Special Report

NIH vs. NSF

A Comparison & Guide for Biomedical Researchers Seeking Grants
A Note from the Publisher

Dear Professional:

This resource is designed to help you better understand how two major federal agencies — the National Institutes of Health (NIH) and the National Science Foundation (NSF) — go about the process of awarding grants for research in nearly all fields of science.

It begins by giving an overview of each of their missions, their size, budgets and scope of operations, and then explains the criteria they use and steps they follow in choosing the projects they will fund.

It shows where their procedures overlap and where they differ, and explains under what conditions or circumstances a researcher might submit a proposal to both agencies.

At the end, you’ll find a list of 15 frequently asked questions (FAQs) and answers.

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We are always on the lookout for interesting topics, researcher challenges and ways we can be of service to you. If you have a success story you’d like to share with your colleagues, please do not hesitate to contact me. We look forward to serving you and your organization with the best advice and information available in the months and years to come.

Best Regards,

Leslie Norins, MD, PhD
Publisher
Principal Investigators Association
3606 Enterprise Avenue
Naples, FL 34103
info@principalinvestigators.org
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NIH vs. NSF Overview

Most biomedical scientists have at least heard of the National Science Foundation (NSF) but many are hazy on how it resembles — and differs from — the larger agency that is probably better-known to bioscientists, the National Institutes of Health (NIH).

In this Executive Review we summarize both the unique and the overlapping aspects of these two agencies, especially as they relate to biomedical funding.

Before examining how they approach various scientific disciplines and their review processes, let's first take a look at their overall missions and budgets:

Each contributes to thousands of U.S. institutions each year, sponsoring research that meets rigorous criteria. NIH approves about 21 percent of the applications it receives, NSF about 28 percent.

There is strong overlap in the types of projects funded. Both are committed to training; for instance NIH provides pre- and post-doctoral fellowships and institutional training grants. And though both are interested in education, NSF is far more so: It awards graduate and post-doctoral fellowships and grants to undergraduate students and K-12 educators. NIH champions new investigators and offers Pathway to Independence Awards, Career Development Awards and New Innovator Awards.

Differing missions

The most striking difference between the agencies is that NSF invests in all areas of science and engineering, while NIH specifically embraces projects that advance health and medicine.

That difference is reflected in their official missions: NIH's mission focuses on science in pursuit of fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to extend healthy life and reduce the burdens of human illness and disability. The NSF mission is to support all fields of fundamental science and engineering — except medical sciences — and national defense projects, with a strong education component.

Essentially, then, NIH funds biomedical research and NSF funds this plus all of the other sciences, including social, engineering, and mathematics, and science education.

Different budgets, spending patterns

NSF’s 2010 fiscal year budget is about $6.9 billion. It funds about 20 percent of all federally supported basic research conducted at colleges and universities. It’s the major source of federal funding for mathematics, computer science, and the social sciences, sponsoring about 11,500 new awards each year, each averaging three years. These grants cover both traditional research and higher-risk projects.

NIH, by contrast, is the primary federal agency for conducting and supporting medical research. Compared to NSF, it has a much larger annual budget — $31.2 billion for fiscal 2010. With that amount, it sponsors five times as many proposals each year as NSF.
Another spending difference is that 10 percent of NIH’s allocations go to its own labs (mostly those on its huge campus in Bethesda, Md., near the nation’s capital), and it supports about 1,500 clinical trials at its own hospital there.

The top-funded research categories at NIH are clinical research, followed by genetics, cancer, biotechnology, prevention, neurosciences, women’s health, brain disorders, infectious disease, and behavioral and social science.

As to organizational structure, NIH operates 27 institutes and centers, spanning a wide range of research areas and diseases from cancer to alcoholism. (There are currently initiatives to possibly combine some institutes related to alcohol and drug abuse.)

NSF, whose employees and scientists work mostly from its Arlington, Va., headquarters, organizes its research and education support through seven “directorates,” each encompassing several disciplines. The directorates are Biological Sciences; Computer and Information Science and Engineering; Engineering; Geosciences; Mathematical and Physical Sciences; Social, Behavioral, and Economic Sciences; and Education and Human Resources. NSF also funds some research through four agencies within the Office of the Director.

To which should you apply?

Is your research aimed at curing a form of cancer? Heart disease? Alzheimer’s? If so, you should look to NIH. If presented to NSF, such straightforward medical-research proposals have little chance of being funded.

On the other hand, NSF often supports basic biological science, so there is some overlap here between the agencies. However, be careful about how you “sell” your basic-science plan to the NSF. If you can’t do it without referring to the medical benefits of the research, you shouldn’t apply to NSF.

The take-home point here: If your project is in any way related to human health — even basic science that merely has some “potential” to affect the diagnosis or treatment of a disease — you stand a much better chance applying to NIH.

But if you’re a PI focusing on pure math, physics, computer science, astronomy, oceanography, polar research, etc., look to NSF because NIH would probably not fund such research.

However, once again there is an overlap: For instance, while NIH has no interest in funding research to determine the impacts of the Gulf oil spill on the Florida Everglades, it might fund research aimed at writing computer algorithms for computed tomography scanners. Why? Because even though the research involves mathematics, there’s a potential medical benefit.

Bottom line: If a proposal doesn’t have any biomedical relevance, NIH will most likely not review it. If there is indirect biomedical relevance, both agencies might review it.

If you’re not sure which agency is better suited for your application, it’s best to contact a program officer (PO) at either agency. The specific duties of POs differ at the two agencies (explained later), but any PO can help you decide where to apply.

Can you apply to both?

It’s important to note that only new investigators, without previous federal funding as a PI or co-PI, can submit their proposals to both agencies. Otherwise, this is not allowed.
But who’s a new PI? If your previous participation on a federally funded project involved work on a doctoral dissertation, research planning grant, or postdoctoral fellowship, you are still considered a beginning PI or co-PI and thus are eligible for simultaneous submissions.

However, even though a new PI can submit to both agencies in some cases, he or she cannot accept funds for the same work from both agencies unless the agencies agree to fund the project jointly, each providing a portion of the total grant.

Do the agencies know if a PI is applying to both simultaneously? Yes, because both ask applicants to list any “current or pending” funding requests. In the end, if you’re fortunate enough to interest both agencies, most likely, even as a new PI, you’ll have to choose one unless there’s a joint-funding agreement.

**Differences in scope of funding**

The scope (budget and period) of funding of an NSF proposal is quite different from that of the most common NIH funding mechanism, the R01 Research Project Grant.

If you’re considering applying to the NSF, first look up the data for the last year or two for the directorate and organization (within the directorate) covering your particular discipline. Study those numbers — not the funding rates. Study the mean award duration and the median annual award size, including direct plus indirect costs. Tailor your proposal to the NSF to be similar to those awards (unless you’re applying to a special program with special budget instructions). Most proposals funded by the NSF are for up to three years and have a modest budget.

Applicants for NIH’s R01 award should tailor their proposal to reflect the actual needs of their project. Modular applications are most prevalent with modules of $25,000, up to the modular limit of $250,000. Applications that exceed this level have to be submitted as non-modular and provide detailed budget information. Grants typically are for three to five years, awarded in three to five budget periods of 12 months each.

The Modular Grant Application Concept at NIH establishes specific modules or increments in which direct costs must be requested, up to the maximum of $250,000. The modular application doesn’t require a categorical breakdown of direct costs in the application, but there may be some other specific modular instructions.

Next, let’s look at how the two agencies approach the various scientific disciplines:

**Agencies overlap on biology, chemistry, nanotechnology, materials science**

Perhaps the strongest overlap between the two is in biology and chemistry. For instance, in biology both NSF and NIH have financed investigations of bacterial and viral invasions of cells, the control of development by genes, DNA repair, cell division, the development of antibiotics for medical devices, and the use of model organisms to understand human biology.

However, NSF funds are not limited to studies that relate to cell biology, health and medicine. For example, the agency has supported research on the anatomy of dinosaurs, color pigments in fossil feathers, ladybug populations, diving penguins, clams that turn air into food, and sea turtle conservation. And NSF monitors a range of habitats, from kelp forests to the Arctic tundra, to detect long-term changes in ecological patterns.
The overlap is also substantial in chemistry, nanotechnology and materials science. For instance:

- Both NSF and NIH have advanced initiatives aimed at uncovering the structure of proteins and nucleic acids.
- They are both investing in new materials and nanotechnology to produce artificial skin, biosensors and drug-delivery systems.
- Both supported chemistry studies leading to the development of more environmentally friendly industrial-scale processes. The NIH contributions aimed at improving the drug-making process, whereas NSF-funded research was applied to a range of applications, including the manufacture of Teflon and semiconductors. Moreover, NSF has invested in solar panels, hydrogen fuel cells for automobiles, and diamond nanowires for fast computing.

**Distinct funding patterns on earth, environmental and space sciences**

The two agencies funding patterns are most diverse in these three sciences. NSF, but not NIH, has dedicated programs and divisions for astronomy, geosciences and polar research. NSF also has devoted an interagency program to climate-change research, investing more than $200 million each year to interdisciplinary research. Examples of the latter include:

- Research on the dynamics of water processes with the goals of understanding the effects of climate and environmental change;
- Devising strategies to conserve water resources; and
- Projects relating to environmental pollution, such as floating plastic debris in the ocean, carbon dioxide absorption by concrete, and effects of the Gulf of Mexico oil spill on salt-marsh ecosystems.

But NIH does have an institute that sponsors research on environmental health topics, such as the role of environmental toxins in disease.

**Math, computer science, physics and engineering**

NSF tends to promote a broader range of research projects in the hard sciences, encompassing some that NIH would support. By contrast, NIH tends to stick to research focusing on health and medicine.

For example, NSF-sponsored research in math and computer modeling may be used to design a concert hall, simulate weather patterns, and assemble an investment portfolio that reduces risk and maximizes reward. NSF has funded computer-science projects that spawned the Internet and Google, and the agency continues to uphold strengthening the infrastructure of networks, such as electrical grids and communication systems. It also backs the general development of hardware, software and security features.

On the other hand, NIH-funded projects have used computer models to predict the structure of cellular proteins and the spread or containment of infectious diseases, such as avian flu.
Both agencies fund bioinformatics projects, such as the analyses of datasets to advance knowledge about the genetic and environmental contributors to disease.

Both also embrace bioengineering, including the development of biosensors, drug-delivery systems and biomaterials for replacing tissues. Both also are committed to biomedical imaging, such as the development of magnetic resonance imaging (MRI).

However, NSF has invested in a broader scope of projects, such as physics research on the formation of black holes and galaxies, the behavior of minerals in the deep Earth, and the dynamics of earthquakes. NSF-sponsored engineering projects have aimed to strengthen buildings to withstand earthquakes, improve armor and helmet design, and develop robots for military purposes.

**Social, behavioral and economic sciences**

NIH has separate institutes dedicated to child health and human development, mental health, drug abuse and aging. It has funded research on early learning, bilingualism, learning disabilities, social and cognitive development, exposure to violence, mental disorders, cognitive and behavioral effects of drug abuse, cognitive processes involved in drug craving and relapse, and the behavioral, social and economic consequences of aging.

NIH also invests in research on strategies for communicating genetic risks and the social, ethical, and policy implications of genomic research.

NSF contributes to the same areas, plus topics that are not health-related. Some examples include anthropology and archaeology, as well as the full spectrum of research in psychology, sociology and linguistics.

**How the two agencies review proposals**

Once you’ve decided which agency is more appropriate to submit your proposal, what are its review criteria and procedures?

Each has criteria and a process that suits its mission. Each has two *general* kinds of review criteria that are overarching across the agency and apply to every grant application.

For example, at NSF the two general criteria on which proposals are judged are called **Intellectual Merit** and **Broader Impacts**.

At NIH, the five core criteria are **Significance, Approach, Innovation, Investigator(s)** and **Environment**. Other criteria typically include factors such as experience and past performance of personnel, facilities and reasonableness of proposed costs. The Significance section of the application is where researchers outline their long-term project goals, but there is also a Specific Aims section where they can briefly state their assessment of the “impact” their proposal will have on their field of study.

**The NSF review process**

While NSF uses several different review procedures depending on the particular directorate and program, all the reviews are conducted by external “peers” using merit-based criteria. Many reviews, especially unsolicited proposals to disciplinary
programs, are *ad hoc* — meaning that reviewers are invited to review a particular proposal based on the match between the topic and the reviewer’s expertise.

Most *ad hoc* reviews are conducted using NSF’s Web-based “FastLane” system, its site for submitting and reviewing proposals. For an *ad hoc* review, the NSF PO will send a proposal to three or more reviewers knowledgeable in the topic area — not always expert in the PI’s particular subfield but usually at least in a related field.

For many proposals, NSF uses a panel-review process. In this case a panel of scientists, engineers and/or educators, depending on the particular program, are invited to NSF for two or three days to participate on a panel that reviews a large number of proposals for a particular program.

That means there may be some reviewers who are experts in your field, or a closely related one, and some who are not. For example, if a solicitation specifies that proposed programs must meet interdisciplinary scientific research goals, education goals, and outreach goals the panel might include scientists from each of the disciplines involved as well as educators who may not have disciplinary expertise in your field.

NSF strives for diversity in review panels. Therefore, while the majority of reviewers will be well-established researchers, some panel members will also be junior faculty. In addition, while many reviewers work at larger research-oriented universities, some may come from industry, two-year colleges and mainly-undergraduate institutions.

NSF often combines the *ad hoc* and panel-review processes, sending proposals first to *ad hoc* reviewers to evaluate the scientific merit (requiring discipline-specific knowledge), then having a panel evaluate other aspects.

The identities of NSF reviewers are always confidential, and they usually differ for each funding cycle of a program. This can sometimes present problems if you’re a PI who’s responding to reviews of a declined proposal while revising and resubmitting the proposal in the next funding cycle. That’s because reviewers in the next cycle may have different opinions than those in the previous cycle. However, reviewers generally look for similar things in a proposal. And because they’re guided by the review criteria and the Program Officer, reviews tend to be generally consistent.

Each NSF reviewer rates a proposal as Excellent, Very Good, Good, Fair or Poor. To be competitive, proposals typically need to receive an overall rating of Excellent or Very Good. Each reviewer on a panel rates the proposal and writes an individual review before the group meets. Then the full panel discusses the proposal. Because a reviewer’s mind might be changed by the discussion, the written summary the PI receives from the panel might be different from the comments he receives from an individual reviewer.

Based on the panel discussion, the panel makes one of three recommendations: Funding Highly Recommended; Fund if Possible; Do not Fund.

**But remember this:** The role of these reviewers is simply to advise the PO.

Ultimately it’s the PO who decides which proposals to fund — taking into account the recommendations and reviews of the panel, as well as the portfolio of projects in the PO’s program. For example, if the three proposals that rank highest all focus on the same narrow scientific topic, the PO may decide to fund some proposals ranked slightly lower in order to balance the portfolio.

The PO also looks for balance in the types of institutions funded (research-intensive, predominantly undergraduate, etc.) and may choose a particular proposal simply based on the topics that the PO wishes to emphasize in his program.
NSF depends on the scientific community to provide reviewers and aims for diversity, so you might get the opportunity to serve as a reviewer even if you haven’t received any NSF funding as yet. It can be a valuable experience and help you learn to write more effective proposals.

POs select reviewers, but here are four ways you can enhance your chances of being invited to review an NSF proposal:

1. Volunteer. Some of the directorates have instructions on how to do this. If not, you can e-mail the PO and include a copy of your CV.
2. Ask a senior colleague who is well-funded in the same area at NSF or has served as a reviewer to suggest your name.
3. Submit good proposals to NSF. Even if you don’t get funded, the PO may recognize your name and recruit you.
4. Maintain a good Web site on your current research program. POs seeking reviewers with certain expertise often use Google.

The NIH review process

Even though both agencies use peer review, NIH’s process is quite different from the foregoing. Instead of POs making key decisions the way they do at NSF, NIH peer review and funding decisions are administered by two separate officials and processes.

Most NIH reviews are administered by the Center for Scientific Review (CSR), regardless of the institute(s) funding the program. The CSR sets up review panels, called Study Sections, each administered by a Scientific Review Officer (SRO), to review proposals. For most programs, including all unsolicited R01s, the Study Sections are “standing.” They meet three times a year, and each of the 20 or more members usually serve four years.

Study Sections are organized around the scientific subject rather than around a particular Funding Opportunity Announcement (FOA). That means the proposals of two PIs who respond to the same FOA could be reviewed by different Study Sections if their scientific topics are different.

In contrast to NSF, where the identity of reviewers is anonymous, you can request a particular Study Section in your cover letter to their proposal with a short explanation and rationale for your request. (But, of course, you cannot request specific individuals.)

Besides the standing Study Sections, there also are Special Emphasis Panels (SEPs) for review of fellowships, Small Business Innovative Research (SBIR) grants, and other programs; these panels may have no standing members. Those designated for a particular review meeting will be members of the SEP for that meeting only.

In addition, the review of proposals submitted in response to an FOA supported by a single participating institute or center (IC) often is administered by that IC, although with a process similar to that used by the CSR.

The merit-review scoring process at NIH changed during 2009 for proposals eligible for funding in fiscal 2010. Now, each reviewer at NIH evaluates and scores a proposal from 1 (exceptional) to 9 (poor) on each of the five previously listed core criteria.

Reviewers also give your proposal a “preliminary impact score” from 1 to 9 before the Study Section meets. These scores determine which proposals the Study Section will discuss (approximately the top 50 percent) and which will not be discussed nor considered for funding (commonly called “triaged”). (Editor’s note: The term stems from a concept in battlefield medicine, wherein the hopelessly wounded are not actively treated but merely given pain relief and sedation.)
While all PIs receive the numeric scores for their proposals from the two or three reviewers who (anonymously) prepare a written critique, those whose proposals are triaged don't receive a panel-discussion summary or overall score. (Contrast that to NSF, where every proposal is discussed and a summary of the discussion is provided in the reviews.)

Those proposals discussed by the Study Section are given an overall impact score, ranging from 1 to 9, by each section member. Impact scores are averaged to one decimal place and multiplied by 10 to yield a priority score from 10 to 90. The priority score is then converted to a percentile ranking.

Unlike NSF, where the PO makes the final funding decision, the SRO does not control the funding decision. POs (not involved in the peer review) based in an IC make recommendations based on the merit review priority score, the IC mission and priorities, and the current “payline,” to the IC Advisory Council. Then the IC Director makes the ultimate funding decision.

The payline is the minimum score converted to a percentile (to account for score inflation) required to receive funding and is determined by each IC based on available resources. Paylines can differ noticeably among the different funding mechanisms (R01, R03, R21, etc.) and among the ICs.
Frequently Asked Questions

1. What is the major difference between NSF and NIH?
   
   A. The most striking difference is that NSF invests in all areas of science and engineering, whereas NIH specifically embraces projects focused on health and medicine.
   
   NIH’s mission is science in pursuit of fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to extend healthy life and reduce the burdens of illness and disability.
   
   NSF’s mission includes support for all fields of fundamental science and engineering, except for medical sciences.
   
   NIH funds biomedical research. NSF funds all of the other sciences, including social, engineering and mathematics, and its mission includes a strong science education component.

2. How do their budgets compare?
   
   A. NSF’s 2010 fiscal year budget is about $6.9 billion. It funds about 20 percent of all federally supported basic research conducted at colleges and universities. NIH has a much larger annual budget — $31.2 billion for fiscal 2010. It sponsors five times as many proposals each year as NSF.

3. If my project is related to health, should I apply to NSF or NIH?
   
   A. If the project is health-related — even basic science that has some potential to affect the diagnosis or treatment of a disease — it’s better to apply to NIH.

4. If my proposal doesn’t have any biomedical relevance, will NIH review it?
   
   A. Typically, No. However, if there is indirect biomedical relevance, both agencies might review it. If you're unsure which agency is better suited for your proposal, contact a Program Officer (PO) for direction.

5. May I submit the same proposal to both NSF and NIH at the same time?
   
   A. Only “new” investigators, without previous federal funding as PIs, may do so.

6. What is the average length of an NSF grant?
   
   A. Most are for up to three years and have a modest budget.
7. If applying to NSF, how much grant money should I request?

   A. Look up the data for the last year or two for the directorate and organization (within the directorate) where you intend to apply. Then study those numbers, not the funding rates. Study the mean award duration and the median annual award size, including direct plus indirect costs. Your funding request should be similar to those awards (unless you're applying to a special program with special budget instructions).

8. What is the average length of an NIH grant?

   A. Proposals generally are funded for three-to-five budget periods of 12 months each.

9. How would I determine how much grant money to request from NIH?

   A. Your request for an NIH Research Project Grant (R01) should reflect the actual needs of your proposed project. Modular applications are most prevalent with modules of $25,000, up to the modular limit of $250,000. Applications that exceed this have to be submitted as non-modular and provide detailed budget information.

10. Who administers reviews and funding decisions at NSF?

    A. At NSF these are handled by POs in charge of the particular program of interest.

11. What is the NSF review process?

    A. NSF uses several procedures depending on which of its seven directorates and which program is involved, but all reviews are conducted by external “peers” using merit-based criteria. Many reviews, especially unsolicited proposals to disciplinary programs, are ad hoc — meaning reviewers are matched to programs according to their areas of expertise.

    Most ad hoc reviews are conducted using NSF's Web-based FastLane system. The PO will send a proposal to three or more reviewers expert in the topic area — not necessarily expert in the PI's particular subfield but at least in a related field.

    For many proposals, NSF uses a panel-review process. Here a panel of scientists, engineers and/or educators, depending on the particular program, are invited to NSF for two or three days to participate to review a large number of proposals for a particular program.

    NSF often combines the ad hoc and panel-review processes, sending proposals first to ad hoc reviewers to judge the scientific merit (requiring discipline-specific knowledge) and then to the panel to evaluate other aspects.

12. Who makes the final funding decision at NSF?

    A. The panel makes a recommendation: Funding Highly Recommended; Fund if Possible; Do not Fund.

    Ultimately, however, the PO decides which proposals to fund, taking into account those recommendations and the portfolio of projects in his or her program, aiming to achieve a balance there.
13. What is the peer review process at NIH?

A. Most NIH peer reviews are administered by the Center for Scientific Review (CSR), regardless of the institute(s) funding the program. The CSR sets up review panels, called Study Sections, each administered by a Scientific Review Officer (SRO), to review proposals. For most programs, including all unsolicited R01s, the Study Sections are “standing.” They meet three times a year, and each of the 20 or more members generally serve four years.

Each reviewer evaluates and scores a proposal from 1 (exceptional) to 9 (poor) on each of the five core review criteria (Significance, Investigator(s), Innovation, Approach, and Environment). Reviewers also give proposals a “preliminary Impact score,” also from 1-9, before the Study Section meets. These are used to determine which proposals will be discussed by the Study Section (approximately the top half), and which will neither be discussed nor considered for funding (called “triaged”).

While all PIs receive the numeric scores from the two or three reviewers who prepare a written critique, those whose proposals are triaged don’t receive a panel discussion summary or overall score.

Proposals that are discussed by the Study Section are given an overall impact score, ranging from 1-9, by each Study Section member. These overall impact scores are averaged to one decimal place and multiplied by 10 to yield a priority score of 10 to 90. That score is then converted to a percentile ranking.

14. Who makes the final funding decision at NIH?

A. POs (not involved in the peer review) based in an institute or center (IC) make recommendations to the IC Advisory Council. Then the IC Director makes the ultimate funding decision.

15. About what percentage of the applications received get funded at each agency?

A. NIH approves about 21 percent of the applications it receives, NSF about 28 percent.