Cost share not required
applications from groups of NIH-supported investigators to purchase a single major item of equipment to be used for biomedical research that costs at least $750,000. The maximum award is $2,000,000. Instruments in this category include, but are not limited to, structural and functional imaging systems, macromolecular NMR spectrometers, high-resolution mass spectrometers, cryoelectron microscopes and supercomputers.

National Institute of Food and Agriculture Equipment Grants
Funding Agency: USDA Agriculture and Food Research Initiative
Note: equipment grants are described in conjunction with other types of grants in each RFA.
Equipment Grants are designed to strengthen the research, education, and/or extension capacity of institutions by funding the purchase of one major piece of equipment. These grants are not intended to replace requests for equipment in individual project applications. Rather, they are intended to help fund items of equipment that will upgrade infrastructure.

Energy-related Laboratory Equipment (LEDP) Program
Funding Agency: DOE
Deadline open
No cost share
The Energy-Related Laboratory Equipment (LEDP) Grant Program was established by the United States Department of Energy (DOE) to grant available used equipment to institutions of higher education for energy-related research. Equipment is listed as it becomes available on a searchable website.

The Role of the RFP

The RFP is an invitation by a funding agency to submit proposals on research topics **of interest** to the agency. It contains the key information you will need to develop and write a competitive proposal.   To be competitive, your proposal must respond **fully** to an agency's submission process, program objectives, review criteria, budget guidelines, and other requirements specific to the program. It is important to read the RFP carefully and in its entirety, including review criteria and all referenced documents. Writing a competitive proposal requires that you understand the RFP for what it is--***an expression of agency interest in a specifically defined research area.*** The RFP is almost never a perfect mirror of your research interests. From the funding agency's perspective, the RFP is a **non-negotiable listing of research performance expectations** reflecting the agency's mission, goals, objectives, and investment priorities that **you must meet** to be funded. The RFP is ***not meant as a menu or smorgasbord inviting you to*** address some topics and review criteria but not others. A flawed understanding of the requirements of the RFP, or the agency guidelines defining the unsolicited proposal process and the role they play in structuring a competitive research narrative is one of the more common reasons proposals are poorly reviewed and declined by funding agencies.

   The competitiveness of your proposal will depend on how well you understand the RFP as a very detailed expression of an agency's interest in a specific research topic area. Once you clearly understand the agency's objectives, the next step is to map your expertise to the RFP to determine whether or not you should respond to the solicitation. If your interests and expertise do not map tightly to an RFP, it is wise not to submit and wait for a more appropriate solicitation.   Invest your time, resources, and energy wisely—they are your most valuable assets and they must not be squandered.   Having a good idea is a necessary **but not a sufficient condition** for successful funding. Funding agencies are seeking exciting ideas clearly stated that ***make a compelling case that your expertise will advance the research priorities of the sponsor*** .

   The RFP needs to be closely analyzed and understood as an integrated whole. This includes understanding the agency's research objectives, desired outcomes or deliverables, the way in which those research objectives will be reviewed, and any referenced strategic plans or research roadmaps that define the research context in more detail.   RFPs are written documents, and, like all written documents, they are not always perfectly clear. Any uncertainties you have regarding the meaning or intent of any portion of the RFP need to be resolved early in the proposal process to ensure your proposal research narrative fully responds to the guidelines. You can often resolve uncertainties through repeated, closer readings of the RFP, discussions with colleagues who have been funded by the agency in similar research areas, or by contacting the program officer directly. The latter is often the best option.

   The same general principles will apply in terms of following agency guidelines for the submission of unsolicited proposals.

Role of the RFP in Proposal Organization

The RFP also plays a key role in proposal organization by establishing the order, required level of detail, and focus of the research narrative in meeting the goals, objectives, desired outcomes, and review criteria established by the funding agency. It is a good idea to simply copy and paste the RFP's key sections, research objectives, and review criteria into a beginning draft narrative. This allows the RFP to serve as an *organizational template* for the full proposal. It ensures that subsequent draft iterations of the research narrative will be **continuously calibrated to the guidelines and fully responsive to all of the sponsor's requirements**. For example, an RFP will often contain a detailed description defining the agency's objectives for the program (e.g., goals, objectives, performance timeline, outcomes, research management, evaluation, etc.) that must be addressed in the full proposal narrative. This detail, including review criteria, can be copied and pasted into the first draft of the proposal itself. This RFP-based proposal template ensures your narrative responses are complete and answer every question, explicit or implicit, in the guidelines. In this way, the first draft of the proposal will fully mirror the program solicitation requirements.

This copy and paste process of transforming the RFP into a narrative template helps ensure that you address several elements key to a successful proposal at the beginning, and adhere to them throughout the writing process. Using this approach, you will ensure that the proposal narrative:

- fully responds to all requested information,
- offers information in the order requested,
- provides the required level of detail,
- integrates review criteria into the narrative, and
- makes a complete and compelling case for the significance of your research.

If the RFP refers to any publications, reports, or workshops, it is important to read those materials, analyze how that work has influenced the agency's vision of the program, and cite those publications where appropriate in the research narrative.

Understanding Funding Agency Mission & Culture

Funding agencies do not passively fund research projects that are disconnected from a long-term, well considered research agenda and research investment strategy. Basic research agencies(e.g., NSF, NIH) often see themselves as leaders in a national dialogue on research topics and directions, and as key players in defining and driving that national agenda for fundamental research. The federal mission agencies (e.g., DOE, DoD, DARPA, EPA, NASA, NOAA, etc.) fund research, either basic or applied, that falls within the scope of their mission objectives and brings value-added benefits to that mission. This can be a source of surprise, and even frustration, to applicants new to the research funding enterprise, who may believe that a good idea alone will merit funding, regardless whether it connects to a particular agency's mission and investment priorities. ***However, agencies fund only very good ideas that clearly advance their mission, vision, and strategic research plan.***

Therefore, the more knowledgeable you become about a funding agency's mission, strategic plans, research culture, investment priorities, and the rationale behind them, the better able you will be to write a more compelling and competitive proposal narrative. This agency-specific knowledge allows you to more convincingly describe how your proposed research is relevant to the research objectives spelled out in the solicitation, as well as place your research in the broader context of the agency's strategic research plan. ***How well you convince reviewers that your research will play a key role in advancing the agency's mission-critical objectives as listed in the solicitation, or in the guidelines for unsolicited submissions, will determine whether your proposal is funded.***

Many research programs funded by federal agencies, and some private foundations, grow out of an evolving consensus among the national research community on the most promising future directions in specific research topic areas. These directions and priorities, in turn, are translated into funding opportunities at the agencies, or are incorporated into an agency's strategic plans and given an investment priority level within the agency. These reports may be published at the National Academies, for example, or be posted to agency websites. (All National Academy reports are **[downloadable in pdf format for free](#)**.) In many cases, these reports and studies will be cited with a URL link in the solicitation or program guidelines. It is always wise to review these reports, particularly the executive summary, to become more knowledgeable and better informed on possible persuasive arguments you might advance in your research narrative. These reports can help you enhance the perceived significance of your research by clarifying for program officers and reviewers the value of your research to the agency mission.

Educational programs targeted at universities, e.g., curriculum reform or undergraduate research, are often developed through the same process. It is not uncommon, for example, for reports of the National Academies, the American

Association for the Advancement of Science, or similar associations to significantly influence funding directions at one or more agencies, and for those reports to form the underpinnings of subsequent solicitations. Understanding the origins, underpinnings, and rationale behind funding solicitations will help you better frame your claims of research merit and thereby better position you to write a competitive proposal narrative.

Some agencies, such as the National Science Foundation and National Institutes of Health, are composed of directorates and divisions, or institutes and centers, and these, too, have defined missions, strategic plans, investment priorities, and cultures, at times almost acting as autonomous funding agencies in themselves. It may, therefore, also be necessary to understand the mission, culture, and priorities of the particular organizational unit to which you will be submitting your proposal.   Other agencies, e.g., DOE, NOAA, DoD, NASA, etc., may often have very dispersed mission areas with multiple research offices acting autonomously.   In these cases, it is important to familiarize yourself sufficiently with the agency and program websites in order to become very knowledgeable about the mission, culture, and research investment priorities of that part of the agency that most fits your research expertise and interests.

A successful proposal allows the funding agency to form a partnership with the submitting institution and principal investigator that will help carry out the agency's vision, mission, and strategic research goals. As the applicant, you must understand the nature of this partnership and the expectations of the funding agency, both during proposal development and throughout a funded project. ***Analysis of the funding agency helps you better understand several key elements common to every competitive proposal narrative:***

- Who is the audience (e.g., agency program officers and reviewers) and how are they best characterized in terms of the expertise they bring to the review process?
- What is the best way to address them?
- What is a fundable idea and how does it support the agency's research investment priorities?
- How are claims of research uniqueness and innovation best supported in the proposal text and connected to the agency's research objectives?
- How do you best communicate your passion, excitement, commitment, and capacity to perform the proposed research to review panels and program officers?

Program Officers and When to Contact Them

The role of the Program Officer (sometimes called the Program Director or Technical Point of Contact) varies markedly among funding agencies. In some agencies, they dictate the priorities of their program and may have almost sole control over which proposals get funded. In other agencies, their role may be more administrative, and they may have very little influence on the funding decision. An important part of getting to know the funding agency to which you plan to apply is to determine the role of the Program Officer for that agency and the culture regarding relationships with the Program Officer. At the Department of Defense, for example, it's virtually impossible to get funded if you haven't talked to the Program Officer. At NSF, most Program Officers see themselves as mentors to new faculty and are happy to provide advice and guidance. At NIH, PIs are often funded without ever having talked to the Program Officer. In some foundations, the Program Officers are so busy that they may discourage you from contacting them.

When to Contact the Program Officer

There are several reasons to contact the Program Officer: (1) there is a point of ambiguity in the solicitation that you need to clarify; (2) you need to determine whether your project is appropriate for the funding agency or program and perhaps solicit advice on how best to present your idea; or (3) you need to get to know the Program Officer and s/he needs to get to know you (this applies to some agencies and not others).

Timidity is never rewarded in the grants process, and ambiguities are always punished. The clearly understood solicitation forms the foundation of the successful proposal. If you don't clearly understand the research expectations in a solicitation, or if you feel the solicitation is ambiguous on some details or requirements, which can occur, call the program officer for clarification before you start writing. When you email or call a program officer, be informed. Questions should be based on a repeated reading of the solicitation after which clarification is still needed or ambiguities remain. You cannot write a successful proposal narrative based on an ambiguous understanding of any portion of the RFP. If you don't clarify ambiguities in the RFP, they will metastasize to the research narrative and almost certainly result in a declined proposal. Program officers usually are happy to respond to queries by potential applicants, especially questions that are thoughtful, clearly stated, and focused on the research topic. **Do not ask the program officer** to make speculative comments on the likelihood that your idea will be funded, or to engage in similarly inappropriate discussions. But **do call them to resolve any ambiguities you feel exist in the RFP**, or to develop a more nuanced understanding of the agency's intent and your potential fit to it. (One caveat is that the Department of Defense often forbids Program Officers from talking to potential applicants after the RFP has been released. However, this is not always the case, and if

you need clarification of a point in the RFP, an administrative contact may be able to answer your question.)

For many funding agencies, particularly NSF, it isn't always obvious which program within the agency your research fits, and submitting to the wrong program can doom a good proposal. While many useful resources on the NSF website can help you understand the research interests of each program, it's always a good idea to contact the Program Officer to discuss your research and the specific interests of the program. In addition, NSF Program Officers will often point you to particular solicitations and discuss any recent changes in the focus of their program. The same is true of many other funding agencies.

Getting to know the Program Officer and making sure they know you and your research can also be very important at many agencies. The Department of Defense and many of the mission agencies (such as NASA, NIST, and NOAA) see externally-funded researchers as collaborators helping them to meet the needs of their agency and program. For that reason, you need to develop an understanding of their needs and a relationship with the agency and program in order to be competitive for funding. As mentioned above, NSF Program Officers often see themselves as mentors to early-career researchers; they want you to submit a high-quality proposal and encourage PIs to contact them for information about what NSF is seeking and what you need to do to submit a competitive proposal.

How to Contact the Program Officer

Even when Program Officers encourage PIs to contact them, that doesn't mean the contact will go smoothly. Program Officers tend to be very busy and to travel quite a bit. For that reason, it's usually a good idea to send an email with a short summary of your research idea and ask to schedule a phone conversation. Give the Program Officer at least a week to respond, and if you don't hear back, try again. Program Officers typically get a large number of emails each day, and yours may have gotten lost in the inbox. If, after several attempts, you don't hear anything, it could be that your Program Officer prefers to communicate by voice mail, so you might try leaving a phone message. If that doesn't work, look to see whether there is another point of contact for the program and try that.

Before you talk to the Program Officer, be sure to do your homework. At the top on Program Officers' list of pet peeves is PIs who call them up and expect the Program Officer to read the solicitation to them. As was mentioned above, read the solicitation or program description thoroughly. Also read any background material that was cited in the solicitation, and look in the funding database to see what other projects have been funded by the program. When you talk to the Program Officer, ask open-ended questions and listen carefully. Take what the Program Officer has to say seriously, even if what she's telling you is not what you want to hear. For example, if the Program Officer says your research doesn't fit his program, it's much better to accept that fact and talk to him about other programs where it might fit or how your research project could be modified rather than spend time on a proposal that's unlikely to succeed.

In addition, many Program Officers attend conferences in their field. If you happen to be at such a conference, take the opportunity to introduce yourself to the Program Officer if you have the opportunity.

Writing for Reviewers

Specific review criteria and review processes differ from agency to agency, as well as by program within an agency, and by type of solicitation. **But the core, generic questions program officers and reviewers want answered can be simply stated**:
- What do you propose to do?
- Why it is it important—what is its significance?
- Why are you able to do it?
- How will you do it?
- How does it contribute to and advance the research interests of the agency, or the field?

These simple questions may be expressed in various ways by different agencies and programs, and more specific details will often be requested in the solicitation or program announcement (e.g., NSF has both overarching review criteria and program-specific review criteria), but ultimately most review criteria can be distilled down to some equivalent version of these simple questions. Your challenge when writing for reviewers is to answer these questions in a clear, convincing, and compelling way that is **easily accessible and understood by the reviewers**.

Solicitations may often contain a fairly long listing of review criteria specific to the program, but if you keep these core criteria in mind while writing your project narrative, you will better infuse your narrative with the key arguments, details, internal connections, and explanations all reviewers will look to in making their evaluation of your research, regardless of discipline, agency, or foundation.

Your proposal typically will be read by two basic types of reviewers: those who are expert, or at least knowledgeable, in your research domain, and the those who are not. The program officer will play a key role in this process as well, but that role will be **agency specific** (e.g., at NSF reviewer inputs are advisory to the program officer, whereas at NIH the percentile score is key to your success). Unless you are confident you know otherwise, when writing to reviewers, **write for the intelligent reader and not the expert**.   Remember you are most likely writing to a **panel** of reviewers, **each of whom** will be selected for a needed expertise. In all cases:
- You must craft a persuasive argument presenting the merit, significance, rigor, and relevance of your research that **makes the reviewers want to fund it**;
- You must convince reviewers you have the capacity to perform, and the institutional infrastructure to support your research;
- You must extend your argument to discuss the likely impact your research will have in advancing the field and creating new knowledge, both in your research area and possibly in other research fields as well; and

- When writing to federal mission agencies, you must demonstrate to the program managers and reviewers that your research advances the mission of the agency.

The author of a funded proposal has successfully accomplished the following basic goals of writing for or with reviewers in mind:

- Ensured the reviewers were intrigued and excited about the proposed research;
- Understood its significance;
- Understood that existing research enhances the likely success of the proposed effort;
- Understood how the proposed research will be accomplished; and
- Developed confidence in the researcher's capacity to perform.

The proposal review is the most important factor influencing the likelihood your proposal will be funded. More than one person typically will review your proposal – these may be personnel at the agency or foundation, peer reviewers from academia, other people from outside the funding agency, or a combination. Reviews may be conducted on an ad hoc basis or by a standing panel. Reviewers will evaluate the proposal based on review criteria, both explicit (stated in the solicitation or other agency documents) and implicit (commonly held but unstated expectations held by the reviewers). Understanding how the reviewers will evaluate your proposal is critical to learning how to write a winning proposal. This, by the way, is not a simple task. It is a learned skill and, once mastered, a very valuable one.

Writing for Reviewers—Generic Narrative Tips

- Sell your proposal to a good researcher but not an expert;
- Write to **all the reviewers** on the panel, as some review panels may not have an expert in your field, or panels may be blended for multidisciplinary initiatives;
- Keep in mind that proposals are not journal articles; proposals must be user friendly and offer reviewers a **compelling and memorable** narrative;
- Proposals are not mystery novels. Reveal the significance of your research quickly, not at the conclusion;
- Check carefully for sloppy errors in language, usage, grammar, and logic, which reviewers may assume will translate into sloppy errors in your research;
- Write a compelling project summary (or abstract) and narrative introduction:
  - This is where you must capture the interest of reviewers and win them over by making them intrigued enough to want to read your entire proposal closely and with interest;
  - Define the significance of the core ideas quickly, clearly, and concisely;
  - Describe the connectedness of the core ideas to specific research activities and outcomes, and advance your ideas with sufficient detail to make your research **memorable after the proposal has been read**.

Agency Review Criteria

Each funding agency develops review criteria and a review process that best serve the mission of the agency, as well as the requirement of each solicitation. In the case of unsolicited proposals, the review criteria will most often be addressed in the agency guidelines for submitting unsolicited proposals, or in other agency documents.   For example, BAAs from DoD agencies that are open for a year or more will typically have a section on the review process for unsolicited proposals as well as solicited proposals. Agencies usually post review criteria and review processes on agency websites and include them within program solicitations, submission guidelines, and other documents. Two of the major funders of university research, NSF and NIH, have developed elaborate and comprehensive information on their websites about the review criteria and process.

   Agencies typically develop two general kinds of review criteria: first, overarching criteria that apply across the agency to every grant application, for example, intellectual merit and broader impacts at NSF; significance, approach, innovation, quality of investigators, environment, and overall impact at NIH; or, at defense research laboratories, scientific and technical merit and the contributions of the research to the agency mission. Depending on the agency, not all overarching review criteria are weighted equally in terms of importance; for example, some mission agencies may list them in descending order of relative importance.

   The second type of review criteria apply specifically to the particular program and may be very detailed in terms of expected project objectives and outcomes. The overarching review criteria of any agency typically are clearly stated and well explicated over time. For example, the "broader impacts" criterion, one of two overarching review criteria at NSF, has been much written about and discussed with detailed examples on the NSF website, as well as at various NSF workshops.

   Solicitation-specific review criteria, however, especially on new programs, may not have been as fully vetted for possible ambiguities, in which case it becomes ***important to discuss the criteria with a program officer***. If you are uncertain about the meaning of one or more review criteria, it is important to clarify the agency's intent with an agency program officer, or perhaps a colleague who has been well funded by the agency. In summary, it is important to identify these review criteria, understand exactly how the agency defines them, and determine the relative weight (if applicable) the agency assigns to each criterion.

The Review Process
The review process itself can vary significantly from one agency to the next and from one program to the next. It may be conducted in an ad hoc fashion or by panel. Reviewers may be experienced researchers and academics (a "peer review"); the reviewer may consist only of the program officer or a group of personnel from the funding agency (an "internal review"); or they may be a combine these two groups.

Furthermore, reviews may be written independently and mailed in, or reviews may be conducted by a panel of reviewers who convene at the funding agency (often called a "panel review"). Reviewers may be experts in your field; they may be experts in related fields; or they may have little or no knowledge of your field. They may be a standing committee or the membership may change. A writer who knows the backgrounds of the people who will review his or her proposal and crafts the proposal with those reviewers in mind obviously will have a substantial advantage over a writer who blindly writes a proposal without knowing the kind of audience he or she is trying to convince.

The most comprehensive information on the agency review process will come from visiting the agency website and talking with agency program officers as well as with colleagues who have served as reviewers for the agency, served as rotating program officers at the agency, or who have been well funded by the agency. Below are descriptions of procedures used by some of the major research funding agencies.

Finding Research Funding Mentors

One of the best ways to get a successful start in finding and competing for research funding is to draw on the knowledge of others who have been successful. Seek out faculty in your field who have succeeded at winning research funding. These may be colleagues in your department, your former advisor, or colleagues at other institutions.

First, offer to take them out to lunch if they'll allow you to pick their brain about funding. Most faculty are delighted to talk about their experiences and share their hard-won knowledge. Ask them: what agencies and programs fund our kind of research? What are their expectations in terms of publications, preliminary results, type of research, etc.? How does the funding agency operate (i.e., what is its culture, mission, investment priorities, and research strategic plan)? Have you been a reviewer for these agencies or served as a program officer? If so, are there common mistakes that you see in proposals that you've reviewed? How did you get your first few grants? What advice would you give a new faculty member who is pursuing his or her first grant? How should I interact with program officers? Ask whether the faculty member might be willing to let you see a successful proposal. Finally, ask them whether, in the future, they might be willing to read a draft of your proposal and give you feedback when you are ready to submit it for funding.

Keep in mind, however, that agencies and programs can vary significantly in their cultures and expectations, and that they also change over time. One PI's experience may be very different from another's, and advice that might have been valid for a program five years ago might no longer apply. For that reason, it's important to talk to a number of successful researchers to get a wide range of perspectives.

Be aware, also, that the halls of academia are rife with myths about funding agencies, the most prolific sources of which are faculty who have been unsuccessful in winning grants. Most of these nuggets of conventional wisdom concern reasons why you or faculty from your institution cannot be successful in winning a grant. So when someone in your department explains that NSF only funds east and west coast universities, or that NSF reviewers really don't care about broader impacts, be sure to consider the source. How well do these people really know the agency? How active are they in pursuing research funding? The best sources of information about an agency are researchers who have been successful in winning funding from that agency, and if there isn't anyone in your department who fits that description, you'll need to reach out beyond your department or institution to find a mentor.

In some agencies, the Program Officer can be one of your most helpful funding mentors. This is particularly true for the Department of Defense, some of the mission agencies like USDA and NASA, and many programs within NSF. If you are doing research of interest to the Program Officer, she can often help steer you to the right solicitation, ask for an unsolicited proposal, and give you feedback on your ideas. Program Officers want good quality research proposals that fit the goals of their program, so they are often motivated to provide guidance to help you prepare a better proposal. The extent

to which a Program Officer will help you depends on the culture of the agency, the personality of the Program Officer, and how busy she or he is, so be sure to solicit advice from the Program Officer, but be careful not to overburden them with requests. For example, most Program Officers don't have time to read your entire proposal draft before submission, so don't ask them to do so unless they volunteer to do it. However, they are often happy to read an executive summary and give you feedback on your research ideas. Furthermore, NSF Program Officers will often invite you to serve as a reviewer, which is an invaluable way to learn how to write effective proposals. If your university has a Research Development Office, the staff in that office can also serve as excellent funding mentors. Their job is to keep up with the latest developments at funding agencies, and since they are involved in dozens of proposals each year, they often have much more experience than single PIs with particular funding programs. What's more, if they work across your college or university, they may be able to connect you with potential collaborators and other faculty experienced in a program or agency of interest.

Another important role of a research funding mentor is to read your draft proposals and give you feedback. Undertaking a useful critical review of a proposal takes a significant amount of time, so recruit mentors to review your proposal early and give them sufficient notice when the draft will be ready. It's often a good idea to approach a potential reader at least six weeks before your draft will be ready and ask whether they would be willing to review your draft, giving them the date when you expect to have it ready. When the draft is ready, give them several days to go through it. Line up several readers so that you'll get more than one opinion. Remember that all proposals can be improved, and the best mentors are demanding readers who will read your proposal draft closely and return it with numerous comments, suggestions, and critiques. If a reviewer returns your proposal draft with a few generally positive comments and no significant critiques, it's safe to assume that they didn't read it carefully.

Finally, after you identify particular agencies and programs likely to fund your research, work to connect with the community of researchers funded by that agency. Talk to colleagues at conferences and ask where they have been funded. Look for faculty at your institution or in your field who have served as Program Officers at the agency. Connect with researchers in your area who regularly serve as reviewers for the agency and program. Don't discount the value of gossip. When you see these people at faculty meetings or conferences, ask them about any developments at the agency. Often, there will be buzz among the community about a solicitation that is expected but hasn't come out yet, a workshop that's being planned in preparation for a new area to be funded, or news about a new Program Officer. Networking with the community of funded researchers can also be a good way to find collaborators for future proposals.

Working with Research Collaborators

Early-career researchers can be intimidated by the prospect of competing for funding with more senior researchers with long track records and extensive lists of publications. You may feel that you're facing the classic chicken-and-egg conundrum: how can you get funding without a track record, and how can you build a track record without funding? One way to get your foot in the funding door is to collaborate with a more established researcher as a co-PI on a grant. This approach can allow you to demonstrate your ability to conduct research, generate publications, and get to know program directors at the funding agency.

There are also a number of other good reasons to collaborate. Your project may call for knowledge, skills, or resources that you don't have – an increasingly common occurrence as research becomes more multidisciplinary. You may be invited to participate in a large, multi-PI proposal such as a center-level grant. Or the project may require the participation of more than one type of institution (for example, some programs encourage or require collaboration with industry, international universities, or minority serving institutions).

When considering a collaboration, first find out the current policy in your department for assigning credit for jointly-funded projects and joint publications. In most departments, promotion and tenure policies have been updated to avoid punishing researchers for collaborating, but that is not always the case. Also, find out the procedures for collaborating with researchers outside your department, college, or institution, if applicable. There can sometimes be issues related to how the indirect cost (the "overhead") is shared among multiple departments or colleges, so it's best to bring this up with your Department Head or Chair early so that those issues can be resolved before your proposal is ready to submit.

Structuring the Project

When structuring the project, select an identifiable part of the work that will be your contribution. To avoid the appearance that you're merely serving as an assistant to a more senior researcher, take responsibility for specific tasks, and identify the expertise that you bring to the project. This will allow you to develop a track record that is clearly your own and is generally best accomplished by collaborating with another researcher (or team of researchers) with different, highly distinguishable areas of expertise. The products of the collaboration (articles, a book, book chapters) should also be discussed during the planning stages, along with how the writing will be done and credited.

Discuss distribution of the budget explicitly and in detail early in the project planning process. ***The most common budgeting mistake made in multi-PI projects is to simply divide the budget by the number of investigators. Budgets should be apportioned based on who is responsible for what tasks and the resources required to complete each of those tasks.*** If a project is a collaboration between an experimentalist (who needs to buy materials and supplies, pay for equipment time, and support two students

to fabricate and test specimens) and a modeler (who will support one student to conduct computer modeling), dividing the project budget in half will raise red flags for the reviewers and leave the experimentalist with insufficient resources to accomplish her part of the project.

It's almost always the case that, when the budget numbers are calculated based on the resources needed to accomplish the proposed research plan, the budget will be very tight. As the junior member in a collaborative project, you need to make sure that you'll have sufficient resources to conduct your portion of the research project. If it appears you won't have enough funds, work with your collaborator to modify the research plan to make it more realistic. Not only will this make it easier for you to perform the research successfully if you win the grant but it will make your proposal more competitive, since reviewers usually notice when a research plan is unrealistic based on the budget, and they'll hesitate to fund such a project.

MSI and PUI Faculty

If you are faculty at a minority serving institution (an HBCU or HSI) or Predominantly Undergraduate Institution, you may find that you're often invited to collaborate on multi-institutional proposals, particularly proposals to NSF, where diversity is an important review criterion. These collaborative projects can be wonderful opportunities, but it's especially important in these situations that you act as a strong advocate for your own interests. While PIs at larger institutions may have the best intentions, they often plan the collaboration from the point of view of their own needs and may not consider how the collaboration will help you build your research program. A PI may initially intend to structure the collaboration so that your role is simply to provide access to minority students who will be recruited to the lead university's graduate program. While this kind of activity may provide some benefits to the small number of students who are recruited, it will do little to help your institution or help you build your research program. Fortunately, PIs are usually very open to suggestions on how to enhance the collaboration and thereby improve the proposal.

In your discussions with the PI, let them know your research interests and capabilities, and work with them to determine what research tasks you and your students could take on. If you have a large teaching load and are dependent on undergraduates as research assistants, you may not be able to take on a big part of the project, but it's often feasible to carve out a subproject from the research that's appropriately scoped for the time and resources you have available. If you don't have all the needed instrumentation, or don't have expertise in a required methodology, perhaps the project could include funds for you and a student to work in the lab of the PI for a few weeks in the summer (NSF has supplementary funding available for this). As we mentioned above, be sure to discuss what the predicted outputs of the project will be in terms of publications, and structure your part of the project so that you'll be able to co-author one or more publications from the research. Let the PI know that you want to be a full-fledged member of the research team, and include travel funds in your

budget so that you can attend project team meetings and perhaps present your results at a conference.

What's more, by structuring the collaboration so that it benefits your research, has lasting impact on your institution, and provides high quality research experiences for your students, you'll also be helping to make the proposal more competitive. And you will develop lasting relationships with researchers at the partner institution that can lead to future proposals, perhaps with you as the PI.

Scheduling Proposal Production

When you first consider applying to a particular funding opportunity, you'll need to ask yourself, "Do I have enough time to produce a well-written proposal before the deadline?" If you don't realistically have time to produce a good proposal this semester, then it's better either to plan to apply late or to rearrange your commitments to make time. Producing a hastily-written proposal in all-night sessions the week the proposal is due will cost you precious sleep, waste time you could have spent on your other commitments, irritate proposal administrators at your institution who need time to prepare budgets and get appropriate signatures, and irritate reviewers who have to read a poorly-written proposal. Producing a good proposal takes time; understanding that will help you avoid frustration, disappointment, and strained relationships with your administrators.

How much time does it take to prepare a proposal? Of course, this varies depending on the type of program, the complexity of the proposal, whether it's a single-PI or a team-based project, and so on. However, you can estimate the time you'll need by listing the required steps for preparing a proposal along with the approximate time needed for each task. Below is a generic list that can serve as a starting point, but you'll need to add any additional tasks that might be required for your particular proposal.

- **Do your homework.** Read the solicitation or program description very carefully. Look at projects that have previously been funded through the program. Contact the Program Officer to discuss whether your project idea fits this particular program. Make sure you're up-to-date on the literature in the topic.
- **Assess whether you're in a position to be competitive for this particular funding opportunity.** Do you have enough publications in the area? Do you have preliminary data, if they are needed? Do you have the resources you need (e.g., access to required instrumentation)?
- **Recruit partners and collaborators, if needed.** If this will be a multi-investigator proposal, be sure to meet early and often with your co-investigators to plan a well-integrated project. *This is best done in person or by teleconference, not by email.* If you'll need letters of collaboration, start working on those early.
- **If cost share is required, start working on lining up your cost share as soon as possible.** The process for providing cost share varies by institution, but usually involves securing commitments from administrators at the departmental, college, and university levels. This takes time (and, often, multiple memos and meetings), so start on this as soon as you know you'll be submitting the proposal.
- **Line up mentors who agree to read your draft proposal and give you feedback.** It'll be easier to recruit colleagues to read your proposal if you ask them well in advance. Recruit mentors in your subfield and some who are outside your subfield.

- **If the proposal will involve investigators from other departments or institutions, let your Department Head or Chair know.** This will avoid any surprises when the time comes for your Department Head to approve submission of the proposal.
- **Contact your Office of Sponsored Projects or preaward services office to let them know you'll be working on a proposal.** If you're submitting to NSF, they'll need to get you registered on Fastlane. They'll also let you know your institution's procedures for routing and approval and when you need to have the final draft of the proposal to them for final check and submittal.
- **Scope out your project and start working on the budget.** Work with your Office of Sponsored Projects or preaward services office to start developing a budget. If this is a single-PI proposal, the budget will probably be fairly straightforward, but if this is a multi-investigator proposal, be sure to go over the budget with your coPIs, and count on multiple iterations of the budget.
- **Write multiple drafts of your project narrative.** This step is usually the most time intensive. Writing a project narrative that's clear, compelling, thorough, and observes the page limits will require multiple drafts. Allow several days between drafts to permit feedback from your mentors who have agreed to read your drafts. Set aside several weeks to get this done.
- **Develop other required material.** Funders typically require a biosketch for each researcher, information on other pending proposals and funded projects, a budget narrative, an executive summary, and a number of other ancillary materials. Make a checklist of everything required for the proposal and work on these in parallel with your project narrative.
- **Finalize your budget and route the proposal and budget for approval.** Some universities require only a project summary along with the finalized budget for routing, while others want a draft of the project narrative or even the final draft of the entire proposal. Contact your Sponsored Projects or Preaward Office to learn your institution's procedures and be sure to have the documents ready in time for routing.
- **Upload and final check of the entire proposal.** Plan to have your entire proposal uploaded (either by your Sponsored Projects or Preaward Office, or by you) and ready for final check at least two days before the due date (some offices require three to five days). This will give you time to address last-minute issues that can come up, such as problems with uploading, errors due to faulty conversion to pdf format, or the realization that you've forgotten a required form (such as the Postdoc Mentoring plan required by NSF).
- **Submit your proposal.** After you give them the go-ahead, your institution's authorized representative (usually someone in your Sponsored Projects or Preaward Office) will submit your proposal. Plan to submit at least one day before the due date. Since most proposals are now submitted over the internet, there's always the possibility that your internet connection will go down on the

due date or that the website used for submission will become overwhelmed due to a large number of submissions. By planning to submit a little early, you'll ensure that your proposal will receive the funders full consideration.

Schedule your proposal development effort by starting with the above list of tasks, adding any additional tasks that pertain to your proposal, and working back from the due date. For a first proposal, it's generally advisable to begin at least three months before the due date. Also be sure to schedule time to work on your proposal; without setting time aside to complete the preparation, it may be written in a rush or not at all. Allot several hours each week to work on your proposal without interruptions (with more time allotted as you get closer to the due date). If you'll be submitting as part of a team, also plan at least weekly meetings with your team.

Producing a proposal is a time-consuming effort. As a new faculty member, you'll need to be strategic in selecting the grants to pursue and deciding when to pursue them. But developing a grant proposal can also be very rewarding; it can help you clarify your research plans, develop new collaborations, and even obtain funding to support your research.

Typical Proposal Structure

The required components for research proposals vary considerably depending on the funder and the program. Be sure to check the specific requirements of the particular grant program for which you're applying. Many agencies provide a set of overall guidelines (e.g., the Grant Proposal Guide for NSF and the SF-424 for NIH), which may be modified or supplemented by the particular solicitation. Also be sure to check page limits (listed here for NIH) and formatting requirements. A list of *typical* components is given below (different funders use different names for these components).

Component	Description
Project Summary/Executive Summary/Abstract	Typically 1 or 2 page summary of the project. Sometimes specific content is required (e.g., intellectual merit, broader impacts for NSF; type of project or list of institutions for some programs)
Proposal Narrative/Project Description/Research Plan	This is the "meat" of your proposal, where you describe what you're going to do and how you're going to do it. Some solicitations specify how to structure this component, and some leave it up to you. Typical sections may include: • Introduction/Overview/Objectives/Rationale/Specific Aims/Significance • Background/Lit Review/State of the Art; Preliminary Results/Studies • Methodology/Technical Approach/Experimental Plan/Research Strategy • Project Schedule/Milestones/Deliverables/Outcomes • Management Approach • Education/broader impacts/diversity
References Cited/ Bibliography	References cited in your proposal narrative (this section may or may not have a page limit – be sure to check).
Facilities and Equipment	Reviewers will look to make sure you have the equipment and infrastructure you need to accomplish the proposed project
Budget	Usually a form filled in with the help of your grants office
Budget Narrative/Justification	A description of each item in the budget and why it is needed
Biographical Sketch	Usually includes education, professional position, selected publications. May also include a personal statement.
Other Materials	As specified by the funder; e.g., Statement of Work, Public Health Relevance Statement, Data Management Plan, Postdoc Mentoring Plan, Letters of Support, Collaboration or Reference.
Various forms and assurances	These include the cover page and other online forms that your grants office will likely fill out for you as well as IRB, human subjects, vertebrate animals, and other forms that may be required.

Writing a Compelling Project Summary

One key skill to master as you develop a more robust repertoire of research grant writing expertise is the mastery of the one- or two-page description of your research objectives and their significance, herein called the ***project summary***. Depending on the agency and the specific solicitation, this brief statement may also be referred to, or serve as, a ***project abstract, executive summary, research vision statement, project rationale, or as the introduction to the full proposal.*** In some cases, the agency may dictate precisely the content, order, and format of the summary, while in other cases, an agency may leave the form and content fairly open ended and generic. Often the content, order, and format will be suited to a particular solicitation. Regardless, the common characteristic is brevity, typically a length of one to two pages. This constraint requires that the successful summary statement be clear, succinct, and compelling . Achieving those characteristics requires significant preliminary thought, discussion, and ***multiple draft iterations*** of what will become the final project summary text.

When writing the project summary, keep in mind Mark Twain's comment in his correspondence with a friend: "***If I had had more time I would have written you a shorter letter***." This captures what needs to be done in ***crafting***, as opposed to merely writing, the project summary. This brief overview statement at the front end of the proposal offers you the best opportunity you will ever have to capture the interest of the reviewers early on as they decide whether or not to fund your project. ***It is here you must convince your reviewers to <u>want to read</u> the rest of your proposal***—thoughtfully, carefully, and attentively, with interest and curiosity. If you lose the reviewers here, you have likely left them without reason or interest to read the next fifteen, or twenty-five, or more pages of your proposal.   Your clarity of language, logic, and argument is critical in the project summary. You certainly don't want to write a project summary that puts reviewers in mind of H. L. Mencken's comment on an article he reviewed as "***an army of words marching across the page in search of an idea***."

Avoid the Generic Introduction

Put yourself in the place of a reviewer. You've been asked to review proposals for a DOE biofuels program, and you have nine proposals to review before you participate in a panel. You open the first proposal, and it begins, "Biofuels are critical to the national goal of achieving energy independence…". The introduction to the proposal continues on for several paragraphs, explaining the importance of biofuels and discussing why biofuels need to be developed. Of course, you've been asked to review these proposals because you're an expert in biofuels, so none of this information is news to you.

You finish reading that proposal and open the second one. It starts, "Biofuels are an important component of the US's future energy policy…". It goes on to explain why biofuels are important and why research on biofuels is needed. You open the third proposal, and guess what? It starts with another discussion of why biofuels are important – some of these discussions even stretch to a page or more. You wade through these proposals, and then you get to the sixth proposal, and it starts out, "A critical problem in making biofuels practical is making step x in the synthesis process more efficient. Our proposed project will address this problem by using the following innovative approach….", and it goes on to outline an interesting and innovative approach to the problem.

Which proposal would you remember?

The First Impression

A common mistake in writing proposals is to spend the first critical paragraphs explaining to the reviewer something that he surely already knows and probably has read in all the proposals leading up to yours. The truism that *you never get a second chance to make a first impression* holds particularly true when it comes to proposals. Your reviewer's interest is at its height when she starts reading your proposal. At that point, you can either reward her excitement or lull her to sleep. Starting with an introduction that does nothing to distinguish your project from all the other proposed projects will lull her to sleep.

To develop an exciting introduction, you need to identify the kernel of your great idea. How is your idea different from what others will propose? What important problem will it solve? Why is it innovative and exciting? Don't bury that kernel at the bottom of page 3 after you've lulled your reviewer into a pleasant stupor with generic discussions about your topic area. Put it right up front in the first paragraph. When you finish your first paragraph, it should be absolutely distinctive. If that introductory paragraph could be put into another proposal on the same topic area, delete it and start over.

Many PIs like to start their proposal with a description of the need or problem they're addressing. This approach is fine, but be sure to pinpoint the *specific need or problem* you'll be addressing (not "biofuels production needs to be made more

economical," but "step x in the production of biofuels is inefficient") and quickly follow with a discussion of how you'll address that problem (e.g., "We have an innovative idea y for increasing efficiency of that step by 40%").

Providing Context without Boring the Reviewer

It is important to demonstrate to the funder that you understand the significance of the topic area and the motivation for the program, but it's not necessary to discuss those things in the first couple of paragraphs. Save that discussion for your background section, which should be placed after an introductory section that provides a compelling overview of your proposed project. This overview should concisely summarize what you're going to do, why you're going to do it, and why it's significant. When you get to that background section, be sure to tailor it to your specific project. You'll not only want to demonstrate to the funder that you understand the funder's goals for the program but at the same time you'll want to describe how funding *your specific project* will help the funder achieve those goals.

When you discuss the state of the art, it similarly can be tempting (particularly if you've been teaching a course on the subject) to write a long section that is essentially an introductory lecture about the topic. Unless you have good reason to believe that the reviewers are not well versed in the subject of your proposal, it's best to avoid this temptation and instead focus quickly on the specific problem or challenge within the topic that is the focus of your proposed project. What have others done to try to address this problem? What holes in current knowledge must be filled in order to solve this problem?

So, taking our earlier biofuels example, that would mean discussing the state of knowledge about the specific synthesis step that you plan to improve, not providing a long description of the state of the art in biofuels. If your state of the art section could be interchanged with that from any other proposal on the topic, then you can be assured that the reviewer will be asleep by the time he finishes reading the section. Even more concerning, he will have gained no insight into the motivation behind your particular proposal, as compared to all the other proposals he has been reading.

Remember that your proposal will be evaluated along with a pile of other proposals submitted in response to the same funding opportunity. Whatever you can do to make your proposal stand out as more original, more thoughtful, more significant, or more exciting than the others will increase your chances of funding, and that starts with a strong introduction.

Writing A Competitive Proposal Narrative

The fundamental requirement of the proposal narrative at the time of submittal is that it be a well-written document that responds fully, clearly, and persuasively to the research goals and objectives and review criteria defined by the sponsor in the funding solicitation, or the agency guidelines in the case of an unsolicited proposal. However, long before submitting the proposal narrative to a funding agency, you will find that it **plays a key role in the conceptual development of the proposed research.**

The proposal narrative development process is akin to a slowly lifting fog, whereby a **continuous process of draft text iterations** gradually transforms initially diffuse ideas into a tightly crafted proposal narrative. Equally important, the evolving proposal narrative **serves as an incubator of ideas**, particularly in the early stages of proposal development, and **acts as the structural framework,** imposing rigor, clarity, and simplicity on evolving ideas and concepts and establishing their connectedness to operational and performance details. The proposal narrative process typically begins with a significant amount of (pick your adjective) chaos, uncertainty, vagueness, ambiguity, false starts, and indecision, among many other indeterminacies, concerning how best to meet the funding agency research objectives. Do not be alarmed by a certain amount of uncertainty and ambiguity about the shape the final proposal will take. This is fairly common at the beginning of any proposal development effort.

In much the same way as mathematics or a computer program helps impose rigor, relational clarity, logical sequences, and simplicity on our understanding of the behavior of the physical world, language plays a similar role in the evolving proposal narrative. The key point to understand and anticipate is that **competitive ideas evolve and converge over time; they do not appear fully and perfectly formed by a narrative genie**. Most ideas that eventually evolve and mature during the development and writing of a proposal narrative originate from your first reading of the solicitation. Sometimes ideas will come from "collaborative brainstorming" discussions with a few colleagues. In any case, if it is determined that a solicitation matches your research interests and expertise and that a competitive proposal can be written in the time available, **the path to the end product, a competitive proposal narrative, is often far from clear at the earliest stages of proposal development**. **Successful proposals converge on excellence by going through multiple iterations wherein ideas and the language used to express them are continuously refined and made clear draft after draft after draft.**

Bringing clarity to the proposal development process typically starts with ideas, concepts, and directions expressed verbally among researchers related to meeting the research objectives of the solicitation. Depending on the type of proposal, initial discussions, or even "brainstorming" ideas **initially expressed verbally** can range from slightly to extremely illusory when attempting the first draft. The real challenge occurs when it comes time **to translate ideas expressed verbally into the narrative language required to make a compelling case for the significance of the research**. Verbal

"understandings" among participants can be both illusory and transitory, **and multiple participants may carry away multiple understandings** from research development meetings. In fact, in the initial stages of drafting the proposal narrative, there are often many uncertainties and unknowns about the final research plan that will emerge by the time the final proposal takes shape.

This makes the proposal writing process itself one of **iterative exploration** converging on a compelling and competitive research narrative over time, i.e., before the due date. What seems like a "good idea" at the start of this iterative process can often disintegrate under closer examination. Verbal epiphanies are deceptive because they lack connectedness and the appropriate balance and synthesis of ideas with detail needed for a successful narrative. It is this **conjoining of ideas with the performance details** that offers the central challenge to crafting a competitive proposal narrative.

However, this iterative process of translating ideas into the structure imposed by language in the research narrative serves many important functions—it helps tame the conceptual excesses and unwarranted effusiveness that may occur among some members of a research team at the early stages of proposal development; it helps define the clear boundaries, scale, and scope of the initiative; it sharpens the focus and tightens the descriptions of concepts and ideas; and it forces connectedness among ideas, and between the ideas and operational details that transition and transform ideas to clearly stated research or educational outcomes, or research deliverables.

In effect, the evolving proposal narrative helps transform ideas and anchor them in a **common reality—the research narrative**—a reality that must be shared by research colleagues, program officers, and review panelists if the proposal is to meet with success. In this regard, a proposal narrative is not unlike a novel or a movie. It creates its own, self-contained reality. It contains all the information that the funding agency and review panel will know about your capabilities and your capacity to perform. With a few exceptions (e.g., site visits), an agency bases its decision to fund or not to fund **entirely on the proposal narrative and the persuasive reality it creates**. The construction of this common reality through a process of writing and rewriting draft after draft of text helps test ideas in a "**language lab**" in a way not unlike experimentalists test ideas about the physical world.

Moreover, this process of defining a common reality and a common language through multiple draft iterations of the research narrative becomes particularly important in multidisciplinary efforts and collaborations. These situations require a common structure to meld multiple disciplinary research strands, or research focus areas, and to make ideas accessible to collaborators of potentially synergetic but differing disciplines. One common challenge in multidisciplinary research initiatives is the sponsor-required vision statement, or similar integrative and synthesizing statement. The key role of this statement is to unify the research effort and make a convincing case to the sponsor that critical and beneficial synergies inhere in several research strands integrated within one research project that would not be possible were the research strands funded separately as discrete projects to unconnected PIs. **The**

crafting of a research vision statement or other unifying statement is as critical to a proposal's competiveness as it is challenging to write.

The Role of Specificity in the Successful Proposal

As one of the most critical components of a successful research narrative, specificity must be evident throughout project descriptions*. **Specificity grounds the research vision and goals in the key performance details unique to your research objectives, and thereby illuminates the importance of your research for reviewers**. Judiciously selected specifics display the uniqueness of your research narrative and define the particularity of your research plan. When key research specifics are embedded in, or follow, overarching statements defining the research vision and project goals, they significantly enhance the clarity and persuasiveness of the research narrative. Well-chosen specifics serve as the glue that binds together the more general narrative statements introducing your research topic to the reviewers. In effect, specifics help transition the narrative from a "black and white" portrait to a "full color" portrait of your proposed research (see *Writing a Compelling Project Narrative* in the February 15, 2012 issue).

    However, providing specificity should not be confused with inflating a research narrative with technical minutiae impenetrable to the typical reviewer. Specifics should be clear, precise, logically ordered, and, like Goldilocks, supplied in just the right amount. They should be chosen to illuminate rather than disguise the importance of your research. Specificity should sharpen rather than blur the focus of the research narrative*, **encouraging reviewers to recall the key factors that make your research feasible, unique, significant, and hence fundable***.   As in all effective narrative techniques, balance and proportion are important; therefore, you might think in terms of "Goldilocks Specifics," somewhat like the "Goldilocks Planets" that are not so near a sun, nor so far away, that liquid water does not exist on their surface. In this case, the successful narrative gives neither too few nor too many specifics but just the right amount. Make your point, but don't belabor it, **and remember that superlatives are not specifics**. Any attempt to substitute superlatives for specifics will be quickly noted by reviewers, and likely in an unfavorable way. **Specifics function in the narrative text as mirrors that reflect your capacity to perform.**

    For example, vision statements and project goals, such as the following from a Department of Energy funded proposal, define the proposed research landscape in broad brush strokes: "*The goals of the Greater Philadelphia Innovation Cluster ([GPIC](#)) for Energy Efficient Buildings are to improve energy efficiency and operability and reduce carbon emissions of new and existing buildings, and to stimulate private investment and quality job creation in the Greater Philadelphia region, the larger Mid Atlantic region, and beyond. GPIC will focus on full spectrum retrofit of existing average size commercial and multi-family residential buildings*." Think of the vision and goals statements, such as this one, as descriptions of some promised "units of change" (e.g., improved energy efficiency, improved energy operability, reduced carbon emissions, investments stimulated, and jobs created) that will occur over some "unit of time" that will result in some "unit of benefit." Essentially, vision and goals statements promise better things to

come based on the proposed research. Without specifics, they are empty promises, or, as some might say, "all hat and no cattle."

The basic role of specifics in the research narrative is to make your research vision and goals ***believable, convincing, and memorable to reviewers***. Specifics will convince reviewers of your capacity to perform, of the reasonableness of your research plan and objectives, and of the promise that your research will advance the field or the strategic mission of a funding agency in some important way. By contrast, entire proposals or sections of proposals defining a major project goal, e.g., energy efficiency, but lacking a detailed description of the research to be done, the justification for doing it, the manner of doing it, the people who will do it, and the benefits of doing it, lack specificity. Generous reviewers of such uninspiring text might first question their own short-term memory and hold themselves at fault for flagging attention, but one important rule of grant writing is to always blame the writer and hold the reviewer blameless should the narrative fail to make a convincing case for funding. ***If reviewers must repeatedly look back in your narrative text to find and recall the essential specifics of your proposed research, then the fault lies in the writing and not the reviewers' memories***.

Why might narrative text lack specificity? It is easier and less time consuming to make general claims and promises than it is to select a logically-connected series of specific details that illuminate your research objectives and answer the core questions listed above. ***Specifics serve to both test and prove the value of your ideas, and when they are lacking, it tells a reviewer that your ideas may also be lacking, or have yet to become fully developed.*** A proposal is judged in a kind of courtroom: the specifics of your proposal must answer reviewers' questions and overcome their skepticism to pave the way for a positive verdict.

In other cases, narrative text might lack specificity because one or more authors have mistakenly repeated various versions of the same goals and confused this repetition with an offering of specifics. Repeating goals in various ways does not address the core questions reviewers need answered. In this regard, keep in mind Richard Feynman's observation: "*You can know the name of a bird in all the languages of the world, but when you're finished, you'll know absolutely nothing whatever about the bird. So look at the bird and see what it's doing. I learned very early the difference between knowing the name of something and knowing something*." In the example used above, think of a goal as the name of something, in this case, "energy efficient buildings." ***Think of the specifics in your narrative as proof or validation that you know something about achieving your research goal***. In this case, it might be offering specifics about how building envelopes, smart buildings, sensors, materials, design practices, energy systems, construction practices, and the like, contribute to achieving your research goal. ***Stating a goal without then offering compelling specifics that make clear the process you will use to transition a goal to reality, i.e., a research outcome, is the domain of politicians and bumper sticker slogans and not that of the successful research proposal***.

Moreover, continuing with the energy efficiency example, specifics need to be judiciously selected and characterized by the following:

- **Relevance to the research goal**, e.g., if your energy efficient materials research focuses on only one of several areas, such as photovoltaics, thermoelectrics, solid-state lighting, among many others, your task is to offer specifics relevant only to your proposed research and not offer specifics relevant to the entire universe of energy-efficient materials;
- **Appropriateness of scale**, e.g., if the crystal structure of a material is not key to understanding the research, then don't belabor the Miller Index; similarly, if only the duration of an event is key to your research, then there is no need to belabor the cesium oscillator or explain the history of NIST;
- **Priority for accomplishing research goal**, e.g., offer the key specifics first that **make your case most clearly and briefly and in a way most memorable to reviewers**, but don't offer an exhaustive list of specifics that overwhelms reviewers, thereby leaving it to reviewers to determine the most important details needed to convince them of your capacity to achieve your research goals.

Vision, Goals, Objectives, Rationale, and Outcomes

To craft a competitive proposal narrative requires that a research project description address the vision, goals, objectives, rationale, and specific outcomes of your proposed research. Depending on the specific solicitation, this requirement may be explicit or implicit, but either way, the care with which you address these factors will determine whether or not you persuade reviewers to recommend funding for your proposal. While the definition of these terms may differ somewhat by disciplinary domain, or by funding agency, it is helpful in research grant writing to define these terms in ways that best reflect what might be considered the generic narrative structure of most research proposals. Some funding agencies are very prescriptive in defining a narrative structure, such as the U.S. Department of Education, whereas other agencies, such as the National Science Foundation, allow the author greater flexibility in choosing a narrative structure.

   Of course, when a specific agency or solicitation prescribes a required format for a research narrative, then that format must be followed exactly as the sponsor presents it. ***However, in cases where the agency or the solicitation leaves the research narrative structure open or even undefined, then it is helpful to have in mind your own conceptual framework for best presenting your ideas to program officers and reviewers***. Moreover, it is common in the case of unsolicited or investigator-initiated proposals for only a very general narrative framework to be defined by the agency, or by program officers. Finally, the five generic elements of a competitive proposal discussed herein are scalable, from large center proposals to small research grants and to white papers and concept papers that may initiate an invitation to submit an unsolicited proposal.

   Regardless of where any particular agency or solicitation falls on this spectrum, ***the generic underpinnings of a successful research grant include a sequence of five key persuasive elements: the research vision, goals, objectives, rationale, and specific outcomes.***   Depending on the solicitation, these elements may or may not appear in the order described here , but they typically provide the critical mass of the persuasive argument in successful proposals. They also provide clarity through a logically tiered framework that allows reviewers to differentiate your research at multiple levels of specificity and detail, from the macrovision to microperformance details.

   Unless defined otherwise in the solicitation, these ***terms may be self-defined for the purposes of a specific grant,*** since your goal is to define them in ways that assist the reviewers to more clearly and convincingly understand the value of the proposed research in a logical, stepwise fashion. This understanding should include an overarching vision illuminated by increasingly detailed or finely grained narrative text that validates in detail your capacity to achieve the research vision. Of course, the goal here, as in all strategies to write a more competitive and hence fundable grant, is to make the research narrative more clear, accessible, and memorable to reviewers ***in a positive way***. Unfortunately, as experienced reviewers will tell you, there are also many

ways to make your proposal ***memorable to reviewers in a negative way*** (for example, by not following directions, or by preparing a vague or poorly organized proposal).

These five elements provide a series of sequential waypoints or critical touchstones that, in the aggregate, validate the merit of your research, much like the original touchstone was used as an assaying tool in ancient Greece to determine precious metals and compare unknown samples to those of known purity. Addressing these five key elements in your project description will enable reviewers to "assay" the value of your proposed research compared to that of your competitors. In essence, they form the critical building blocks of a compelling research narrative by ***giving reviewers the structure, order, detail, scale, and perspective needed to easily judge the value of your research***.

In all cases, come to your own working definition of these terms in a way that clearly will help the reviewers understand your research. Think of these terms as ***differentiating tools*** bringing clarity to your research narrative. Don't worry so much about how others define these terms, but instead adopt and adapt them to suit your own purposes. We address below some possible ways to think about these terms with the overall intent of using the key distinctions they provide to improve the quality and hence competitiveness of your project description.

A vision statement typically provides the global, unifying, thematic overview of the research to be accomplished over the proposed funding period and its significance and value-added benefits to the funding agency mission, or to the research field itself. For example, the vision statement might address some ***significant transformation that will occur over the grant period at a particular scale most relevant to your research focus***. This might range from large-scale transformations made possible by center-level research funding, or a transformation on a small scale related to a very narrowly focused research question. Regardless, being able to describe your research in an integrative way ***within the defined research boundaries*** described in the specific agency solicitation is an important first step in the sequence of steps you must take to construct a clear and compelling project narrative.

A research vision will typically be better understood by ***defining one or more research goals to be achieved over the term of the award***. The research goals are more specific than the research vision and serve as the major organizing framework for achieving that vision. Goals are defined both in terms of representing one or more research milestones or major accomplishments and in demonstrating how the goals intersect over the performance period. For example, a research center proposal will present an overarching research vision to be achieved by specific research goals that, when integrated over the performance period of the grant, allow research synergy to be achieved in some way. Institutional transformation proposals, e.g., NSF ADVANCE, IGERT, CREST, among others, all define a vision and then list programmatic goals that, when achieved, make the vision possible. Smaller grants may have only one or two goals. It is also important, given the emphasis on performance metrics and evaluation at federal agencies, that you define your goals in ways that render them easily evaluated, both by reviewers and, on larger proposals, by a sponsor's annual

performance review. Don't confuse goals with nebulous wishes. Goals need sufficient clarity and specificity to permit reviewers to evaluate them for their potential impact on the agency's mission, or for advancing the research field in some way, or for accomplishing the broader goals and objectives defined specific to the solicitation.

Once the research goals have been defined, clearly state the **key research objectives**. Unfortunately, the definition of goals versus objectives can cause organizational confusion in the writing of a project narrative, most often when these terms are used interchangeably. This discussion of the distinction between goals and objectives can sometimes turn into the equivalent of the arguments posed by medieval theologians asking how many angels can dance on the head of a pin. It is always best not to go down these rabbit holes and simply self-define the terms consistently and in ways that best suit your narrative needs. For research grant writing, if the terms are not defined in the solicitation, the key is to produce a clear, compelling, and easily understood project narrative for reviewers. In this instance, **defining goals** as the overarching, longer-term outcomes, milestones, or accomplishments of the research, and **defining research objectives** as the critical operational subsets **used to achieve each goal** works well as an organizational framework for the narrative and allows the reviewers to quickly grasp the significance of the research at various scales. For example, research objectives in aggregate define a key research goal; research goals in aggregate define a research vision. The intent here is to provide reviewers clarity. **The foundation of clarity is defining an organizational framework for the research narrative that allows distinctions to be easily made and in a logical sequence.** The increasingly finely-grained sequence of vision, goals, and research objectives offers one such narrative pattern that can be used to make a proposal more easily **accessible and memorable to reviewers**.

Moreover, reviewers must **understand the rationale motivating your research**, for example, why your research idea is a good one; why your research is important and significant, why your research approach will be productive; why your research expertise makes you uniquely qualified to advance the proposed research; why your institutional research infrastructure (equipment, instrumentation, support, resources) will enable your research; and why your research plan is appropriate, effective, and efficient.

Finally, while your research goals address overarching milestones, accomplishments, or outcomes, reviewers will also appreciate a more finely-grained understanding of the **specific outcomes** of your research in a way that encourages them to clearly understand the value of funding your research. In this regard, it is important to define specific research outcomes in a way that invites a rigorous evaluation of your research performance over the term of the grant or for annual performance reviews on larger grants. Given the emphasis on research metrics at federal agencies, defining and integrating key performance metrics into the research could positively influence your proposal's competitiveness. In some cases, particularly at the research center level or for institutional and educational transformation grants, among others, an external evaluator may be required. So it is important that the narrative discussion of specific outcomes be made clear to reviewers.

The foregoing steps are not meant to be cast in stone, but to offer a starting point for a framework for organizing the research narrative that will enhance your chances of success.

Don't Build Your Proposal Out of Spare Parts

Learning how to develop and write successful proposals begins with gaining an understanding of some of the key generic strategies that enhance the competitiveness of proposals regardless of discipline or agency. These core generic strategies form the necessary foundation for presenting your research idea most effectively to program officers and review panelists. The counterpart to understanding successful strategies amounts to understanding unsuccessful "strategies," or unsuccessful practices that diminish the competitiveness of your proposal by obscuring your research idea in a patchwork research narrative .

In fact, a list of common mistakes, or common misconceptions, made in the development and writing of proposals can be of enormous value to new and junior faculty beginning a research career, as well as to more experienced investigators seeking to continuously improve the success rate of their proposals in a difficult funding climate. This critical information often comes from a senior faculty mentor with a history of successful funding, or it can come from research development and grant writing professionals who have benefitted from working with highly successful researchers on successful proposals of all sizes, especially center-level proposals in which many component parts comprise the center narrative.

The most successful faculty researchers tend to be those whose success in funding begins with smaller grants of a few PIs and grows over time to research centers or other large grants. These researchers can develop a capacity to frame the development and writing of the proposal by thinking strategically about every part of the proposal narrative, from the overarching vision statement to the smallest details that illuminate the research team's capacity to perform.

New and junior faculty can learn from successful researchers that successful proposals represent new and exciting ideas originating from the PI and the PI's research team, or, as NSF and NIH might characterize the research, it must be "***transformative***" research. ***This requires that the research narrative be as close to perfect as possible***—perfect in its vision, perfect in the operational details that advance the vision, perfect in its synthesis and integration of all component parts with the overall goals and objectives, and perfect in every section and subsection required to respond fully to the solicitation.

Therefore, it is important not to be tempted to use spare parts from older proposals (successful or unsuccessful), or information archived in database files, or narrative text created as so-called boilerplate by known or unknown authors. While writing a successful proposal narrative that advances new ideas in a compelling way is hard work, it cannot be made easier by the use of off-the-shelf text or boilerplate text written by others. On the contrary, ***it can be significantly harmed by that practice.***

In specific terms, ***the use of boilerplate imposes a distorting structure on the proposal narrative*** that should evolve logically, consistently, proportionally, and integratively from a core research idea. This consistency should apply to the ideas

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advanced by the principal author as well as the language patterns and structure used by the author to describe those ideas. Unfortunately, no antirejection drugs exist to ameliorate the harm done by attempting to transplant boilerplate text into a proposal in hopes of making it more successful. In the successfully crafted proposal narrative, ideas and language interweave to create a coherent and seamless synthesis. Boilerplate or recycled text will destroy the needed symmetry at all scales.

What else is not a successful proposal? Edited collections of many short articles, or sections written by an army of authors, some known and, in the case of boilerplate, some unknown, lacking a coordinated evolution of the research ideas, will not meet with success. Unfortunately, however, once a proposal narrative has been built in a way that reveals gaps between sections, parts, or topics, renovating that inchoate narrative will require significant time and energy. If a researcher also introduces boilerplate into the proposal narrative, either verbatim or modified, she will push the narrative structure further in the direction of a crazy quilt of ideas rather than a seamless integration of text and ideas.   In many ways, the use of boilerplate text is akin to distributing a few counterfeit bills among the legal currency you use for cash purchases. At its worst, boilerplate text may come near to flirting with unintentional plagiarism, depending on the source of the text, and it is certainly not something federal research agencies would expect in a proposal that presents itself as a persuasive argument for the significance and merit of the proposed new research.

Having understood the disadvantages of boilerplate text, it's worth taking a moment to ensure that we all understand what this term means. Most successful PI's don't use this term (or the text itself), but inexperienced and eager researchers may use it. While various professions may use the term to refer to various types of text, *in most cases it refers to inferior, off-the-shelf writing, often of unknown and dubious origin, that operates as a static, plug-in set of phrases, sentences, paragraphs, or conceptual outlines. By definition, boilerplate fails to change or to reflect the evolving set of ideas associated with the successful proposal.*

Boilerplate is frozen in time, whereas the successful research proposal originates with a good idea that evolves during the development and writing of the proposal narrative to make an original and compelling case for funding. Moreover, *even the most excellent writing has a very short shelf life*, perhaps a matter of months. In fact, most often by the startup period of a grant, perhaps six to twelve months after the submission of the proposal, the successful narrative is typically dated and showing signs of age. If you are maturing research and educational ideas, then the ideas you have six months from now should be more robust and better explicated than the ones you have now. *Do not encumber your good ideas with spare parts developed by someone else with absolutely no knowledge of why your ideas are significant and how best to configure those ideas within an integrated proposal narrative.*

When the term "boilerplate" in used by those who develop and write proposals-- typically within private sector consulting firms (engineering, architectural, scientific, etc.)-- then it typically refers to a description of past performances on similar projects in a capabilities section of the proposal. This recycled language is used to bolster the case

that a contract awarded to the applicant would once again result in successful deliverables of one kind or another. However, when the term begins to migrate from contract work into proposals describing exploratory and transformational research to federal agencies, *it has crossed the boundary from an appropriate to an inappropriate use of the term*.

While faculty should avoid boilerplate, they can become knowledgeable about successful models for some of the common sections required in a proposal, particularly in larger proposals, such as those related to institutional infrastructures, access to equipment, instrumentation and facilities, plans for undergraduate research or post-doc mentoring, management plans, diversity plans, data management plans, and the like. Descriptions of these resources may be adapted judiciously to inform possible topic points but not as transplanted text that disturbs the context of the proposal narrative. Moreover, research development professionals can make this information much more robust by working with successful PIs during the start-up period of grants where the concepts defined in the proposal may be significantly modified to work more effectively in actual operation. This represents one place where the use of boilerplate, for example related to NSF's "broader impacts" requirement, can do a real disservice to the PI. Boilerplate is like the minispare tires that come with new cars: it is not intended for use on your extended research journey.

Bottom line: if you are proposing new research ideas, express the significance of those new ideas, and all topic components of them, in newly-crafted writing for every word of the proposal narrative. Success in proposal writing will not be achieved using after-market parts. *Successful proposals are not renovations of the past but a creation for the future and the compelling arguments you make for the place and significance of your research ideas in that future*.

Research Affinity Groups

Given the increase in federal agency funding for projects of all sizes that are multidisciplinary, interdisciplinary, or, to use NSF's term, transdisciplinary in nature, new faculty need to explore the development of institutional affinity groups, collaborations, and partnerships across university colleges, departments, and disciplines, as well as consider potential multi-institutional initiatives at the regional or national level. Often the start of this process may begin with exploratory meetings to identify, define, and characterize the potential scope, vision, uniqueness, possible team configurations, and funding potential from federal agencies that matches the research interests of a faculty affinity group, or possible subgroups.

Research affinity groups often function as a precursor to research partnerships and collaborations. Research partnerships and collaborations often have their origins in the pursuit of a specific open solicitation or anticipated solicitation on an annual grant cycle. By contrast, research affinity groups tend towards a more open-ended timeline that permits them to consider an array of possible funding opportunities across several agencies under an overarching research theme such as sustainability or health disparities.

This process of developing and configuring exploratory affinity groups can often challenge new and more junior faculty, nor does it always appear easy or obvious to more senior faculty. Often the research opportunities driving the need for affinity groups have very broad, overarching themes, such as sustainability, health disparities, climate, water, and energy, among many others. NSF often emerges as a major funder in many of these overarching research areas, e.g., through cross-cutting programs, but these global research themes can also receive significant funding from many of the federal mission agencies as well, and sometimes in partnership with each other.

The NSF program Research Coordination Networks, for example, offers funding not to conduct research but to advance a field or create new directions in research or education by developing a network of researchers. It supports groups of investigators (aka, affinity groups, partnerships, or collaborations) to communicate and coordinate their research, training, and educational activities across disciplinary, organizational, geographic, societal, and international boundaries. This interesting program promises over time to fund various model configurations of research partnerships and networks across disciplinary and institutional domains. These funded models will prove adaptable and adoptable as generic examples for faculty affinity groups of all sorts.

Given these emerging developments, the need to establish research affinity groups is not new but increasingly common as federal research agencies address the so-called grand research challenges of all sorts, e.g., the **14 grand challenges** of the 21st Century presented by the National Academies. While the processes and protocols for forming research affinity groups may already be fairly common across many disciplines, the disciplinary boundaries are being dramatically expanded by federal agency funding that recognizes the importance of such affinity groups to solving complex scientific

challenges, particularly those with societal dimensions. An affinity group can be started and led by an experienced principal investigator working with a few colleagues and a shared vision, or, increasingly, ***it can be initiated by a group of new and more junior faculty who find intense intellectual excitement in transdisciplinary research***. Regardless how it begins, the group then evolves as an affinity group, with a better defined research vision and more fully developed goals, objectives, and operational details to achieve the vision than would have been possible had they worked in disciplinary isolation.

The core of the research vision will be grounded in disciplines well supported at specific agencies of interest, often engineering and the sciences. But the affinity group for such overarching research themes as those listed above must also include disciplines that complement the core research in such areas as education, societal benefits and impacts, public policy, and economics. In addition, researchers from the social and behavioral sciences or humanities would give significant value-added benefits to the core research by articulating its uses and benefits in terms of societal impacts. In many cases, the absence of these complementary disciplines will disqualify the proposal for funding. For example, NSF made this clear in the *Water Sustainability and Climate* solicitation, stating: "Successful proposals are expected to study water systems in their entirety and to ***enable a new interdisciplinary paradigm*** in water research. ***Proposals that do not broadly integrate across the biological sciences, geosciences, engineering, and social sciences may be returned without review***."

As a result of this dramatic increase in the number of research funding opportunities appearing under the umbrella of overarching research themes or grand challenges, new and more junior faculty not only have to master the craft of writing successful research proposals but also develop the leadership skills to form, develop, and move forward a research affinity group in a way that enhances the opportunities for funding success of all the members. Over the past two decades, this skill set has most often resided with senior faculty who successfully competed for research centers funded by NSF (see **Profiles in Team Science**), NIH, DoD, DHS, and NASA, among other agencies. However, many new and junior faculty may have no connection with senior faculty who successfully secured major center or center-level funding in research areas that required a transdisciplinary partnership approach.

On many campuses, the experience and expertise in the processes and protocols of establishing successful research affinity groups may also reside in research development and grant writing offices, typically at the university or college level, with a track record of assisting faculty on specific projects requiring the formation of research partnerships and collaborations. Regardless where that expertise resides, it is important that new and junior faculty benefit from it, either by linking successfully to senior faculty as mentors, or by seeking support of research office professionals experienced at working with faculty on developing affinity groups and the proposals resulting from such groups.

With this in mind, the first objective of a research affinity group is to define an overarching research vision or goal, e.g., sustainability of regional coastal ecosystems, that maps inclusively to group members and concurrently maps to one or more federal

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agency research funding areas, or agency mission areas. Depending on group dynamics and leadership, participation in exploratory meetings of potential research affinity groups requires at least a moderate tolerance of chaos, disorder, false starts, and confusion, preferably made more tolerable by an experience-based faith that good ideas can come out of what initially appears to be disorder. These early meetings are no place for biblical literalists or constitutional strict constructionists, or those with a preset idea about how an exploratory meeting should progress.

One caveat in this regard is to be both cautious and suspicious of those who offer what might be called "pedagogies of partnerships" or "canned protocols" for developing research partnerships often disconnected from the research culture as well as disconnected experientially from the hard work of having actually developed a successful research partnership in the past. ***When it comes to developing research affinity groups or partnerships, keep in mind the old adage that "experience is the best teacher***." For new faculty, it may be helpful to find an experienced faculty mentor whose past funding success makes her an excellent guide into what may seem like a daunting task at first—forming a successful affinity group or partnership.

Senior faculty or research development offices can assist in this process in several ways. Perhaps most importantly, they can bring an institutional memory to the meeting of models, processes, and protocols that work and those that may not. This helps to ensure that the research affinity group does not reinvent the wheel, or, worse, reinvent the flat tire, as one NSF program officer observed. It is not uncommon for the initial meeting of an exploratory research affinity group to be an all-day affair, or even a weekend retreat. During this meeting, many opportunities will arise to offer observations that subtly redirect some of the more exuberant ideas disconnected from an agency mission or programmatic area of support. While the meeting will likely be called to develop a common research vision or goal as its overarching purpose, it still must be guided by information about possible funding scenarios that can breathe life into the group if it is to sustain itself over the long term.

One way to do this is by a ***judicious reverse engineering of potential funding opportunities***. This would not be expressed in the openly self-serving fashion of Willie Sutton who, when asked why he robbed banks, replied "because that is where the money is." But there is, nonetheless, a bargain to be made that balances the research interests of the group members with the availability of funding. Including someone informed about funding opportunities across some of the key research agencies, particularly NSF, can help this process immensely. Such a group member can ensure that ideas and action plans for implementing them are informed in a general way by funding prospects, particularly the prospects for these overarching research themes with opportunities across agencies. Unfortunately, the "***Field of Dreams***" analogy does not work for the development of research affinity groups—***if you build it they (funders) may not come***, especially if the group vision is established and framed in a way that does not resonate with one or more of a funding agency's mission or research priorities.

Newly forming research affinity groups also need to hear ***advice about what is and what is not a competitive proposal***. Participants must be reminded that research

agencies do not fund ideas, no matter how good, that do not align with the mission objectives of the agency. Some members of a newly formed research affinity group may be overly ambitious, or inexperienced in grant writing to the point that they confuse a research grant to NSF or another federal agency with applying for a MacArthur Foundation Fellowship, or so called "genius grant." Excitement and exuberance must be tempered by a realistic assessment of a group's capacities and the corresponding opportunities for funding. There are benefits to research affinity groups that sustain themselves on ideas alone, without external funding, but in most cases, various academic demands, particularly promotion and tenure for new faculty, will force a more realistic and grounded expectation of anticipated outcomes, i.e., funding. As Samuel Johnson observed, "nothing so focuses the mind as the prospect of being hung."

Support for research affinity groups can be significantly enhanced by offering the appropriate information at the appropriate time with regard to **contextualizing the group's research ideas** to the mission, culture, and strategic plans of federal funding agencies, or programmatic areas within agencies. Some members of newly formed research affinity groups may not have more than a very cursory, at best, understanding of the research priorities of various federal agencies, and it is not uncommon that opinions of what will and will not fit the research mission are not grounded on any understanding of the mission and culture of the agency, or appreciation for what has been funded by the agency, or, more importantly, what characterizes successful principal investigators at the agency.

In some cases, research affinity groups may have ambitious expectations that the group will compete successfully for major awards or funding at the center level. Here, it is helpful to **discuss a range of potential funding configurations**. For example, in most cases, research center awards and other large grants go to a research team with a configuration of funded grants approximating a de facto center. It is helpful to disaggregate the constituent components of a center grant into discrete grants that the research affinity group may consider pursuing to build a track record of success before setting its sights on a major research award. These discrete grants may be developed by disciplinary subgroups within the affinity group, while remaining in harmony with the overall vision of the group. Faculty often overlook the option of configuring a research center as a collection of smaller grants funded in a piecewise fashion.

Moreover, these groups can often benefit from **experience-based observations** on the various processes, protocols, and sustaining practices related to communications, group dynamics, decision making, and leadership needed to advance an affinity group to successful competition for funding. It might be well to observe a caveat in directing the group's dynamics: exercise caution in recommending the use of "group process techniques" that many group members might find personally intrusive, **or worse, a waste of time**. Rather than focusing on topical pedagogies of group dynamics outside the scope and charge of a research affinity group, consider **focusing the group's attention on the research**. Success in funding a research team comes from the hard work of developing good ideas and crafting them into a compelling and competitive proposal.

Finally, in this process of supporting research affinity groups, a senor faculty mentor or an experienced research development professional can act as a referee or umpire at research affinity group development meetings. The referee need not pass judgment on the ideas but rather can offer advice ***when asked*** about whether development plans seem to be aligned with a potentially competitive idea based on a multitude of factors that come from repeated engagement and experience in research team development .

The Challenge of Integrating Multiple Authors

Larger proposals that include multiple research partners pose a particular challenge to the coherence of a project narrative. Individual team members typically contribute individual narrative statements featuring their prior and future research *but with little or no recognition of how that research will integrate with other team members' contributions to the proposed project.* These "stand-alone" statements fail to describe how each research strand complements every other strand, adding up to an integrated set of contributions to the project's vision, goals, and objectives. These individual narrative contributions often do not address the overarching questions that motivate the research, nor do they describe each of the multiple research strands in a context that clearly demonstrates their relationship to the motivating questions or hypotheses.

Too often, these typically one- to four-page *descriptive only* contributions to a proposal narrative resemble a series of isolated numbers comprising the combination to a safe, but lacking the sequence required to open it. In the case of a project narrative, the combination needed for funding must be a *logically ordered sequence* of questions, or hypotheses, or perhaps statements of need, depending on the agency and type of research, that explain the novel and significant features of the research activities described in the narrative.

Descriptions of research activities or capacities improperly sequenced and explained within the overarching context of a research vision, goals, and objectives *turn the narrative into something of a mystery for readers and reviewers.* You don't want reviewers asking themselves and other review panel members after reading the research narrative "*why are all of these descriptions about various research capacities important and what exactly does this research team intend to do*?" However, this will be the result if the research narrative evolves, to use the current vernacular, as a collection of "*stove-piped" or "siloed" contributions by multiple authors.*

For example, a proposal addressing an issue related to sustainability may be comprised of research team members from geosciences; physical, biological, and agricultural sciences; engineering; computational sciences; and the social and behavioral sciences. Perhaps the research focus is on the sustainability of a coastal ecosystem impacted by climate change. In this case, it is easy to envision multiple research contributions by those with research expertise in climate, water, modeling, sensors, coastal biology, social and economic impacts of sustainability on affected stakeholders, and research expertise on one or more species in the coastal estuaries that serve as indicators of ecosystem health. Moreover, it is easy to see how researchers in one of the foregoing research areas important to the sustainability of coastal ecosystems may be tempted to write their narrative contributions as "*siloed text.*"

This will most likely occur when the vision is still evolving as the research contributors draft their narrative contributions, or when the overarching questions motivating the research have yet to be fully defined, or are in the process of being re-

defined. ***The vagueness or incompleteness of the research vision can increase the likelihood that a first full draft of the proposal will read as a series of siloed statements unintegrated with one another***.

Moreover, it is often the case that the ***research team members attempt to do too many important tasks simultaneously but in isolation from each other.*** In these cases, finding time to draft text is often difficult enough let alone adding the requirement of reading and considering others' contributions. This difficulty can be compounded by electronic communications among team members that fluctuate between periods of silence and cascades of electronic messages, often including drafts of graphics, figures, and multiple track-edited versions of an evolving project description that can quickly become a blizzard, or rainbow, of track edit colors.

These issues all cry out for an orderly resolution grounded on a well-crafted proposal development schedule. This planning tool will help meld the vision and goals of the project and communicate them continuously via a defined production timeline to all of the contributing authors. This will better ensure that the text evolves in a way that not only describes the importance of each research-specific strand or research contribution but also describes how it interrelates with every other research strand included in the project description. It is not an easy task, but this integration holds the key to success. The team is well advised to find someone among its own members or from a campus research office who can ***assist the PI in bringing informed coordination to the proposal development process.***

Another pitfall of a multiply authored research narrative or project description lies in writing these ***statements as if the authors were contributing to an edited collection or a journal issue rather than to the single, integrated statement*** identified as the research vision. This occurs most often on multi or transdisciplinary proposals that evolve ad hoc rather than from a well-planned proposal production schedule, or when the decision to submit these complex proposals occurs only a month or several weeks before the due date. In this last case, the proposal schedule can lead to a "fire drill" in which potential new research partners are added concurrently with the writing of the first drafts of the research narrative.

These situations can produce several drafts of the project description at a rapid rate as multiple contributions are added to the narrative. The complete draft of the project description may give the illusion of completeness***, but on closer examination it may lack an overarching organizing theme or research vision that synthesizes the component contributions resulting in a coherent and logically sequenced whole***. Correcting this document after it has evolved can be difficult; unfortunately, such a draft is likely to amount to ***nothing more than a siloed collection of research descriptions*** loosely associated and lacking a narrative thread that can persuade reviewers of its coherence. Once a complete narrative structure has emerged, contributors resist making major renovations to it. However, if the collaborators understand that the first full draft of a research project narrative is best viewed as a preliminary set of loosely associated descriptions, then the principal investigator can call for major revisions designed to produce a more integrated statement.

Indicators of a failed, or a weak narrative may reveal themselves sufficiently before the due date to allow the time and effort required to transform a weak narrative into a competitive narrative. Perhaps the best indicator of a weak complete first draft of the research project description begins with a nagging sense of unease after reading it. It doesn't seem to convey a clear sense of what specifically is being proposed, what questions are being asked, or hypotheses posed, nor does it explain why the research is unique, innovative, or advances the field in some way. It may also fail to convey a sense of how the multiple research descriptions meld to an integrated whole. Another indicator of a failed or weak narrative is a difficulty in clearly explaining the significance of the project and its outcomes after closely reading the 15 or 20 pages describing it.

It is a mistake to assume that your sense of uncertainty and vagueness following the reading of the proposal indicates a lack of technical expertise to critique the narrative, i.e., that the fault lies with the reader and not the writer. Two good reasons to dismiss that thought implicate both you and the proposal author(s): (1) federal research agencies, particularly the major ones that most often comprise the overall research portfolios of universities, advise writing the research narrative for the intelligent reader, not the expert reader. NSF, for example, advises writing to the reader of *Scientific American*, or the scientifically literate reader. (2) Moreover, research agencies that fund large, often transdisciplinary proposals, will have blended review panels comprised of members from various disciplinary backgrounds, including the social and behavioral sciences and, in some cases, the humanities. Research collaborators must describe their research in a way that convinces the entire review panel, not just those from specific disciplinary domains, to recommend the project for funding.   So if you are asked to critique a proposal, ***do not hesitate to note when you do not understand clearly what is being proposed***, or when the project's goals and objectives appear ambiguous. Recall Professor Albert Einstein's observation that put a heavy burden on scientific authors: "*If you can't explain it simply, you don't understand it well enough. Most of the fundamental ideas of science are essentially simple, and may, as a rule, be expressed in a language comprehensible to everyone*." The bottom line: ***When proposals lack clarity, the fault lies with the author and not a review panel***. In practice, it is better to be presented with a challenging critique and penetrating questions in response to a draft project description than to hear those challenging critiques and penetrating questions from a review panel and program officer. In this case, your ***second chance is likely to occur one year in the future when a resubmittal is possible.***

Of course the best solution to the above issues is to formulate a plan for the proposal's production that anticipates such core issues as partnership configurations, vision, and goals in a logical sequence that allows time for a draft narrative of the project description to evolve continuously. A poorly planned proposal has little likelihood of success. Walt Kelly's Pogo once famously observed, "We have met the enemy and he is us!" That observation perfectly fits a ***poorly planned and poorly coordinated*** proposal development effort. But preparation and continuous coordination and communications can save you from becoming your proposal's enemy by avoiding the issues discussed above. A well-planned and well-coordinated proposal

development effort cannot turn ideas of modest importance into ideas of compelling significance, but it can give your ideas a chance to be realized. A well-crafted proposal will anticipate continuous revision to ensure that the project as a whole includes and exceeds the sum of its individual contributors.

Graphics as a Narrative Integrator

Just as the [Feynman diagrams](#) brought clarity to understanding the interactions of subatomic particles, on a less grand scale, diagrams, graphics, figures, tables, pictorial representations, and other visuals play a key, albeit too often overlooked, role as an integrator of the research narrative. This holds true particularly in the case of complex project descriptions whose narratives describe interaction among multiple research strands. Good writing forms the underpinning of any successful proposal, which explains why grant writing workshops, faculty grant mentors, and proposal development professionals all emphasize the importance of writing well.

The same advice is not always given, unfortunately, for the use of visuals as a complement to and integrator of the narrative text. The graphical representation of a research vision, or diagrams that show how the component goals and objectives of a large research project relate and interact together to form a coherent, synergized whole, can make the ***proposal narrative less challenging both to write and to read***. In fact, graphical representations of the main ideas of a proposal discussed and developed concurrently with the drafting of narrative text, can help the members of the research team write their contributions to the overall narrative with more clarity and focus than might otherwise be possible. The end goal, of course, is to achieve a project description that integrates narrative graphics and narrative text so closely as to make both easily accessible to review panels and program officers, especially in those cases where complex interactions among various research strands must be accessible and memorable. ***Good ideas deserve and benefit enormously from the illuminating interplay between well-crafted narrative text and accompanying graphics.***

Graphics can play a critical role in proposals of any size, but become increasingly important in large research proposals describing how the integration of multiple research themes achieves a synergy impossible without the value-added benefits that occur at the intersections and interfaces among research subtopics. The melding of graphical skills and writing skills can energize a research narrative. Moreover, the graphics provide a visual reference point for reviewers as they read the typically 15 to 40 pages of text required by the specific solicitation. Graphics can quickly illuminate the key points of intersection among the research topic descriptions and clarify the interrelatedness of topics in ways that can be quickly understood. Even in well-written proposals, it can be a challenge for readers and reviewers to **capture and hold** an understanding of 3, 4, or even 5 research strands that will be integrated into a coherent research vision.

Narrative text is linear. It is grounded on a logical sequence of explanations made coherent and persuasive by the author's writing skills. Graphics, however, function as a "***visual language***" able to capture complex relationships in a simple and unifying way; hence the importance of the Feynman diagrams to physics for nearly 65 years, or, more recently, the use of computer-generated visualizations as a way of understanding huge

datasets, ranging from the atmospheric sciences to petroleum engineering, among myriad other examples. With this in mind, high-quality graphics can make a significant contribution to the overall success of a proposal by offering a robust counterpart to the narrative text that serves to communicate the core research idea to reviewers and program officers in an alternative and memorable form.

It is particularly important when working on large proposals to identify early any graphics expertise that may reside within the research team, or any research office that may help with the proposal.   Do not wait until a full draft of the proposal narrative starts to cry out for graphical support. Graphics, like the narrative text, need to be developed in tandem with the evolution of the vision, goals, and objectives of the research plan, and the text and graphics need to be logically intertwined to gain the potential synergy inherent within them. Moreover, just as you wouldn't write a proposal using spare parts from other proposals, don't borrow graphics from other proposals, or, worse yet, look around in a clip-art library for your visual materials.

Always keep in mind that graphics should deepen the understanding of the research ideas being proposed in the narrative text and illuminate the interrelatedness among them in a simple and clear way. Graphics should function as a proposal integrator. Given the significant benefits of well-planned and well-crafted graphics to the success of the proposal, it is important that members of the research team give the integration of graphical information into the narrative text the consideration it is due as a potentially valuable contribution to a proposal's success.

Writing Unsolicited Proposals & White Papers

Unsolicited proposals are often a significant source of funding for many academic researchers, but new researchers may not even be aware that they can submit them. Most researchers are aware that funding agencies regularly issue solicitations for proposals, many recurring annually for many years. Because these announced solicitations tend to be highly visible, e.g., they are posted on **Grants.gov**, announced on agency websites, distributed through agency email and RSS alerts, and distributed by many university research offices, researchers who are new to the grants process may think that the only way to compete for funding is to respond to these published solicitations. However, for many funding agencies, responding to solicitations is not the only (and often not the best) way to win grant funding. Many agencies, including NSF, NIH, DoD, DOE, DoED and DARPA, fund research through "unsolicited" or "investigator-initiated" proposals.

While not all agencies accept unsolicited proposals, many do, and those that do have a variety of mechanisms for providing guidance to researchers on the types of unsolicited proposal they want to see. Moreover, as in the case of solicited proposals, agencies will have specific guidelines describing the goals, objectives, review criteria, and research or mission outcomes that will be used to evaluate unsolicited proposals. Depending on funding agency and program areas within a specific agency, the unsolicited proposal process may involve several steps that act as preliminary filters to an invitation to submit an unsolicited proposal. In most instances, regardless of agency, talking to a program officer about your interest in submitting an unsolicited proposal is very helpful. This is especially important at the federal mission agencies where developing a research relationship with the program officer will be an important factor in your long-term funding success.   Preliminary discussions with a program officer will help ensure that your research objectives fit the agency mission priorities. Moreover, after discussions with a program officer, you may discover preliminary gates to be navigated prior to submitting a full unsolicited proposal to the agency.

One of the more common preliminary gates to submitting an unsolicited proposal is the preparation of a brief, ***perhaps three to five-page white paper*** that demonstrates the significance of your research to advancing the agency research mission objectives in specific areas defined in the agency guidelines for unsolicited proposals, or often defined in Broad Agency Announcements that are open for a year or more. The fact that many BAAs that include instructions for unsolicited proposal are open for such long periods of time, up to several years in some cases, offers another important opportunity to develop a relationship with the appropriate program officers. These open BAAs may be modified during the open period in ways that change the research priorities listed in the BAA when it was first published, or add new research priorities that better fit an evolving agency mission. Program officers offer the best sources of information about

how these changes to a BAA affect the focus of what the agency wants to fund through the unsolicited proposals process.

The purpose of the white paper, according to DoD, is to preclude unwarranted effort on the part of an applicant whose proposed work is not of interest to the agency. Based on assessment of the whitepapers, feedback will be provided to the proposers to encourage or discourage them to submit a full proposal. White papers should present the effort in sufficient detail to allow evaluation of the concept's technical merit and its potential contributions of the effort to the agency-specific mission.

Mission agencies may ask occasionally for the submission of a quad chart as part of the unsolicited proposal process. This is a very abbreviated process wherein a one-page document divided into quadrants serves as a template for responding to four key questions related to your research and its relevance to the agency mission.

This abbreviated application process comprised of discrete and briefer preliminary review gates (quad chart/white paper) limits your initial commitment of time and effort. *However, your success depends on your capacity to distill your research vision, goals, and objectives into a very succinct and clearly written response that allows agency program officers to quickly grasp the significance of your research and how it advances the research mission of the agency*. **A white paper must quickly connect the significance of your research and the research mission of the agency.**

Here, too, the more knowledgeable you are about a funding agency's research mission, strategic plans, research culture, investment priorities, and the rationale behind them, the better able you will be to develop highly competitive responses in the form of quad charts, white papers, preliminary proposals, preapplications, and full proposals as required by the agency-specific process.

The brevity required by the white paper format demands clarity and precision, together with an easily understood and compelling statement of significance. Crafting a white paper of five double-spaced pages, for example, requires a laser-like focus and distillation of your research idea into its core essentials, **followed by a convincing mapping of that research core to the agency's research mission and program-specific priorities**.

Once you identify federal agencies that fund research in areas of interest to you, it is appropriate to explore the process of submitting unsolicited proposals. The agency website is the starting point for this process. The generic strategies of writing competitive white papers (or abstracts) and proposals will be similar across most agencies and disciplines; however, each agency will have specific guidelines for submitting unsolicited proposals with which you must become familiar in detail. Become as knowledgeable as possible about the agency-specific guidelines for unsolicited proposals and the research areas for which they are appropriate before contacting a program officer to gain a deeper and more nuanced understanding of the process for submitting an unsolicited proposal to a specific agency.

Some agencies, such as the Department of Energy, have standardized the process for submitting unsolicited proposals across the entire agency as outlined in the DOE

Guide For The Submission Of Unsolicited Proposals. DOE funds research across a very broad spectrum of academic disciplines and a review of the unsolicited proposal guide will give you not only an insight into what is required at DOE but a good understanding of the unsolicited proposal process itself at all mission agencies. The National Science Foundation and the National Institutes of Health, two major funders of basic research awarded to universities, make, respectively, 50% and 80% of their awards through the unsolicited or investigator-initiated process.

The National Science Foundation addresses the unsolicited proposal process in Proposal and Award Policies and Procedures Guide. The National Institutes of Health developed Parent Announcements for use by applicants who wish to submit what were formerly termed investigator-initiated or unsolicited applications. Other agencies, for example, the defense agencies, have information on the submission of unsolicited proposals distributed by agency (Navy, Army, Air Force, DAPRA) websites and also detailed in long-range funding announcements, or BAAs.

The Department of Education's Institute of Education Sciences announces its interest in considering unsolicited applications for research, evaluation, statistics, and knowledge utilization projects that would make significant contributions to the mission of the Institute. The Department of the Interior's US Geological Survey considers unsolicited research proposals in support of any field of study that helps fulfill its mission objectives. More information can be found in their Guide for Submission of Unsolicited Proposals.

The preferred method for submitting ideas and concepts to DARPA is to respond to a Broad Agency Announcement (BAA) in lieu of submitting unsolicited proposals. Interested parties are encouraged to make preliminary contact with appropriate field personnel before preparing a detailed unsolicited proposal or submitting proprietary data. Such contact may provide insight into the general need for the type of effort contemplated. Unsolicited proposals to DARPA must adhere to the policies and procedures concerning the submission, receipt, evaluation, and acceptance or rejection of unsolicited proposals set forth in FAR 15.6.

Finally, a Google search is a good way to find information about the unsolicited proposals at federal agencies or programmatic areas within agencies of interest to you. For example, a search on "*submitting unsolicited proposals to 'AGENCY'*" will often turn up the information you are seeking.

When Your Proposal Isn't Funded: Responding to Reviews and Strategies for Resubmission

If you talk to any well-funded researcher, he'll tell you that he has a drawer full of proposals that were declined for funding. In fact, even extremely successful researchers typically have had more proposals declined than funded. As a faculty member just starting your career, you should expect to have your first several proposals declined. When a funding agency decides not to fund your proposal, there are three ways to respond:

1. Become discouraged and stop applying for funding;
2. Disregard the reviews and resubmit essentially the same proposal, hoping you'll get more intelligent reviewers next time; or
3. View it as a learning process: carefully analyze the reviewers' comments, and revise your proposal for resubmission, or, if appropriate, scrap that idea and start over with a new idea.

Successful researchers take the third approach. They expect to have to revise and resubmit proposals just as they often have to revise submitted publications. They understand that reviewers' comments are meant to provide guidance, and they study them carefully. In cases where it is clear from the reviews that their idea is not a good fit for that program or agency, they either look for a new funding source that's a better fit, or they try a different idea.

When your proposal is declined (remember, this isn't a question of "if," but a question of "when"), take a quick look at your reviews. (If you applied to a foundation or agency that doesn't supply reviews, you'll need to talk to the Program Officer, if possible, to determine what contributed to the decision.) It's very likely that at first reading you'll feel the reviews were unreasonable and that the reviewers obviously didn't understand your proposal and were probably incompetent.

Put the reviews away for a few days and then, after you've had some time to calm down, pick them up again and read them carefully. Reviews can be analyzed in several ways, which we'll discuss. (Since funders use a variety of review processes, it's likely that not all of the statements below will apply to your specific situation, so be sure you understand the review process for the particular agency and program to which you applied.)

➢ **The reviewers felt the project wasn't a good fit for the program.**
The Program Officer is usually the person who instructs reviewers regarding the priorities and scope of the specific funding program, so this issue can easily be explored by talking to the Program Officer. You can respond to this critique by either submitting your proposal to a different program that's a better fit, or by modifying your project so that it better fits the program based on the Program Officer's advice.

➢ **The reviewers felt the scope of the project was inappropriate (either too ambitious for the funding and time available, or not ambitious enough).**

Talk to colleagues in your field to assess whether the reviewers might be correct. If you still feel that your project's scope is appropriate, revise your proposal to directly address this issue. Include a detailed project timeline showing how long it will take to accomplish each task. If reviewers felt the project was too ambitious, discuss your previous experience that demonstrates that you can accomplish what you're promising in the time allotted.

➢ **The reviewers had specific technical concerns.**

This is usually the easiest issue to address. Determine whether the reviewers' concerns are valid. If they are, revise your project plan accordingly. If you don't agree that the reviewers' concerns are valid, talk to colleagues to get their assessment. If you're still confident that you are correct, revise your proposal to specifically and respectfully explain, using data if possible, why those technical concerns aren't a problem.

➢ **The reviewers felt your research wasn't exciting or significant enough.**

This is a more difficult problem to address. First, honestly assess your project. Are they correct? If so, remember that the degree of innovation and impact expected varies by agency, so a project that may not be innovative enough for NSF might be considered by the Air Force Office of Sponsored Research, if it meets one of their specific needs. (This is often the case for research that is more applied than basic.) In that case, you might want to explore revising and submitting your proposal to a different agency. If you do feel the project is significant, then you may simply need to do a better job of explaining that in your proposal. In that case, revise the text of your proposal to make a more compelling argument.

➢ **Most of the reviewers liked your proposal, but one reviewer panned it.**

This is a classic case where talking to the Program Officer can be extremely helpful. Usually the Program Officer was in the room during the review process and can give you some insight into the discussion. It's often the case with review panels that most of the reviewers are not experts in your particular subfield. If the reviewer who didn't like your proposal happened to be the reviewer who was most knowledgeable in your field, then that person's comments likely carried a lot of weight with the other reviewers, and you'll need to take those comments very seriously. However, if the one negative reviewer simply had a dyspeptic disposition or was acting on a pet peeve, and if reviewers change with each cycle, the Program Officer may encourage you to resubmit with minimal changes. If it was clear from the reviews that the sole negative reviewer was not knowledgeable in your field, or his comments seemed to come out of "left field," don't use a lot of space responding to those comments in your proposal revision unless you're reasonably confident that that particular reviewer will be on the next panel.

➢ **The reviewers didn't seem to understand your proposal and brought up concerns that weren't applicable or that were addressed in the proposal.**

In this case, it's tempting to dismiss the reviewers as incompetent. However, it's more likely that your proposal wasn't clear. Remember that reviewers aren't necessarily experts in your subfield; they may have to review a large number of proposals in a short period of time, and they may be reading your proposal at two a.m. Your project description needs to be clear, well-organized, and easy to follow. You need to make it very easy for reviewers to find the main points and to locate where you address each review criterion. Revise your proposal text and ask colleagues from outside your field to read it. If they can understand it, then it's likely that a tired reviewer reading your proposal at two a.m. will be able to understand it.

➢ **The reviewers weren't convinced that the project was likely to succeed (either because of a lack of preliminary data or because they felt the PI or team weren't sufficiently qualified).**

Reviewers want to fund projects that are likely to succeed. If your project appears to be risky, then you'll need to give the reviewers some evidence that these risks are manageable. If the reviewers identified one particular aspect of the project that they felt was too risky, you may need to generate some preliminary data to convince the reviewers that that issue is actually not risky, or you'll need to develop a plan to work around problems in that area to convince the reviewers that the project can still be successful even if that particular program component doesn't work out. If reviewers weren't convinced that you or your team had the required expertise, you might address that concern by generating preliminary data (and, ideally, publications in the topic). Another approach is to bring in a collaborator with the requisite background. If your idea is a high-risk, high-payoff idea, and you don't have the resources to generate the needed preliminary data, check to see whether there might be other programs set aside to fund such ideas (e.g., NSF's EAGER grants). In some cases, you may need to carve out a smaller project (for example, cutting back to a one-year project to allow you to develop proof-of-concept data rather than asking reviewers to risk three years of funding); or, you may need to find another funder that is more comfortable with higher-risk research (e.g., DARPA). This is another case where the Program Officer can give you invaluable advice.

➢ **The reviewers were generally complimentary, but didn't give the proposal a high enough score to be funded.**

This can be one of the most frustrating kinds of reviews – the reviewers were all generally complimentary; they might have brought up a few minor points but didn't mention any major shortcomings of the proposal, but they just didn't give the proposal high enough ratings to be funded. In fact, if it was an NSF panel, they might have recommended the proposal for funding, but didn't "highly recommend" it. In all likelihood, your project idea had merit, but it didn't excite the reviewers as much as some other proposals did. This is another case where it's important to talk to the Program Officer. Often, the Program Officer can give you an idea of how close you were

to being funded, and she can tell you whether any other factors played a part (for example, yours may have been one of several good proposals in a narrow subtopic, and they only wanted to fund one). If the reviewers just weren't as excited about your proposal as they were about others, you may need to rework your proposal to explain more compellingly what the ultimate outcome of the research will be, why it's significant, and what the impact will be. Be sure that you clearly communicate the big picture – how will this research advance your field? How does this particular project contribute to your long-term research goals? Ask your colleagues to read the reworked text and tell you whether they find the arguments persuasive.

Based on the information you've gathered by reading the reviews carefully, talking to your colleagues, and talking to the Program Officer, you can then decide whether to: (1) revise the proposal and resubmit to the same program; (2) revise the proposal and submit to a different program within the same agency; (3) revise the proposal and submit to a different agency; or (4) start over with a new or significantly modified project idea. Just remember that even when your proposal isn't funded, you have learned something from the process, and your next proposal is likely to be more competitive.

Conclusion

As with many things related to research, competing for grants can be both an enormously rewarding and an enormously frustrating endeavor. It's important to remember that writing research proposals is a learned skill. You have recently earned a doctorate and landed a faculty position—good evidence that you have the expertise, determination, and (most likely) the small streak of masochism needed to compete successfully for research funding. However, as we've discussed in the preceding pages, winning a grant is not simply the inevitable outcome of articulating a great idea to funders who are waiting to hand out money. Identifying the right funding opportunity and writing a competitive proposal requires a thoughtful, disciplined approach and the development of new skills that you likely weren't taught in graduate school. What's more, with funding rates typically less than 20%, you are virtually assured of having many more proposals declined than funded.

Why go through all that trouble, then? Most obviously, when you do win funding, it can be extremely useful in helping you accomplish your research. However, even when you don't win that grant, the process of developing the proposal can provide a number of benefits. It can help you more clearly define your research ideas and plans. It can provide opportunities and a focus for developing collaborations. It can help you to connect with the broader research community in your discipline, particularly if you get to know the Program Officer and perhaps have the opportunity to become a reviewer. And it can help you vet your ideas with experts in your field (the Program Officer and reviewers).

The single biggest predictor of success in winning research funding is *not giving up* after you've had those first few proposals declined. Learn from your reviews, talk to the funders, continue to develop your research ideas, generate preliminary data and publications if you can, and work with your mentors to further develop your proposal writing skills. These activities will help you not only win funding, but also to build a successful academic career.