

Additional Materials for “Investigating the Effects of Vps45 Mutations Associated with Severe Congenital Neutropenia on SNARE Interactions”

Creating an Online Introductory Guide to Biomedical Grant Proposals

A Supplementary Major Qualifying Project Report
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This report represents the work of WPI undergraduate students submitted to the faculty as evidence of completion of a degree requirement. WPI routinely publishes these reports on its website without editorial or peer review. For more information about the projects program at WPI, please see <http://www.wpi.edu/academics/ugradstudies/project-learning.html>

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Introduction: This Project's Purpose

Grant proposal writing is a necessary communication skill for scientists. As a senior applying to graduate schools' doctoral programs and considering a career in academia, I realized I knew very little about how grants work. I had heard of the National Institutes of Health (NIH) and National Science Foundation (NSF), but had not thought about the specific steps needed to find a grant, apply for it, and receive its funds. For life science majors, the curriculum at WPI places plenty of emphasis on how to read and write a scientific paper, especially through the MQP, but many students may go into graduate school without any idea of how grants work. Understanding the collaborative nature and social implications of science is necessary for success because funding agencies use peer review to decide how best to allocate funds to improve society. I believe it is essential to be at least aware of the basics of the grant application process; those considering a career in academia should be familiar with grants before deciding that this is the path for them. Therefore, I decided to complete an interdisciplinary Biochemistry and Professional Writing MQP incorporating biomedical grant proposal writing research into my research in Dr. Mary Munson's lab at the University of Massachusetts Medical School (UMMS). The goals of the Professional Writing portion of this project were to:

- Develop a technical and rhetorical understanding of biomedical grant proposals.
- Use my grant researching and writing experiences to provide applicable and approachable resources for my peers.

My audience and approach

I chose as my main audience undergraduates considering graduate school and first or second year graduate students, as well as other early career scientists who are unfamiliar with the grant application process. After researching grants, I first created an online introductory guide that contains information about finding grants, writing proposals, and the life cycle of a grant for those new to the process. When I began organizing the guide, I needed to decide how to best show the information to this audience and answer the questions I had before I started researching. I initially thought an elaborate infographic or a manual would be best, but then realized that this did not serve my introductory and user-friendly aims. The guide is not meant to contain all the information needed, but to serve as a place to start for those overwhelmed by all the information out there, as I was at first. I settled on an online guide created through WordPress, drawing inspiration from the process-driven structure of the NIH website. The website's address is: <https://biomedicalgrantguide.wordpress.com/>. Figure 1 below shows a screenshot of the home page.

A BIOMEDICAL GRANT GUIDE

RESOURCES FOR RESEARCHERS NEW TO THE GRANT APPLICATION PROCESS

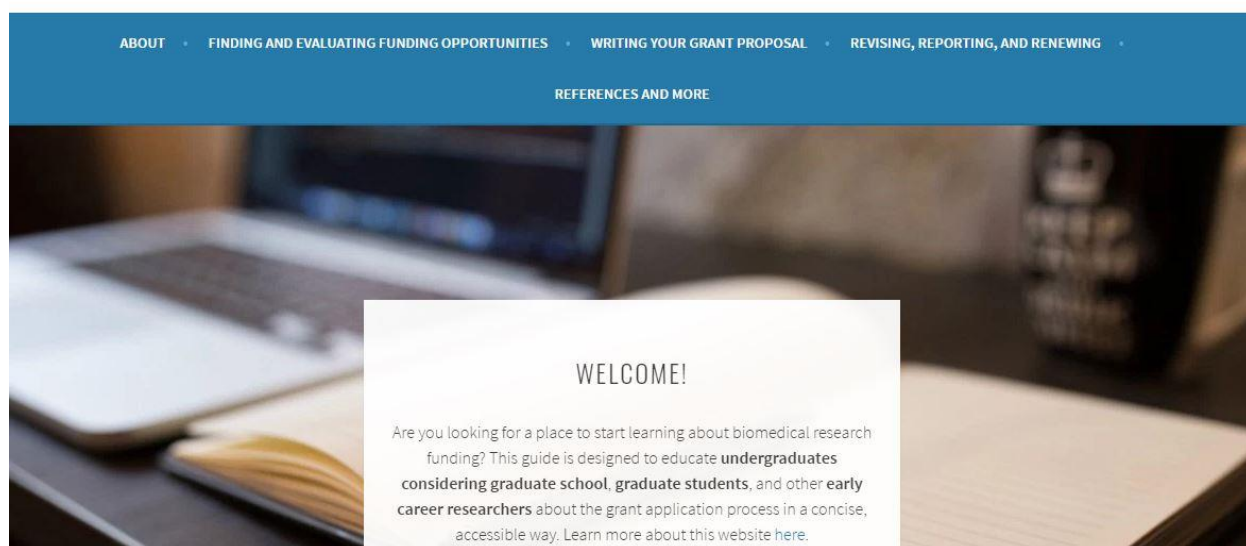


Figure 1: A screenshot of the guide's homepage, showing the five menu categories under which the pages are organized.

Figure 2 further shows the website's organization based on the three stages of the grant application process. I wanted the reader to be able to navigate through this structure to find the examples and resources they need organically, and the online platform allowed me to link between pages, as well as incorporate external links such as the NIH website or other guides. This proved very useful when it came to integrating citations for the information I summarized; instead of referring the reader to a full citation as would appear in a references list, I could directly link to the source's graph or article and allow the reader to explore related information on the webpage if they so desire. The website also allowed me to separate the information into small stages of the process on different pages, which is more approachable for the reader. Likewise, I decided to include many bulleted lists, visuals, and diagrams to summarize concepts, as opposed to solid blocks of text, as often as possible.

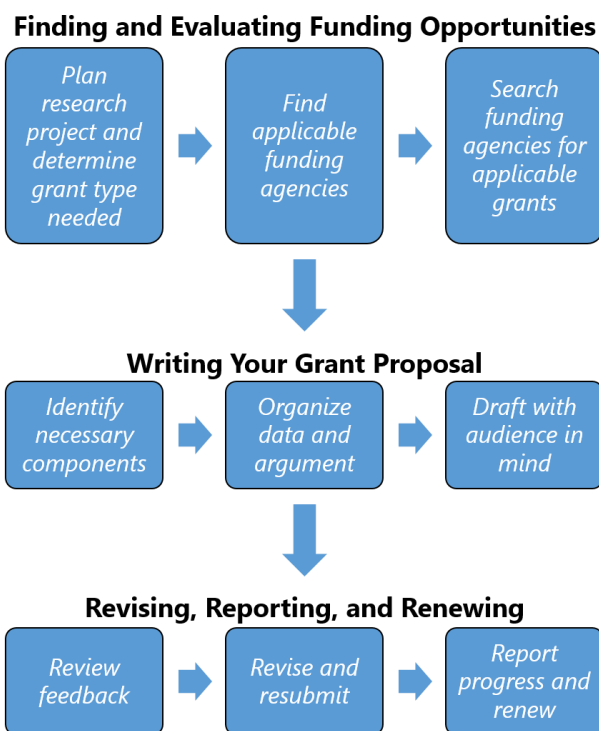


Figure 2: An outline of the website's three main sections and topics covered under each. The website also contains an "About" page (where this graphic is located) and a "References and More" section with additional links, citations, common misconceptions, and social features.

I also used what I learned informally to construct a hypothetical proposal for a fellowship, a type of grant that supports a scientist in their pursuit of a project, based on my research at UMMS. Though the guide focuses on the NIH research project grants, which are more applicable to principal investigators, I decided to write a fellowship instead for two reasons. At some graduate schools, the written portion of the qualifying exam takes the form of this NIH Predoctoral Individual National Research Service Award F31 fellowship, as you are proposing your thesis research. In addition, many of the proposal sections and rhetorical moves, strategies used by the writer to guide the reader through the argument, used to argue the study's case are shared between the research project grants and fellowships. Therefore, analyzing the R01, the most popular research project grant at the NIH, in detail with the guide and practicing the fellowship format would be most beneficial for me and my audience.

Finally, here I have reflected on the struggles and surprises I have encountered while researching grants, creating the website, and writing the fellowship proposal. While researching, I kept a journal of sources I used and topics I explored. I also recorded my reactions to information I found and my writing experiences. In many cases, this included explaining how I wanted to incorporate certain concepts into the website. Using this journal and the hypothetical proposal, I wrote this report to reflect on the project as a whole. This allowed me to highlight key points for readers who also are researching grants. This reflection is organized in terms of important pieces of advice for each part of the process. Figure 3 summarizes my methodology for this project.

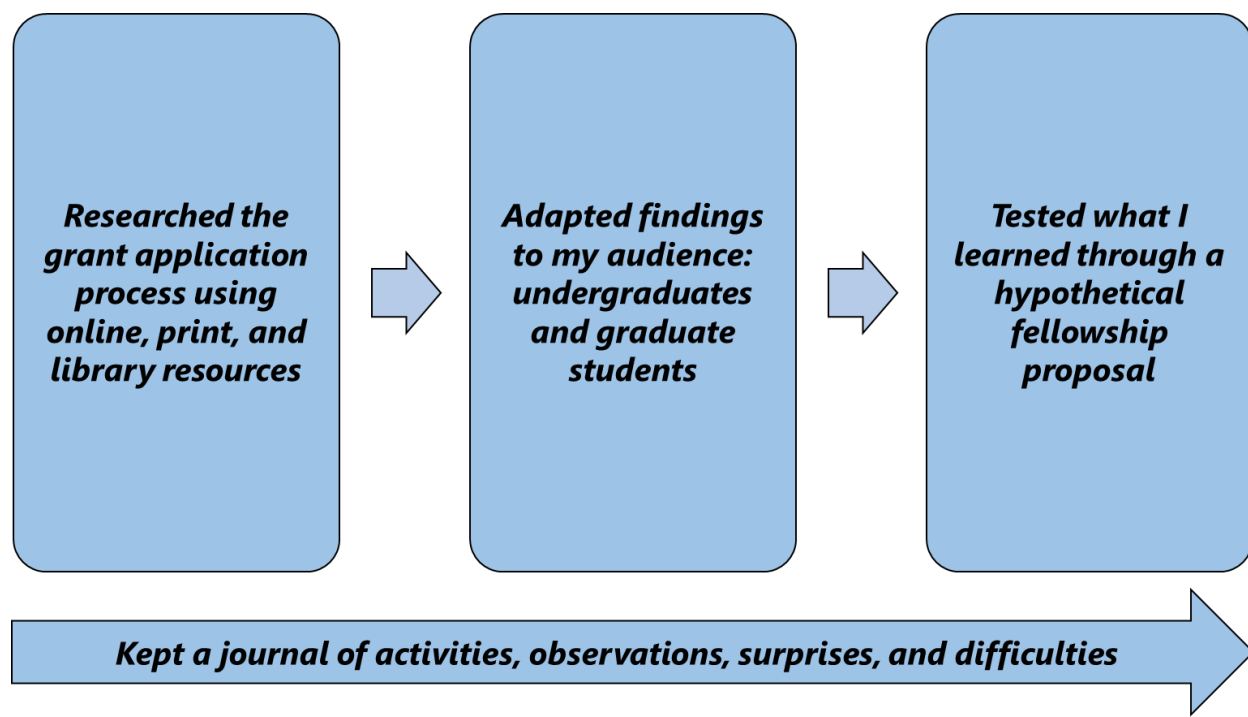


Figure 3: An overview of the activities completed during this project.

Investigating the Grant Researching Process

My first step was to determine what information my audience would need, and find a way to organize it. To do this, I needed to find where to begin myself, and I started with how to find relevant grants. I began by researching to answer some questions that I already had about grants going into the project and to create more. Who provides grants? How do you apply? Who can apply? What is included in a grant application? I used the websites of funders, university webpages, and textbooks about academic science writing for the bulk of my research, as well as discussions with professors. In addition, I met with a research librarian from the WPI Gordon Library early on in the process to learn about resources at WPI for grants.

Research online, in books, and in-person

I discovered different advantages of researching using the main three types of sources I consulted: websites, books, and in-person conversations. I found the online resources most helpful overall, since they had the most up-to-date information about the process and requirements. However, some books, though several years old, gave me a more general overview of the concept of peer-review outside the procedures of an individual funder. For example, the book *The Research Funding Toolkit* (Aldridge and Derrington, 2012) discussed grants and policies from governmental organizations that fund research mostly in the U.K. and Australia, but they were still relevant to requirements for agencies in the U.S. Another book, *Scientific Writing and Communication* (Hofmann, 2014) became very useful when researching how to write each section of the proposal. The consultation with the research librarian led me to more similar resources. We also discussed offices that handle the logistics of grants at WPI. This made me realize that each institution most likely has their own process for handling the financial logistics of grants. They likely also have people dedicated to helping researchers find grants and complete the process, as I have heard about at UMMS. Because of this, I decided not to focus on these logistical or administrative details in the website, but only make the reader aware that these are resources they should use. While someone may be tempted to rely on a quick Google search to familiarize themselves with grants, I believe that looking through examples in books and talking to those who have experience handling grants, such as faculty members or librarians, can help when researching. On the “Sources and Further Reading” page, I separated the webpages and books to further emphasize the variety of sources.

Begin with grant types and funding sources

I found that understanding grants types and applicable funding sources was an important step to provide a foundation for further research. I noticed the types of grants that were common across various agencies. For example, there is a clear difference between research project grants (what most people think of with regard to grants) and fellowships that are awarded to support specific scientists. I thought it would be important to differentiate between these grant types and

other categories. Since graduate students often apply for fellowships to support their research and they may be less well known or understood, I made sure to include information about specific programs to pursue. However, because research project grants are more prevalent, especially at the NIH, I decided to focus on those grants for the majority of the details. When I include statistics about the grants or go into detail about the structure on the website, I am referring to the research project grants at the NIH. These grants are more applicable to a scientist's career overall, and much of the advice about how to write each part of the proposal can be applied to fellowships as well.

[Start searching for grants broadly in terms of source and topic](#)

Although I had initially assumed that I should search for grants by research topic, I found it was best to start searching for individual grants broadly; many grants for basic science, and fellowships for scientists at particular points in their careers, are not topic-dependent. In terms of sources, two important funders of basic science (research not directly applicable to a disease but that contributes to knowledge in a particular field), the NIH and NSF, contain the most grants that were applicable to biomedical researchers across the board. I was initially surprised by the NSF's popular graduate fellowship opportunities that can be applied to many scientific disciplines. However, their project grants tend to focus on organismal research or engineering applications as opposed to biomedical science. One website, Grants.gov, allows you to search both these agencies simultaneously, as well as other federal funding sources. This would be a good place to start searching broadly. I also found private funders for narrower topics, such as blood disease research, but these sources offer mostly specialized project grants. For example, the Howard Hughes Medical Institute funds scientists through fellowships, as opposed to grants dedicated to the research project directly. This also influenced my decision to focus the website on the NIH as it is the largest funder of biomedical research in the world and a major funder of basic science research. This focus on basic science research also showed that searching for grants that support a specific research topic may limit results early. This is especially relevant to those researchers whose projects are less applied. On the website I made sure to emphasize using broad search terms to find these different types of funding opportunity announcements.

[Familiarize yourself with grant terminology](#)

I also found that learning grant terminology was another important component to build foundational knowledge about grants. While reading through all these sources, I also noticed that the authors used many terms that I had to look up separately. On some webpages, the words linked to a large glossary page, such as at the NIH, but in many cases they did not. For example, the written portion of the application that most people think of as the grant proposal is called the "research plan" at the NIH. However, there are other parts that are necessary for the application, such as a budget, personal statement, CV, etc. This seems obvious once you consider the finances at stake, but I decided I would include pages on each of these components to at the very

least expose the audience to them. They are not part of the research plan or research strategy, but must be included in the full grant application, showing the importance of knowing what each vocabulary word refers to specifically.

To complicate matters, I also found some words that mean the same thing across funding sources and others that are used differently. Even within the NIH, there are different terms to describe available grants. For example, NIH Parent Announcement Funding Opportunity Announcements (FOAs) apply to multiple of the 27 Institutes and Centers (ICs) the NIH includes and are considered unsolicited because the applicant decides the topic of research, whereas Requests for Applications (RFAs) focus on an area of study the IC would like to support. Other sources, such as private foundations, may use the term Request for Proposal (RFP) for their available grants in general. Federal agencies and private funders do use similar terms such as Early Career Researcher and Early Stage Researcher, but they cover slightly different ranges of a scientist’s early career. This caused me some confusion when first researching, so I thought I could help readers by either creating a glossary of terms or linking to one online, and I chose the second option. Similarly, terminology for whether a grant proposal is a new application, revision, resubmission, or renewal was not as straightforward as it would seem, so I dedicated a page to the types of applications in the first section of the website. Though these applications would not occur until after the initial proposal has been submitted, I wanted the reader to be aware of other application types that may be more useful in certain situations. To sum, learning these terms is important to build a grant-jargon vocabulary and avoid becoming overwhelmed by familiar words.

Figure 4 below summarizes the activities, key points, and their influence on the website from researching this stage in the grant application process.

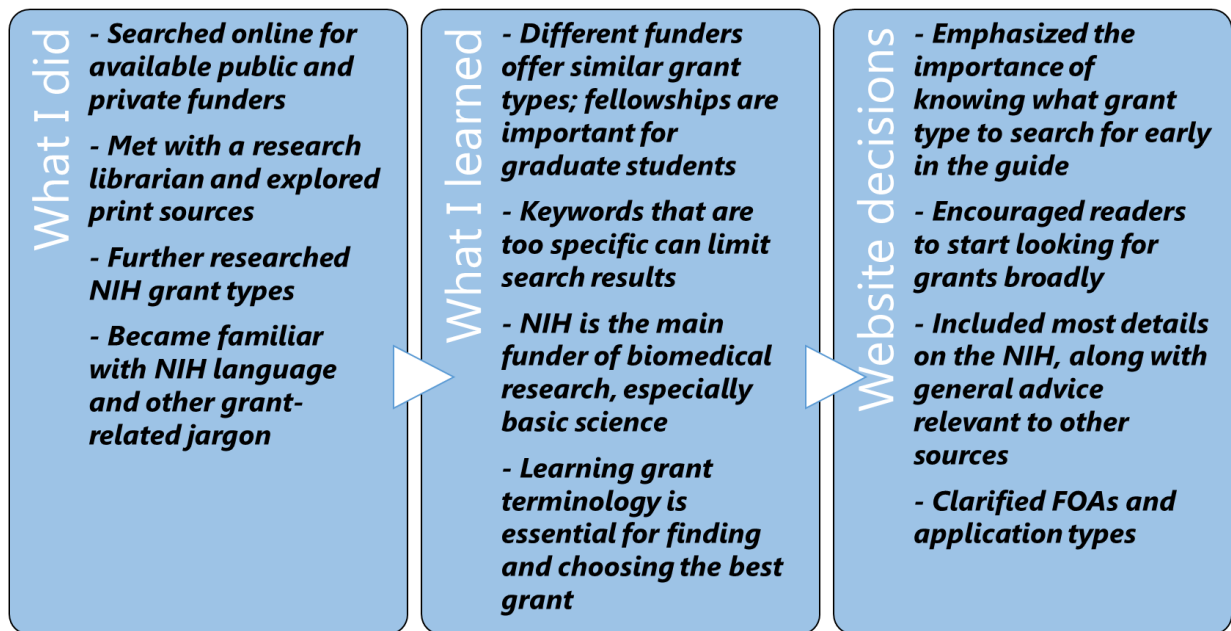


Figure 4: An overview of key points from my experience with the grant researching process and how it influenced the content of the guide.

Understanding Grant Proposal Writing

After learning about funding sources, grant types, and the application process, I began researching the procedure for writing the proposal, using the R01 as a general example. I found two full R01 applications provided by the NIH, in addition to several other related research project grants and fellowships. Using the analysis of each section of the proposal from *Scientific Writing and Communication* as a starting point, I found other online and print sources that described the general sections applicable to the R01 and most grant proposals. I also researched the reviewing process at the NIH.

Cater to your broad audience of scientist and non-scientist reviewers

Considering the many reviewers from different backgrounds is essential when beginning to write the proposal. Before starting this project, I had only heard of the “study section,” the committee of scientists in a researcher’s area of study that evaluate his or her grant proposal, with regard to the reviewing process. However, I now know about the multiple steps that contain reviewers from different parts of the NIH and with different levels of familiarity with biomedical science. Around three members of the study section particularly familiar with your area of interest read the application in its entirety and present it to the rest of the study section. The group then scores the proposal together and provides feedback to the writer and recommendations to the individual IC that the scientist’s research applies to. Based on the IC’s budget and the comments from the study section, the IC’s advisory board, comprised of scientists that are not necessarily in your field and public servants, decides whether or not to fund the proposal. As a result, I frequently brought up the broad audience of reviewers to remind the reader to be cognizant of them while writing each section. I initially had put this information about reviewers and the reviewing process in the third section of the website, since it covers what happens after the grant is submitted. However, the more I read about strategies for writing proposals and the functions of each section, the more I realized that understanding the reviewers was especially necessary at the beginning of the writing process.

Use the abstract to concisely summarize your proposal

The abstract is important as a stand-alone summary of your proposed study that is located early in the grant application. Though only around three reviewers read the full proposal, and everyone else only reads parts of it, nearly everyone reads the abstract. For some non-scientist reviewers, this may be all they read; for all reviewers, it will probably be the first part they read, so I wanted to pay special attention to this section on the website. Another unexpected characteristic of the abstract was that it is not located with the rest of the research plan within the application at the NIH. Instead, it came earlier in the application for the examples I read, for both the research project grants and fellowships. This further emphasized the importance of the abstract as a good first impression. This was enforced after I completed my Inquiry Seminar

about the content, style, and syntax of abstracts in scientific research papers. I saw many of the rhetorical moves overlap, such as establishing the gap in research and discussing broad implications of the study. I also noticed some more subtle differences, such as the level of knowledge assumed of the audience; the grant abstracts I read included more background than research paper abstracts. Since most students are familiar with research papers, I incorporated these comparisons into the guide to give readers a reference point for grant proposal abstracts.

Repeat rhetorical moves in multiple sections

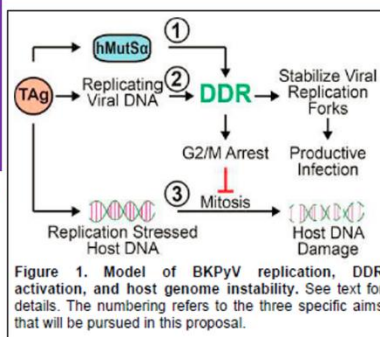
Once I moved onto other sections of the proposal, I saw that many of the rhetorical moves were repeated: background, gap in knowledge, objective, preliminary results, aims, approach/rationale, impact, outcome, and significance. Students are often taught to avoid repetition when writing, so I thought it was important to make it clear that this repetition is actually encouraged. Part of this relates to the many people who only read certain parts of the application, and some mimics the structure of a research paper. However, more emphasis is placed on the specific impacts of the proposed study when compared to the discussion section of a paper. This also relates to the broad audience; those who cannot evaluate the details of your approach will look for the “bottom line,” the importance of your study. For each section, I pointed out and explained the important rhetorical moves using the examples provided by the NIH, acknowledging the repetition by color-coding. Figure 5 below shows an example of this from the Specific Aims section of one of the grants.

SPECIFIC AIMS

Polyomaviruses are ubiquitous in human populations and cause serious life-threatening diseases including cancer, particularly in immunocompromised individuals. Currently there are no specific treatments or prophylactic approaches to target this family of viruses and their related diseases. Our long-term goals are to elucidate the fundamental mechanisms of polyomavirus replication, to understand how these viruses hijack and subvert normal host cellular processes to facilitate viral replication, and to dissect how these interactions may result in polyomavirus-induced oncogenesis.

One of the emerging concepts in the polyomavirus field is that cellular DNA damage response (DDR), which is a network of cellular pathways required for maintaining genome integrity, is essential for viral replication. The molecular details of DDR manipulation by polyomaviruses and the exact functions of the DDR during viral replication are not well characterized. On the host side, polyomavirus infection—in particular the virally-encoded T antigens—have been shown to cause host cell genomic instability, which could ultimately lead to oncogenesis. Currently, the underlying molecular source of such genomic instability remains unclear.

Using BK polyomavirus (BKPv) and a primary renal proximal tubule epithelial cell culture infection model, we have recently demonstrated that (a) BKPv activates and hijacks the DDR to promote viral replication, and that (b) BKPv infection induces host chromosome damage, but only in the absence of viral DNA replication or DDR activation. These findings lead us to propose a novel balanced model to link virus replication, DDR activation and host genome instability together (Fig. 1). The central hypothesis of this model is that an activated DDR is important for both facilitating virus replication and maintaining host genomic stability during polyomavirus infection. We propose that viral DNA replication actively drives productive infection by inducing the host DDR, thereby stabilizing viral replication forks and preventing replication-induced DNA damage on the viral genome. We also propose that the DDR is essential to prevent host genome instability during polyomavirus infection through G2/M cell cycle arrest. To test this central hypothesis, we propose the following three specific aims (Fig. 1):



- The author restates the **background**, **problem/gap in research**, and **objective**.
- The author includes more **background** and some **preliminary results** that have influenced the objective.
- Before detailing each **specific aim**, the author describes the overall **hypothesis**.

Figure 5: Annotations of rhetorical moves from the Specific Aims section of one of the example R01 grants. All rights to the National Institute of Allergy and Infectious Diseases and the grantee: Mengxi Jiang of the University of Alabama at Birmingham.

As the pages on each section became longer and started to contain subsections, I decided to include a “Dos and Don’ts” visual to summarize some of the most important points. Unfortunately these pages are much longer than the others, but my annotations of the examples and breakdown into subsections should help the reader to not be overwhelmed by all the information.

These common repeated rhetorical moves are especially important to be aware of because the organization and formatting of the grants can vary. At first I struggled with this variation in the two examples provided by the NIH. Others encountering grant proposals for the first time might also become frustrated with the lack of consistency. These differences may result from varying requirements between ICs or when the applications were submitted. To avoid this issue, I decided to focus less on the exact formatting or structure and emphasize the common subsections and connections between them, as well as the reasoning behind the rhetorical moves. I chose this focus to enforce the idea of not getting caught up by details. Besides, the NIH Application Guide explains how to format the proposal. Plus, these more general descriptions of each section’s function and rhetorical moves can be more easily translated to other funding agencies and grant types.

Figure 6 below summarizes the activities, key points, and their influence on the website from researching grant proposal writing.

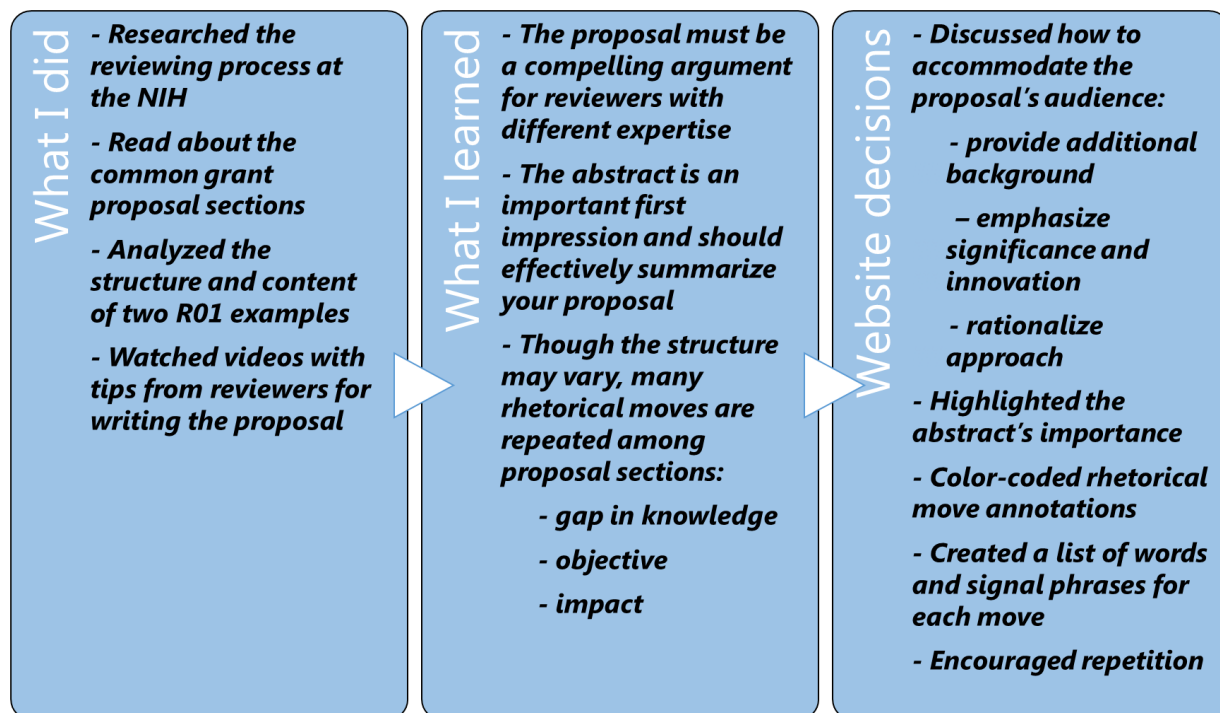


Figure 6: An overview of key points from my experience researching the grant proposal writing process and presenting that information in the guide.

Researching Steps after Submission

For this part of the guide, I learned that reviewers send summary statements with feedback and scoring to the applicant, as well as the IC to aid them in making their final decision. I read the summary statement examples provided by the NIH, which correspond to the example R01 grants. I used the summary statements and other online sources to find common critical comments. In addition to revision, I researched other options for those whose applications have been rejected. I also read about the renewing and reporting processes at the NIH for those who have been funded.

Be prepared for an initial rejection

I learned that the acceptance rate for grants is low, especially for new applications. Around 13% for new R01 grant applications are funded, but the percent nearly triples for resubmissions. As a result, I wanted to include tips for revision based on the reviewers' advice and a breakdown of the summary statement; many reviewers in videos and articles I found emphasized how important it is to understand their feedback. With this came explaining the scoring system at the NIH, in which I needed to make it clear that a good score does not guarantee funding. I know I would be excited seeing a good score, so I thought it would be important to tell the audience that this is not the end of the process.

The grant application process does not end with the funder's decision

Despite the low acceptance rate, I found several options for applicants to secure funding in addition to revising based on reviewer feedback. One surprising piece of advice I found was that in some cases it is better to create a new application than resubmit. I had assumed that revising would be the best option because the reviewers already would be familiar with the material and the acceptance rate increases greatly with resubmission. However, certain issues disclosed in the summary statement, such as a faulty hypothesis or a low impact study, may require larger changes better suited to a brand new application. Similarly, I found out that you can request a different study section to consider your resubmission if you felt like the reviewers' comments stemmed from a misunderstanding of the material. I also learned that the grantee must stay in frequent contact with the funder even after receiving the funds. For example, many federal funders like the NIH require regular reporting of progress and expenses during the course of the grant award period. After this ends, the grantee can create a new application or build off the specific aims of the initial grant. This gives the researcher more options for how to proceed after the initial grant period has ended or if they are not funded, which I thought was important to communicate to readers who may feel overwhelmed after reading through the advice for writing a proposal. To make these options clear, I divided much of the information for this last section of the guide into two branches, one if you are funded and one if you are not. This allowed me to

create a process to follow for either case. For example, this meant I could give readers a checklist of strategies if their proposal is rejected or steps to look out for if their proposal is funded.

Figure 7 below summarizes the activities, key points, and their influence on the website from researching steps after submission.

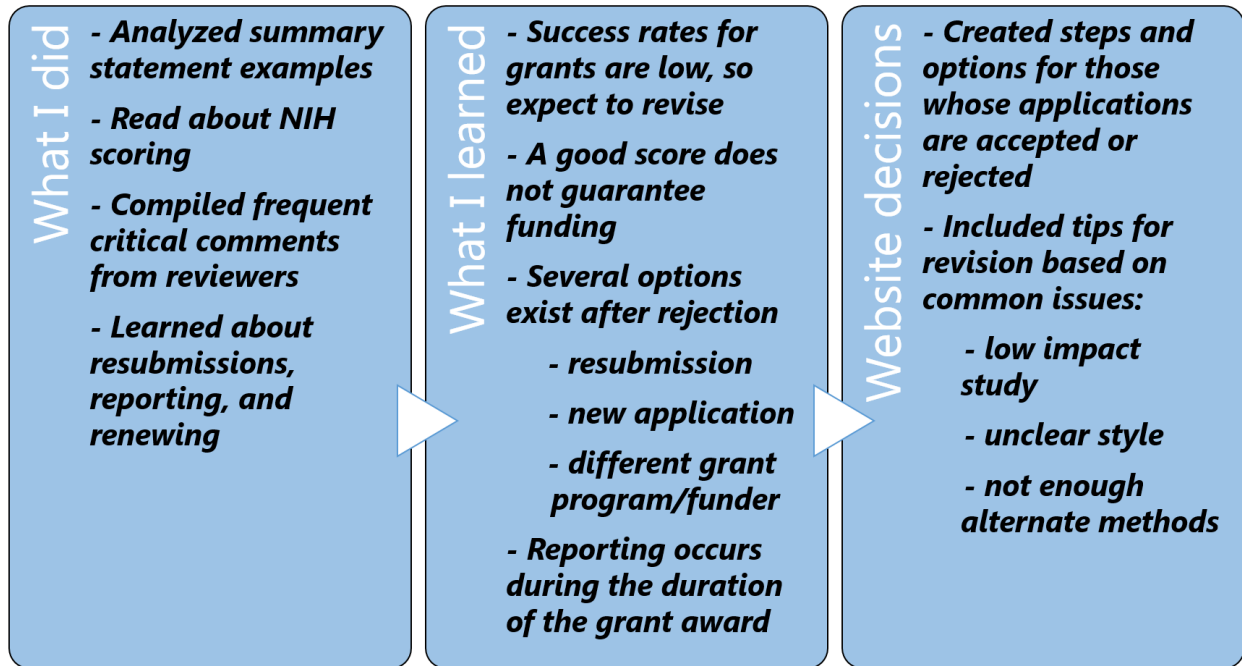


Figure 7: An overview of my experience researching steps to take after submitting a grant application and how I incorporated that into the guide.

Reflections on Instructional Writing

After researching and planning the website, drafting the pages provided additional challenges. Through this process, I learned about instructional writing and tailoring my writing style and level of detail to the audience.

Creating the guide's informal style

One of the first roadblocks I hit once I started writing pages for the guide was the style. I quickly found that my style was too academic to accomplish my goal of being approachable. I have been so conditioned to write very distantly, without first or second person pronouns and while maintaining objectivity, that it sounded like I was writing an academic essay. In future revisions, I attempted to use a more informal tone compared to my first drafts and some of the sources I had come across. This reminded me of the Technical Writing course I took sophomore year in which we learned about and practiced instructional writing. The short pages and informal address of the reader were initially difficult for me to write in those projects, but once I became aware of the issue it became easier to use the pronouns. Addressing the reader directly with instructional commands actually helped convey the information more effectively. Similarly, even though my audience for the guide may not be in the process of applying for a grant, I use “your proposal” and “your research” to make the reader think as if they were. This informality also helps the reader perceive me as a peer learning about this process as well, as is truly the case.

Choosing the level of detail

The audience also played a role in helping me decide which information to include in the guide, as you have read about. As mentioned above, my goal was to write informally about the basics of the grant application process, and then provide links to additional information. All of the information you need to write a grant proposal can be found through research, but as I found myself getting caught up and discouraged by details, I decided that distilling down to the most essential advice would be most beneficial. For example, when writing the proposal, formatting and related characteristics are lower-order concerns; the argument and organization are much more important, especially when introducing someone to a particular genre of writing. This approach was also necessary because many of the details vary between funding agencies, so the broader the tips, the more readers that the information will be applicable to. The general argument of the proposal and its sections do not vary significantly between funding agencies and even grant types (depending on the requirements), whereas the steps to submit the application and reporting process vary more. Therefore, I included more tips on the former than the latter.

The audience's role in the grant proposal and the guide

This importance of the audience is also reflected in grant proposal writing itself. Audience is always an important consideration when writing, but particularly with grants due to

the broad audience and the aim of the proposal to convince the reviewers that the research is worth funding. My understanding of this concept was strengthened by the Rhetorical Theory course I took this year. Learning about the ideas of the rhetorical situation, exigence, and transformative power of rhetoric allowed me to see how grant proposals can be difficult to write due to the audience; you must be able to persuade most, if not all, readers to recommend your application for funding, even though they may present different constraints.

Reflections on Writing the Hypothetical Fellowship

In order to informally practice the grant proposal writing process based on what I have learned over the course of the project, I wrote a hypothetical proposal for an NIH F31 fellowship based on my research for the Biochemistry side of this MQP. In lab, I investigated the effects of mutations in the SM protein Vps45, which is involved in vesicle fusion. These mutations have been associated with the immune disorder severe congenital neutropenia. I tested the way mutated Vps45 interacts with its binding partner Tlg2/Sx16 in order to understand how the mutations may interfere with vesicle trafficking in neutrophils. I used the Introduction and Results of my Biochemistry MQP report as guides for the Background and Significance and Preliminary Studies sections, respectively. I also used the abstract that I submitted to present my poster at the American Society for Biochemistry and Molecular Biology Annual Meeting to draft the fellowship's abstract. This gave me a place to start and also a convenient way to compare the grant proposal sections to similar sections in genres that my audience may be more familiar with.

Choose Background information needed to understand the study's significance

As I began to re-read my conference abstract, I realized I should only provide background needed to understand the impact of the research. I also added more about the plans for proposed research instead of only discussing the results I have already obtained. I similarly used my report's Introduction, but eliminated much of the general details about vesicle trafficking in favor of details needed to understand how the proteins I am working with interact. For example, though I removed some extraneous details about the types of SNARE proteins and vesicle transport pathways unrelated to Vps45, I kept all the details regarding the different binding sites on each protein. This becomes important later in the proposal when I discuss plans to test different truncations of Tlg2/Sx16 and compare affinity. In some cases it was difficult to determine what needed to be removed, but when I re-read the entire section after reducing each subsection individually, it became easier to revise. Along with this, the repetition between sections to remind the reader of the truncations I was using and the mutations was more natural than I thought it would be.

Focus on Preliminary Studies details relevant to Research Design and Methods

I only included preliminary results that related to the experiments I proposed in the Research Design and Methods section. When preparing to write the Preliminary Studies section, I was surprised to find that one of the two example F31 proposals provided by the NIH only referred to a paper that contained the results without pointing out the relevant assays. Though I started off following the structure of the Results section of my report, while writing I thought it was very important to guide the reader through the results and emphasize certain details because I would need to refer to them later in the Research Design and Methods section. In some ways I thought it would be easier to combine the two sections, as one of the R01 examples did with the

Approach section. But once I began writing Research Design and Methods, I found that I was referencing the same previous results in multiple subsections corresponding to each aim, so it was more useful to have the sections separate. Still, among the various sections, I was frustrated by the differences between the two F31 examples. For example, one explained the aims in more detail in that section, while one only listed them and further expanded on them in Research Design and Methods.

Revise the Aims after beginning to write Research Design and Methods

Though the Aims section was one of the first parts I drafted, I found that I needed to change them after starting to write the Research Design and Methods section. I noticed that the aims actually overlapped too much to be considered independent questions, so I had to restructure them to keep my proposed methods from being repetitive and too reliant on each other. One surprisingly easy part of writing the Research Design and Methods section was rationalizing the approach and alternative methods. Combining the preliminary results with my thought process for what I would do if one experiment did not work flowed easily. In a way, explaining the alternatives in detail made me think about the methods again but differently, which helped me come up with some other ideas.

Treat the fellowship's tone like an oral presentation

The hardest part of writing the fellowship was using first person and assertive language. To fix this, I revised the fellowship's language by treating it as if it were a formal oral presentation or conversation with the reviewers. Some first person is used in papers and other related types of scientific writing, but passive voice predominates. I believe this difference in the proposal is related to its argument and the fact that it is for a fellowship. While not overstating your results or being too ambitious with your plans, you want to convince the reviewer that you are a confident researcher. The examples frequently used "I" instead of "we" as well, enforcing the idea that the fellowship is meant to support a researcher as they complete a project.

Conclusion: Future Directions

I believe this online guide could be a useful resource for other undergraduate life science majors who would like to learn more about grants. This could complement some of the more general or engineering-based resources on the WPI Gordon Library Research Guides or appear as a useful link for students in the Chemistry & Biochemistry and Biology & Biotechnology departments. Instead of spending time reading through all the websites and other sources I encountered (and more) and becoming distracted by the details, students could use the guide to begin their research. I tried to anticipate their questions using the ones I initially asked. Once I had an idea of the different steps in the process, as emphasized throughout the guide, it became easier to find the pertinent information for my situation. That being said, since the website is available to everyone online and is not specific to grants at WPI, readers could also include graduate students who are curious about grants or are looking for a refresher. I am not an expert on grants and have never submitted one in reality. However, my position as a graduating senior studying Biochemistry and Professional Writing allowed me to research grant proposal writing and present it in a way that I would have found useful at the beginning of the academic year.

Sources and Further Reading

Below are some of the most useful sources I consulted while researching. I also have included additional resources for readers. These links and descriptions appears on the website as well. More links can be found integrated into individual pages on the website.

Online Sources

Research Training and Career Development (<https://researchtraining.nih.gov/>): This website allows you to select your career level and browse corresponding funding opportunities. The information focuses on K, F, and T series as opposed to research project grants.

All About Grants Podcasts (<http://grants.nih.gov/news/virtual-learning/podcasts.htm>): These podcasts cover many topics related to grants. This includes an “Advice for New and Early Career Scientists” section.

The NIH R01 Toolkit (<http://www.sciencemag.org/careers/2007/07/nih-r01-toolkit>): This article from Science Magazine contains more details about the R01 grant. Since it is about 10 years old, some of the specifics about submitting the grant (for example, due dates and similar requirements) may be outdated. The “Other resources” section of this article is also very helpful, including a six-article series called “How Not to Kill a Grant Application.”

NIH “How to Apply” (<https://grants.nih.gov/grants/how-to-apply-application-guide.html>): This page contains links to the SF424 (R&R) Application Guide for each grant series.

Glossary of NIH Terms (<https://grants.nih.gov/grants/glossary.htm>): This page defines many important terms and acronyms used by the NIH.

Sample Applications and Summary Statements (<https://www.nichd.nih.gov/grants-funding/grants-process/application-samples/Pages/default.aspx#r01>): Though I only referenced the R01 example grants in detail in the guide, this page has examples of other R-series grants and the F31 fellowship as well.

The Ins and Outs of NIH R-Grants (<http://www.public-health.uiowa.edu/wp-content/uploads/2014/10/R-Grants-Transcripts-Guide-ONLINE.pdf>): This very detailed guide from the University of Iowa focuses on R-series grants.

The Anatomy of a Specific Aims Page (<http://www.biosciencewriters.com/NIH-Grant-Applications-The-Anatomy-of-a-Specific-Aims-Page.aspx>): This webpage breaks down the Specific Aims section of the research plan in more detail than the page on the guide.

R01 Guide for Reviewers

(https://grants.nih.gov/grants/peer/r_awards/R01_Guide_for_reviewers.pdf): This short document gives reviewers an overview of the R01 grant program with additional links detailing the funding announcements and guidelines.

Write Your Application (<https://grants.nih.gov/grants/how-to-apply-application-guide/format-and-write/write-your-application.htm>): This is another good NIH webpage that overviews the application process with many links to additional information.

Options if Your Application Isn't Funded (<https://www.niaid.nih.gov/grants-contracts/options-if-application-not-funded>): This is one of several pages with very useful advice on the website for the National Institute of Allergy and Infectious Diseases. Check out the links on the left side of the page for others.

Books

Aldridge, J., & Derrington, A. M. (2012). *The Research Funding Toolkit*. London: SAGE Publications Ltd.

This book contained useful information about the argument of the grant proposal and how to properly plan to write. Many of the examples were from British and Australian funding agencies, but the writing process advice is applicable regardless of the funding source.

Hofmann, A. H. (2014). *Scientific Writing and Communication: Papers, Proposals, and Presentations*. New York, NY: Oxford University Press.

This book contained the most helpful information of the three I used. It broke down the general grant proposal sections, which mostly corresponded to the R01 sections I analyzed. This gave me a place to start looking for important rhetorical moves that may or may not be present in the R01 examples or described in more specific resources.

Penrose, A. M., & Katz, S. B. (2010). *Writing in the Sciences: Exploring Conventions of Scientific Discourse*: Pearson Education, Inc.

This book provided some general information about grant proposals, mostly focusing on the social aspects of science and peer-review. Therefore, this source helped me learn about the reviewing process, as well as the proposal's argument. It also contained some example proposals that were useful to peruse.