Who we are and why we're here

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The Graduate Research Fellowship Program History

The National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) is the country's oldest fellowship program that directly supports graduate students in various STEM (Science, Technology, Engineering and Mathematics) fields. In March 1951, Alan T. Waterman, the chief scientist at the Office of Naval Research, was appointed by President Truman to become the first Director of the National Science Foundation. Waterman defined the Foundation's policy role as "one of advocating a research support program, improving government-university relations, and compiling reliable information on scientific research and manpower." In 1951, Congress appropriated only $151,000 for the agency to start administrative operations. Very early on, the Foundation created the Division of Graduate Education (DGE) to be responsible for fellowships and scholarships for graduate students and postdoctoral scientists. The GRFP was established early in the foundation's history, to encourage the best basic research and ensure a comprehensive research program.

Since 1952, NSF has funded over 46,500 Graduate Research Fellowships out of more than 500,000 applicants. More than 30 Fellows have gone on to become Nobel laureates, and more than 440 have become members of the National Academy of Sciences. In addition, the Graduate Research Fellowship Program has a high rate of doctorate degree completion, with more than 70 percent of students completing their doctorates within 11 years.

Learn more about the history of the National Science Foundation.

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Fellowships to consider

- National Science Foundation Graduate Research Fellowship Program (NSF GRFP)
- National Defense Science and Engineering Graduate Fellowship (NDSEG)
- Hertz Fellowship
- HHMI International Student Research Fellowships (invite only)

Fellowships to consider

- NSF GRFP:
  - 3 years, $32K stipend (+BE supplement)
  - $12K cost-of-education
- NDSEG:
  - 36 consecutive months stipend, tuition, fees
  - requires “Summary of Goals” statement
- Hertz Fellowship
  - 5 years, $32K stipend over 9 months
  - Several short (300 wd) essays

Strategies for fellowship success

1. Analyze what your audience wants.
2. Demonstrate relevant qualifications explicitly & concretely.
   a) Personal statement
   b) Research proposal
3. Craft a unified message.

How does the NSF define impact?

NSF Vision Statement

1. **Sustain and strengthen** the Nation's science, mathematics, and engineering
2. Promote the use of those capabilities in **service to society**

NSF GRFP program solicitation

1. To support individuals with the **demonstrated potential** to be high achieving
2. To develop **a globally-engaged** workforce … to ensure the Nation's **leadership** in … research and innovation

"Leaders in their chosen fields"

How does the NSF *evaluate* impact?

“Intellectual Merit”

advances knowledge and understanding

“Broader Impacts”

advance desired societal outcomes

Demonstrate impact using 5 criteria.

You as an individual are qualified.	Your science is qualified.
• Relevant abilities and experiences • Potential for institutional support	• Advances understanding • Creative and original • Well-reasoned and feasible

Personal Statement
(Personal, Relevant Background and Future Goals Statement)

Research Proposal
(Graduate Research Plan Statement)

NSF reviewers seek these personal qualifications

Experiences

- Strong academic performance
- Relevant awards, fellowships
- Significant research experience
- Outreach

Abilities

- Ability to plan research projects
- Independence/leadership
- Communication of findings: presentations, conferences

Your task: demonstrating potential for institutional support

- Consider your research interests
- Brainstorm 2-5 ways in which your lab/MIT can uniquely support your interests
  - Technology, model systems, other lab resources
  - Intellectual expertise
  - Collaborations

PERSONAL STATEMENT

Writing for impact in your personal statement

- Discuss your experiences in a way that:
  - reflects the NSF criteria:
    - ability to advance knowledge & understanding.
    - creativity & originality.
    - qualified as an individual to do great science.
  - **coheres together to make a point.**
- Be concrete and quantitative.
- Make key takeaways absolutely clear.

Building impact: concrete takeaways

As an intern at the Amazon Conservation Team, I studied programs that conserved traditional medicine. My analysis contributed to the growth of their programs. I published my findings in an undergraduate research journal.

As an intern at the Amazon Conservation Team (ACT), I analyzed five prominent medicinal conservation programs and outlined effective strategies. I created a summary of recommendations for the program officers and subsequently authored a paper on my work.

Concrete examples

Quantify

Key deliverables

Application

Building impact: concrete takeaways

I served as treasurer and learned the importance of strategically funding groups to make a difference. Later, as President, I helped make collaborations between groups to publish a journal.

As treasurer, I managed a budget of over $40,000 and oversaw a grant program that enabled student groups to initiate new programs and travel opportunities. Later, as President, I leveraged my experiences to bring together two student groups for the purposes of publishing the first ever *Spectra*, an engineering-specific, undergraduate research journal.

Application

Quantify

Creativity, independence

Key deliverables

Building impact: unified message

Experiences in executive and judicial positions have increased my capacity for motivating students, working within or managing teams, and providing innovative policy solutions, as well as developing communication and oratory skills. […]

[In founding] the Mandarin Association of Life and Language, I have followed a steep learning curve through the struggles of organizational start-up. It has required innovating processes to motivate fellow students, generate interest, and optimize our collective education and preparation with regards to the Mandarin Chinese language by hosting various multicultural events. […] I believe these experiences have played a critical role in supplementing my technical and methodological science capacities with similarly important leadership, communication, educational and project management skills.

John's application

Building impact: unified message

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Outcomes relevant to NSF objectives

Unify disparate endeavors

John's application

Courtesy of John Casey. Used with permission.

Highlight merit & impacts

The project has **intellectual merit** in that it will facilitate photobiologists and expedite the development of precise drug delivery techniques. The **broader impacts** of the work are in its likely cooperative nature, utilizing contributions from different levels of students and partnering our department with chemists and other disciplines.

John's application

RESEARCH PROPOSAL

Writing for impact in your research proposal

Demonstrate your potential as a scientist to…

- Identify interesting and significant scientific problems.
- Design feasible approaches.
- Translate your findings into impact.

The research proposal has a standard format

Title and keywords

General background

- establish significance of problem

Specific background

- current work/approaches
- where is the gap?

Your plan (summary)

- what is new/creative?
- how will it impact the problem/gap?

2-3 specific research objectives

- stand alone, but synergize

Approach and expected results

- methods with enough detail to show well thought out
- the expected results and contingency plans
- institutional resources
- advising/lab opportunities

Impact

- intellectual merits
  - significance of problem
- broader impacts
  - dissemination
  - education

References

Establishing significance of your work

Title and keywords

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- establish significance of problem

Specific background
- current work/approaches
- where is the gap?

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Establishing significance: general to specific

As the use of enzymatic reaction pathways becomes increasingly important for drug synthesis, biofuels, and other applications, controlling and optimizing enzymatic systems represents a crucial engineering challenge. Nucleic acid scaffolds have emerged as a powerful method to organize enzymes on the nanoscale due to their programmable geometry and addressability.

In preliminary studies, scaffolding enzymes on DNA or RNA has demonstrated dramatic increases in reaction catalysis for a variety of systems. For example, one study achieved a 50 fold increase in output of a hydrogen producing pathway by organizing enzymes on rationally designed RNA scaffolds [3].

While recent studies are a promising proof of concept, the general principles that guide the design of a scaffolded system of enzymes remain unknown.

Tony's application

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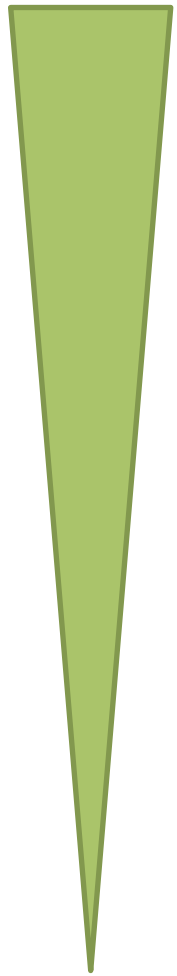
General background: establish need for field

Specific technology introduced

What has been done already?

The gap in current knowledge



Tony's application

Courtesy of Tony Kulesa. Used with permission.

Establishing significance: addressing the criteria

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Tony's application

Advances understanding
Unique & original

Research objectives should not depend on one another for success

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- establish significance of problem

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Demonstrating thinking and feasibility of your approach

Title and keywords

General background
- establish significance of problem

Specific background
- current work/approaches
- where is the gap?

Your plan (summary)
- what is new/creative?
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Demonstrating thinking and feasibility

Tony's application

This enzyme pair is a simple, well-characterized system which has been used in preliminary experimental studies by Fu, et al. at the Woodbury and Yan labs at ASU [4]. By choosing this system, the model will be verifiable by replicating data from Fu et al in [4]. Further verification can be performed with this system in collaboration with the Woodbury and Yan groups at ASU, built on the existing relationship between these labs and Mark Bathe at MIT.

Demonstrating thinking and feasibility

Tony's application

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Feasible
Potential for institutional support

Address broader impacts

Tony's application

I will **make any software and findings available to the community at large through a website to catalyze development** of new scaffolded multi-enzyme systems which are experimentally difficult to characterize and optimize. I will also work with the MIT UROP program, MIT Biomod and the MIT Biological Engineering REU program to **educate and involve undergraduates** in this emerging field. This work can also be used to build computer-based teaching examples for the MIT Educational Studies Program to **increase awareness of biotechnology and DNA nanotechnology at the high school level**, and if possible, MIT edX, which provides **free online courses** to interested students worldwide.

Advances Understanding
Creative & Original
Feasible
Potential for institutional support

Activity: Share examples of broader impacts.

Final Tips

- **Put statements in bold** if you want reviewers to see and remember them
- Brainstorm & test ideas with older students/ postdocs/faculty
- Read the solicitation carefully and use its language as much as possible
- Stay away from controversial research topics

20.416J / 7.74J / 8.590J Topics in Biophysics and Physical Biology
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