

NSF Graduate Research Fellowship

Intellectual Merit Criterion

NSF Official Statement

Panelists will consider factors including: the strength of the academic record, the proposed plan of research and whether it is potentially transformative, the description of previous research experience, references, Graduate Record Examinations (GRE) General and Subject Tests scores, and the appropriateness of the choice of institution relative to the proposed plan for graduate education and research.

NSF Bullet points

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

Broader Impacts Criterion

NSF Official Statement

The broader impacts criterion includes contributions that infuse learning with the excitement of discovery, and assure that the findings and methods of research are communicated in a broad context and to a large audience.

A strong application will encourage diversity, broaden opportunities, and enable the participation of all citizens-women and men, underrepresented minorities, and persons with disabilities-in science and research.

In addition to reaching a broad audience, a strong application must demonstrate how it will enhance scientific and technical understanding, while benefiting society.

Applicants may provide characteristics of their background, including personal, professional, and educational experiences, to indicate their potential to fulfill the broader impacts criterion.

NSF Bullet points

- How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
Eg.
 - Include students (e.g., K-12, undergraduate science majors, non-science majors, and /or graduate students) as participants in the proposed activities as appropriate.
 - Establish special mentoring programs for high school students, undergraduates, graduate students, and technicians conducting research.
- How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?
 - Include students from underrepresented groups as participants in the proposed research and education activities.
 - Mentor early-career scientists and engineers from underrepresented groups who are submitting NSF proposals.

NSF Graduate Research Fellowship

- To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
 - Identify and establish collaborations between disciplines and institutions, among the U.S. academic institutions, industry and government and with international partners.
 - Stimulate and support the development and dissemination of next-generation instrumentation, multi-user facilities, and other shared research and education platforms.
- Will the results be disseminated broadly to enhance scientific and technological understanding?
 - Partner with museums, nature centers, science centers, and similar institutions to develop exhibits in science, math, and engineering.
 - Give science and engineering presentations to the broader community (e.g., at museums and libraries, on radio shows, and in other such venues.).
 - Make data available in a timely manner by means of databases, digital libraries, or other venues such as CD-ROMs.
 - Integrate research with education activities in order to communicate in a broader context.
- What may be the benefits of the proposed activity to society?
 - Demonstrate the linkage between discovery and societal benefit by providing specific examples and explanations regarding the potential application of research and education results.

Phillip Guo Comments

Broader Impacts (mostly expressed within your Personal Statements Essay) makes or breaks your application. Alone, it cannot secure you a victory, but coupled with great technical qualifications (the other criterion, *Intellectual Merit*), it can vastly improve your chances of winning. Every single person whom I've asked about the NSF fellowship tells me to spend lots of time thinking about and addressing Broader Impacts. They've told me stories about how their friends barely missed winning because their Broader Impacts weren't, well, broad enough. You must infuse Broader Impacts throughout all of your essays, but the *Personal Statements Essay* gives you the most opportunities to do so. Let's go through the 4 parts of the criterion one-by-one:

1. *effectively integrate research and education at all levels, infuse learning with the excitement of discovery, and assure that the findings and methods of research are communicated in a broad context and to a large audience*
 - This means not only that you should be enthusiastic about learning for your own hot self, but more importantly, that you should be enthusiastic about sharing knowledge with others. TAing, tutoring, and mentoring are good examples. Even better, if you have done anything with science education, especially for children in underprivileged areas, that would be golden. This should go in your *Personal Statements Essay* and in your short answers about your teaching experiences.
2. *encourage diversity, broaden opportunities, and enable the participation of all citizens-women and men, underrepresented minorities, and persons with disabilities-in science and research*
 - I think that this is the most influential point in Broader Impacts. The diversity point. This should definitely go in your *Personal Statements Essay*. Find SOME way to incorporate this point. If you are a woman, part of an underrepresented minority, or have some disability, now is the time and place to mention it somehow (always tastefully and sparingly, of course; it should not be your main selling point). Have no fear or shame. This is a game, and your strongest competitors who are in these demographics will mention their minority status. I know NSF winners in these demographics who've told me how they mentioned their status in their essays, even though they felt that it sounded a bit cheesy. Whatever. It's better to be a bit cheesy and win over \$100k than to stubbornly stick to your principles and lose out. After all, the primary criteria for evaluation is your technical merit, so if you are really well-qualified anyways, nobody should think that you got this fellowship 'just because you're part of X or Y group'. What if you aren't part of any underrepresented minority? Well, think about anything you have done to promote diversity in science and education, and write about those experiences (if any).
3. *enhance scientific and technical understanding*
 - This one is like doing science for the sake of science. Don't worry about it too much because the boring technical aspects of your application, such as your *Previous Research* and *Proposed Research* essays should cover it pretty well.
4. *benefit society*
 - This is really about the impact of your work, both previous and proposed. Remember: impact, real world impact. You're not doing science in a bubble.

NSF Graduate Research Fellowship

Out of all 3 fellowship applications, I spent by far the most time on the NSF. It was definitely time well spent, though, because it made doing the other 2 applications, especially the NDSEG, much easier.

NSF Graduate Research Fellowship

Previous Research Experience

NSF Prompt

Describe any scientific research activities in which you have participated, such as experience in undergraduate research programs, or research experience gained through summer or part-time employment or in work-study programs, or other research activities, either academic or job-related. Explain the purpose of the research and your specific role in the research, including the extent to which you worked independently and/or as part of a team, and what you learned from your research experience. In your statement, distinguish between undergraduate and graduate research experience. At the end of your statement, list any publications and/or presentations made at national and/or regional professional meetings.

If you have no direct research experience, describe any activities that you believe have prepared you to undertake research.

NSF Fellows are expected to become globally-engaged knowledge experts and leaders who can contribute significantly to research, education, and innovations in science and engineering.

You **MUST** provide specific details in this essay that address BOTH the NSF Merit Review Criteria of Intellectual Merit and Broader Impacts in order for your application to be competitive. Please refer to the Program Announcement for further information on the NSF Merit Review Criteria (examples of Broader Impacts activities).

NSF Bullet points

- What are all of your applicable experiences?
- For each experience, what were the key questions, methodology, findings, and conclusions?
- Did you work in a team and/or independently?
- How did you assist in the analysis of results?
- How did your activities address the Intellectual Merit and Broader Impacts criteria?

Phillip Guo Comments

This essay is pretty plain vanilla. Just follow the prompt and write about all the research projects in which you have been involved, making sure to hit all the points the prompt requires. Briefly describe each project, your particular role in it, how much you worked per week, what you learned from the experience, what impact it had on the world (however small), how it motivated you to want to pursue a Ph.D. (if it did at all), etc.

The flow of my essay was one of build-up and climax. I wrote about 4 projects in chronological order, each one requiring more sophistication and experience than the previous one. The climax came as I described my most significant (which was my most recent) project. I spent the first page describing the first three projects, and the second page solely dedicated to describing the final and most significant one. I suggest devoting more space to your most significant project, because it emphasizes your greatest strength; it also provides good context for your next essay, Proposed Research, as well as ample space for making cross-references between your essays. Don't devote an equal amount of space to each of your projects unless you truly feel that they are all of equal significance.

If you have published (or submitted) papers, in addition to listing them at the end of this essay in a mini-bibliography like the prompt requires, make references to them in the essay itself in order to put those papers in their proper context.

NSF Graduate Research Fellowship

Proposed Plan of Research

NSF Prompt

In a clear, concise, and original statement, present a complete plan for a research project that you plan to pursue while on fellowship tenure and how you became interested in the topic. Your statement should demonstrate your understanding of research design and methodology and explain the relationship to your previous research, if any.

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Format: Include the title, key words, hypothesis, research plan (strategy, methodology, and controls), anticipated results or findings, and literature citations. If you have not formulated a research plan, your statement should include a description of a topic that interests you and how you propose to conduct research on that topic.

In addition to review of the Intellectual Merit and Broader Impacts of your proposal, research topics discussed in your proposed plan will be used to determine eligibility. Refer to the Field of Study eligibility criterion in the program announcement.

NSF Bullet points

- What issues in the scientific community are you most passionate about?
- Do you possess the technical knowledge and skills necessary for conducting this work, or will you have sufficient mentoring and training to complete the study?
- Is this plan feasible for the allotted time and institutional resources?
- How will my research contribute to the "big picture" outside the academic context?
- How can I draft a plan using the specified research proposal format?
- How does your proposed research address the Intellectual Merit and Broader Impacts criteria?

Phillip Guo Comments

This essay is a real doozie. It will take a lot of thinking, planning, and discussion with your advisor and colleagues to come up with a research proposal that makes for a strong essay. What the reviewers are looking for is whether you can write a technical proposal for a project that is feasible, impactful, and realistic given your particular expertise. However, nobody is going to follow-up with you and force you to actually work on the project you proposed.

I would strongly suggest writing a proposal that's somehow based on work that you have already done, so that you can tie it in with your Previous Research essay (cross-references!!!). In other words, don't just make up some cool topic out of thin air. If you're not that excited about your current work and desperately want to switch to something completely different once you start your Ph.D., now is not the time to express your discontent. It's dangerous to propose a research project that's not related to what you've already done because it dampens your credibility. Show, don't tell. If you make a proposal that's based on your current work, you have more opportunities to show rather than tell. However, don't fall into the trap of simply proposing a small step forward for your current research (a slight tweak here and there), because that just makes you sound lazy and unoriginal. The reviewers want to see something innovative. Don't be afraid to make a

NSF Graduate Research Fellowship

bigger, more ambitious conceptual leap, as long as it's grounded in your current work, even if you have no clue whether it's fully tractable to solve the problem you've proposed (just don't leap as far out as cold fusion or perpetual motion).

Oh yeah, you know how the prompt says: If you have not formulated a research plan, your statement should include a description of a topic that interests you and how you would propose to conduct research on that topic. Well, don't ever take this cop-out route! Formulate an actual research plan! Nothing is stopping you, other than lack of effort. Taking this cop-out route is a fast path to the land of loser.

A good research proposal will contain solid anchoring to your previous work, a well-motivated research problem, citations from 4 or 5 references to show that you are familiar with the body of existing work on this problem, and a proposed solution to the problem that sounds somewhat tractable. I know, 2 pages isn't much room at all, but everyone else has the same space constraints too.

The prompt wants you to satisfy the requirement of Intellectual Merit, but that is pretty straightforward. That simply means, write something that's technically competent and shows that you know what you're doing.

In order to satisfy the requirement of Broader Impacts in this essay, you will need to argue for why this research benefits society and the world (feel free to stretch a bit, but don't be too corny). And no, simply advancing the 'state of the art' in your field isn't sufficiently broad an impact, because that doesn't impact the people in the rest of the world who know nothing about your field. Think broader.

NSF Graduate Research Fellowship

Personal Statement

NSF Prompt

Describe any personal, professional, or educational experiences or situations that have prepared you or contributed to your desire to pursue advanced study in science, technology, engineering, or mathematics. Describe your competencies and evidence of leadership potential. Discuss your career aspirations and how the NSF fellowship will enable you to achieve your goals.

NSF Fellows are expected to become globally-engaged knowledge experts and leaders who can contribute significantly to research, education, and innovations in science and engineering. The purpose of this essay is to demonstrate your potential to satisfy this requirement. Your ideas and examples do not have to be confined necessarily to the discipline that you have chosen to pursue. You **MUST** provide specific details in this essay that address **BOTH** the NSF Merit Review Criteria of Intellectual Merit and Broader Impacts in order for your application to be competitive. Please refer to the Program Announcement for further information on the NSF Merit Review Criteria (examples of *Broader Impacts activities*).

NSF Bullet points

- Why are you fascinated by your research area?
- What examples of leadership skills and unique characteristics do you bring to your chosen field?
- What personal and individual strengths do you have that make you a qualified applicant?
- How will receiving the fellowship contribute to your career goals?
- How do these activities address the Intellectual Merit and Broader Impacts criteria?

Phillip Guo Comments

Ok, pay real close attention. This is the essay that will make or break your application. Stop laughing. I'm not kidding. It sounds like a foofy fluffy feel-good personal statement essay, but trust me, the people I knew who didn't take this essay seriously barely missed out on winning an award, getting an honorable mention instead and receiving written reviews along the lines of "you're very strong technically, but you just don't have enough broader impacts." Pretty much all top contenders are technically marvelous, so what makes the difference between a win and a near-win is Broader Impacts, which are best expressed in this essay.

See the next section for more details about Broader Impacts, but the name of the game in this essay is to incorporate as much Broader Impacts as humanly possible while still following the prompt. In previous years, there was a separate essay specifically asking you to address Broader Impacts, but in my year, they eliminated that essay, so this is your primary opportunity to discuss Broader Impacts.

Don't be too selfish in this essay; don't toot your own horn too much because the reviewers don't care about you as a person. Don't just make it all me, me, me, like about how deeply passionate you are about your field ever since you played with your first chemistry or electronics set when you were 6 years old. Instead, try to talk about your own work and interests in relation to other people, such as leadership, mentoring, TAing, learning from research colleagues, working on a team, etc. Show your passion for your field by cross-referencing your internship and research experiences (to weave together different parts of your app) instead of just recounting wonderful childhood nerd stories that nobody except your mother cares about.