NSF GRFP Research Proposal

Graduate Fellowship Application

- http://www.nsfgrfp.org/
- https://www.nsf.gov/pubs/2022/nsf22614/nsf22614.pdf
- https://www.nsfgrfp.org/applicants/tips/

Statements

GRFP applicants are required to provide two statements: a Personal, Relevant Background and Future Goals Statement, and a Graduate Research Plan Statement. The maximum length of the Personal, Relevant Background and Future Goals Statement is three (3) pages. The maximum length of the Graduate Research Plan Statement is two (2) pages. These page limits include all references, citations, charts, figures, images, and lists of publications and presentations. Times New Roman font for all text, Cambria Math font for equations, Symbol font for non-alphabetic characters (it is recommended that equations and symbols be inserted as an image), no smaller than 11-point, except text that is part of an image. Both statements must address NSF's review criteria of Intellectual Merit and Broader Impacts. Please reference the Personal, Relevant Background and Future Goals Statement , and Graduate Research Plan Statement templates for further information.

Research Proposal Timeline

- 2/20: how to write a research proposal
- 2/27: spring break (no class) – proposal topic due to be approved
- 3/5: draft due for peer review
- 3/12: peer review due (each person will receive at least 2 peer reviews)
- 3/19: final research proposal due

- on 3/19 turn in (1) the draft, (2) the reviews you received, and (3) the final version with change highlighted based on the reviews
- only final version will be graded
- Double blinded peer review: anonymous for both the reviewer and the reviewee (not blinded to me)
- Your reviews for others (2-3) will also be graded for helpfulness by me, which will be part of your own final proposal score

From NSF

- When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit**: The Intellectual Merit criterion encompasses the potential to advance knowledge; and

- **Broader Impacts**: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

What is the potential for the proposed activity to:

- Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and

- Benefit society or advance desired societal outcomes (Broader Impacts)?

To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?

Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?

How well qualified is the individual, team, or organization to conduct the proposed activities?

Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

#5: Know the agency's mission

- Every funding agency has ideas and rules about what it wants to fund.

- An agency usually does not fund re-written proposals previously sent to other agencies, because the overall goals are different.

- Don't attempt to contort the agency's mission to fit your research project.

#4: Read all instructions carefully

Be sure to follow the instructions.

A common reviewer's view:

If the PI can't follow instructions for the proposal, then the PI probably can't follow instructions to do elaborate research.

#3: Write with confidence, but don't disregard other ideas

Your proposal should convey the attitude that:

- You have identified an important problem, and you are the right person to do the work.

- You will get the job done and find answers to the problem discussed.

- You are aware of previous relevant studies.

#2: Have a great scientific idea

One that can be investigated thoroughly, within the context of the institutional resources available to the PI, and within a reasonable time-frame.

An Agency Wants to Know:

- What is your approach?

- Why is this important to your research community?

- If successful, what will be the benefit to society?

- Be ready to answer:
  - What is your research objective?
  - How does this meet the agency's mission?

Deciding a Research Topic

Your research must be:

• Methodical, repeatable, and verifiable.

• Not done before.

• Significant.

• Reasonable probability of success.

• Lends itself to a viable research plan.

You must have facilities to accomplish the research.

Know Your Field

- What is the current state-of-the-art?

- What are the top ten researchers in the field doing now?

- What are the sources for funding?

- What are the key research issues?

- Who would likely review your proposal?

Now that you have an idea, how do you go about writing the proposal?

Keep in Mind While Writing

- **<u>Carefully</u>** follow all instructions provided by the funding agency.
- Don't run the risk of having your science "down-graded" or your proposal rejected, because you didn't follow instructions.

Basic Concepts

- Write to be readable.

- Make the level of detail appropriate.

- Find out how much money is available, and follow the budget guidelines.

- Have clearly defined hypotheses, goals, and approaches.

State Your Research Objective

- Make clear in the first paragraph exactly what your proposal is about.
- The statement of your research objective should lead you directly to your methodology.

Clear Presentation

- State the problem or hypothesis.

- State why the issue is significant.

- State what you are going to do.

- Explain how you will carry out the proposed work.

Competitive Proposals

- Keep the narrative focused on the project.
- Use tables, charts, and figures effectively.
- Mention role students will play in research.
- Present preliminary results if you have them.

Language and style recommendations

- ❑ Use **accessible** language for a smart 'lay' audience of scientists.

- ❑ Be personal – talk about the work YOU will do in first-person language

- ❑ Use **bold, ambitious** language to share your **passion** and **vision** for where you want your research to go

  - ▪ *"my ambitious new research program"*

  - ▪ *"I have taken up this challenge"*

- ❑ Use **active** words: invented, created, explored, discovered, etc…

Common Errors in Proposals

- Does not fit agency's mission.

- Violates one or more agency guidelines.

- Beyond capabilities of PI, students, or institution (don't propose too much).

- Lack of proofing: Grammar, spelling, formulas, numbering, math errors.

More Common Errors

- Missing pages, figures, tables, or signatures.
- Unfocused, poorly organized.
- Low personnel budget – Not enough people.
- Low impact – no publishable results even if funding is obtained.

Reviewers Want to Know

1) What is it about (research objective)?

2) How will you do it (technical approach and methodology)?

3) Can you do it (you and your facilities), and is it worth doing?

4) Are there any secondary objectives that are relevant to the agency (*e.g.,* education of students, broader impacts of research)?

Proposal Review Criteria

1) Significance:

  – Does this study address an important problem?

  – If aims of application are achieved, how will scientific knowledge be advanced?

  – What will be the effect of these studies on concepts or methods that drive this field?

Proposal Review Criteria

2) Approach:

– Are the conceptual framework, design, methods, and analyses adequately developed, well-integrated, and appropriate to the aims of the project?

– Does the applicant acknowledge potential problem areas and consider alternative tactics?

Proposal Review Criteria

3) Innovation:

- Does the project employ novel concepts, approaches, or methods?

- Are the aims original and innovative?

- Does the project challenge existing paradigms, develop new methodologies, or technologies?

Proposal Review Criteria

4) Investigator:

- Is the investigator appropriately trained and well-suited to carry out this work?

- Is the work proposed appropriate to the experience level of the PI (and other researchers, if any)?
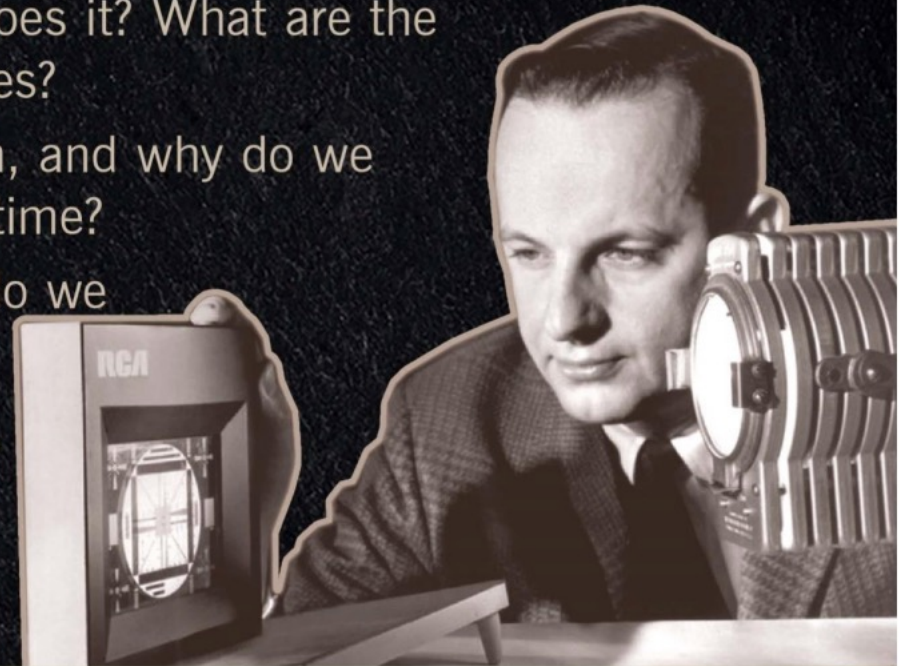
Proposal Review Criteria

5) Environment:

– Does the scientific environment in which work will be done contribute to the probability of success?

– Do proposed experiments take advantage of unique features of the environment, or employ useful collaborative arrangements?

– Is there evidence of institutional support?

1. What are we trying to do?

2. How is it done today and who does it? What are the limitations of the present approaches?

3. What is new about our approach, and why do we think we can be successful at this time?

4. If we succeed, what difference do we think it will make?

5. How long do we think it will take, and what are our mid-term and final exams? How much will it cost?

George Heilmeier
DARPA Director 1975-1977

- 1 inch page margin
- 11 pt font
- Single space
- Introduction (half page)
- 1-2 figures (2 if you have heavy preliminary data)
- Research plan (1 page)

Graduate Research Plan Statement

Introduction Out of 32 million injuries that occur each year in the United States, 45% are caused by ███.[1] These injuries can result in ███. Current treatments include ███. However, these treatments do not address the underlying limitations of ███.[1] Promoting tissue regeneration could lead to scarless healing and enhanced functional (*e.g.,* mechanical) properties. Recent studies have demonstrated that ███.[2]

Developing technologies to 1) screen for optimal methods to ███ and 2) direct differentiation of ███ would enable new therapeutic modalities that promote ███.

I propose to develop a technology, ███, that leverages ███. ███ is an effective ███ method that improves upon ███, thereby ███, resulting in ███.[3] This method requires significantly less ███ and improves the ███ efficiency and ███ viability.[3] While other traditional methods (███) exist, they are often limited by ███[4] while able to ███, currently exists as a low-throughput platform with low tunability. ███ will leverage well-defined ███ which provides discrete, predictable, continuous, and highly tunable ███ to enhance ███ into a high-throughput system. Introducing ███ will enable a ███ technique that 1) continuously loads and replenishes ███, 2) fine-tunes both the spatial and temporal ███ while minimizing impacts on ███ viability, and 3) incorporates multiplex ███ ███. ███.

Research Plan I am currently building a ███ ███ ███ (schematic illustration in **Figure 1a**).

Objective 1: ███
Objective 2: ███ molecules to ███
Objective 3: ███ stem cells to ███
Figure 1: ███

- 1 inch page margin
- 11 pt font
- Single space
- Introduction (half page)
- 1-2 figures (2 if you have heavy preliminary data)
- Research plan (1 page)
- 2-3 objectives
- Intellectual merit (0.25 page)
- Broader impacts (0.25 page)
- References (3 lines)

Objective 1: ▮▮▮▮▮▮
To analyze if ▮▮▮▮▮▮, I will compare ▮▮▮▮▮▮
▮▮▮▮▮▮. I hypothesize that ▮▮▮▮▮▮
▮▮▮▮▮▮
▮▮▮▮▮▮
▮▮▮▮▮▮
▮▮▮▮▮▮, Next, I will optimize ▮▮▮▮▮▮
▮▮▮▮▮▮, I will introduce ▮▮▮▮▮▮
▮▮▮▮▮▮. I will assess ▮▮▮▮▮▮
▮▮▮▮▮▮ (**Figure 1**, Objective 1).

Objective 2: ▮▮▮▮▮▮.
I will use this technology for ▮▮▮▮▮▮
▮▮▮▮▮▮ (**Figure 1,** Objective 2). Using
optimized in Objective 1, I will ▮▮▮▮▮▮
▮▮▮▮▮▮.5 After ▮▮▮, I will
measure ▮▮▮▮▮▮
▮▮▮▮▮▮
▮▮▮▮▮▮
▮▮▮▮▮▮.

Objective 3: ▮▮▮▮▮▮.
I will use ▮▮▮▮▮▮
(**Figure 1**, Objective 3). I will transfect ▮▮▮▮▮▮
▮▮▮▮▮▮. I will assess ▮▮▮▮▮▮
I will evaluate ▮▮▮▮▮▮
▮▮▮▮▮▮. I will additionally evaluate ▮▮▮▮▮▮
▮▮▮▮▮▮.

Intellectual Merit ▮▮▮▮▮▮, I have the motivation to pursue
advancements ▮▮▮▮▮▮. The ▮▮▮▮▮▮ process is still poorly
understood. With my research, I hope to provide more knowledge to the field of ▮▮▮▮▮▮
▮▮▮▮▮▮. I have begun work for this project by ▮▮▮▮▮▮
▮▮▮▮▮▮ (**Figure 1a)** under the
mentorship of ▮▮▮▮▮▮ at the University of Michigan.

Broader Impacts While my research is aimed to identify if ▮▮▮▮▮▮
▮▮▮▮▮▮, this work will also generate
fundamental insights and elucidate detailed physical mechanisms on ▮▮▮▮▮▮
▮▮▮▮▮▮. Furthermore,
potential applications of this technology may also impact fields like ▮▮▮▮▮▮
▮▮▮▮▮▮. I am currently ▮▮▮▮▮▮
▮▮▮▮▮▮
▮▮▮▮▮▮. Additionally, I will participate in ▮▮▮
▮▮▮▮▮▮.

References [1] G. Yang, *Birth Defects Res. Part C Embryo Today Rev.* **2013**. [2] P. Lui, *Stem Cells Cloning* **2015**. [3] Y. Cao, *Proceedings of the National Academy of Sciences* **2019**. [4] T. Kim, *Anal Bioanal Chem* **2010**. [5] H. Liu, *Cell Tissue Res* **2014**. [6] P. Torricelli, *Age (Dordr)* **2013**. [7] Z. Yan, *J Exp Orthop* **2018**.

Peer review rubrics

Intellectual Merit Criterion

Overall Assessment of Intellectual Merit (select one)

Excellent
Very good
Good
Average
Below average

Explanation to Applicant

Broader Impacts Criterion

Overall Assessment of Broader Impacts (select one)

Excellent
Very good
Good
Average
Below average

Explanation to Applicant

When evaluating both criteria, please consider (and comment in your explanations on):

1. *What is the potential for the proposed activity to:*
   - *Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and*
   - *Benefit society or advance desired societal outcomes (Broader Impacts)?*
2. *To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?*
3. *Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?*
4. *How well qualified is the individual, team, or organization to conduct the proposed activities?*
5. *Are there adequate resources available to the student (either at the home organization or through collaborations) to carry out the proposed activities?*