

Ph.D. WRITTEN QUALIFYING EXAM (Part 2) RESEARCH PROPOSAL GUIDELINES

Part 2: Ph.D. Qualifying Exam - Research Proposal

GOAL: The purpose of this assignment is to make students thoroughly familiar with the theory behind the techniques that they will use; to give them a complete grounding in the literature of their research field (current and historical); and most importantly, to get them to think about their research. After writing the proposal, the oral proposal defense (which must be defended no later than the end of the student's fifth semester) is the time when the student is examined about background and methods used in the proposed work. This exercise is called a **research proposal**, not a thesis proposal. The proposal will cover the expected thesis area, but is it not inconceivable that the thesis will eventually be on another topic.

This document was created to help guide graduate students through the process of writing and defending their "research proposal" (NSF-style grant application) and includes the following sections:

- A. Grant Proposal Timeline**
- B. Required Proposal Format**
- C. General Suggestions**
- D. Anatomy of an NSF-Style Proposal**
- E. Additional Grant Writing Resources**
- F. Appendix** (hardcopies of these documents are found in the "Biology Graduate Survival Guide" binder – contains examples of three different NSF-style grant applications)

Since "real" grant applications must be written using a specific format – student's proposals must be written following the guidelines specified in the attached section entitled, REQUIRED PROPOSAL FORMAT. These format guidelines will be strictly enforced. No exceptions.

The proposal normally must be defended no later than the end of the student's fifth semester (Note: only under extreme circumstances will extensions be granted by the graduate program director in consultation with the thesis advisor). If the direction of the thesis research changes significantly from what has been proposed in this grant application exam exercise, the student's thesis committee can request an additional written description of the proposed work at a later date.

A. GRANT PROPOSAL TIMELINE

To help students pace themselves as they prepare for their qualifying exam, the Biology Department's Graduate Policy Committee has provided a suggested timeline for completing your proposal (see Figure 1). It is not appropriate to halt all thesis research activities and work exclusively on this assignment during the fall semester. In fact, the more preliminary data you collect before you defend your proposal, the more convincing your proposed research will sound to your reviewers. (Note: Although this is a general rule of grant writing – the faculty understand that 5th semester students might not have generated large amounts of data – yet...) These guidelines are based on timelines faculty use when preparing their own research grant proposals. Good writing takes time – and a well-written grant (especially one that contains preliminary data and well-thought out experiments) typically takes many months of hard work to complete. This assignment is NOT one you should procrastinate on – and try to complete at the last minute. The best

proposals evolve over time and require numerous revisions. Try not to get frustrated and eventually you will be astonished by what you can accomplish if you take your time and pace yourself appropriately!

IMPORTANT DATES TO REMEMBER

On or before OCT. 15TH - PRIOR to submitting copies of your proposal to thesis committee members, research advisors **must** pre-approve all student grant applications. The research advisor is given the “final” proposal by the student no later than **Oct. 15th**. Keep in mind faculty are formally allowed 10 business days to return written work – plan appropriately. It is suggested that students consult with advisors and get feedback from their colleagues (for example, other graduate students) many times prior to turning in their “final” grant proposals for advisor approval.

On or before NOV. 1ST - AFTER the advisor has approved the student’s proposal, it is given to the other committee members for their comments. Committee members should receive their “final” advisor-approved copy no later than **November 1st**. Each committee member will return written comments to the student within 10 business days of receiving the proposal. (Please note that the comments may not be extensive – and may just simply state, “this proposal is defensible”.) All committee members must either sign-off on the proposal as defensible or alternatively ask for significant revisions. The final proposal must be approved via signatures from all committee members **before** the defense is scheduled.

Before Dec. 20th - The proposal defense date is scheduled to take place before the end of the fall semester (~Dec. 20th). Students are responsible for reserving a room (typically B207) and scheduling a time when all committee members are available to meet for a TWO-hour block of time.

AT THE DEFENSE –

At the defense, the student presents an overview of proposal orally. Since all committee members have read the proposal prior to the defense, the oral presentation the student prepares to describe their research proposal should be between 20-30 minutes long. Students are asked to answer a series of questions related to the proposal material. At the end of the defense, students are asked to briefly leave the room and the committee discusses the proposal defense. When the committee members reach a decision, students are asked to return to the room.

AFTER THE DEFENSE –

If the defense is satisfactory students will receive either, (1) a clear pass (no other action is required on the part of the student) or (2) a conditional pass (additional action is required on the part of the student). Conditional passes are given if the committee finds there is an area that still needs to be addressed by the student. For example, if a student is deficient in a specific area that the committee feels will be important for the student’s success in the Ph.D. program, they might require the student take an additional course. Re-writing a section of the grant proposal to clarify/correct a point that wasn’t clear in the original version is another common condition that can be assigned to students receiving a “conditional pass”.

If the defense is not satisfactory, the student must be re-examined within four months on those aspects of the defense indicated by the committee. Re-examination can only occur once.

Suggested time-line for Ph.D. qualifying exam NSF-style grant proposal

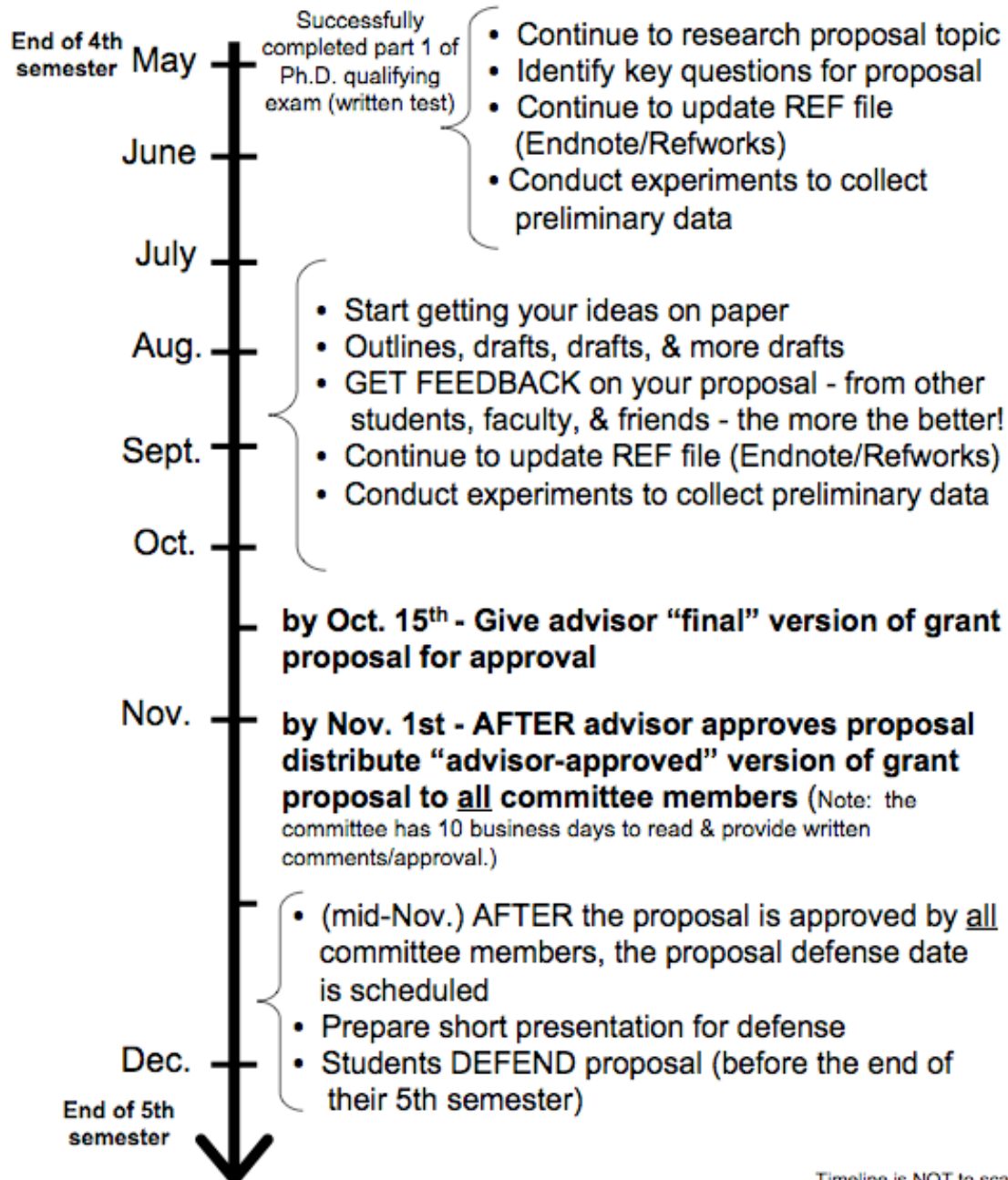


Figure 1: Suggest proposal timeline

B. REQUIRED RESEARCH PROPOSAL FORMAT (based on an NSF-style proposal)

I. Proposal Margin and Spacing Requirements

A. The proposal must be clear, readily legible, and conform to the following requirements:

Use one of the following typefaces identified below:

- Arial at a font size of 12 points or larger
- Times New Roman at a font size of 12 points or larger

A font size of less than 12 points may be used for mathematical formulas or equations, figure, table or diagram captions and when using a Symbol font to insert Greek letters or special characters. Students are cautioned, however, that the text must still be readable.

B. No more than 6 lines of text within a vertical space of 1 inch

C. Margins, in all directions, must be at least ONE inch

II. Page Formatting

Please use only a standard, single-column format for the text.

While line spacing (single-spaced, double-spaced, etc.) is at the discretion of the student, established page limits must be strictly followed. Brevity will assist graders in dealing with proposals. Therefore, your Research Proposal **may not exceed 15 pages**. Visual materials, including charts, graphs, maps, photographs and other pictorial presentations are included in the 15-page limitation (reference lists are NOT included in the 15 page limit). Students are cautioned that the “project description” must be self-contained and that URLs that provide information related to the proposal should not be used because 1) the information could circumvent page limitations, 2) the graders are under no obligation to view the sites, and 3) the sites could be altered or abolished between the time of submission and the time of review. Conformance to the 15-page limitation will be strictly enforced and may not be exceeded. Exceeding the 15-page limit will result in the immediate return of the proposal.

The guidelines specified above establish the **minimum** type size requirements; however, students are advised that readability is of paramount importance and should take precedence in selection of an appropriate font for use in the proposal. **Small type size makes it difficult for graders to read the proposal; consequently, the use of small type not in compliance with the above guidelines may be grounds for us to return the proposal without review.** Adherence to type size and line spacing requirements also is necessary to ensure that no student will have an unfair advantage, by using smaller type or line spacing to provide more text in the proposal.

C. GENERAL SUGGESTIONS

The proposal should state why the scientific problem is interesting and important, how the research will be approached, and why you the investigator are well poised to work on this problem. It is also useful to know the proposal's potential audience. Your graders will have different areas of expertise – thus, make sure you are very clear and concise with your prose. Remember that your proposal will be judged by both experts in the discipline (especially your thesis advisor), as well as generalists in the field (other members of your exam committee). The following steps are provided to help the proposal writer understand the steps that go into preparing a proposal and to share some advice that others have found useful.

Step 1 - Before You Write

Getting Started - Before you start writing the grant, make sure you have done your homework: know the field, choose an excellent idea to pursue. The summer after your 4th semester in the Ph.D. program (May – Aug.) should be spent reading the literature, talking with your advisor and members of your lab, and formulating a series of questions that you can experimentally address as part of your Ph.D. thesis project. Consider the reviewers of your proposal (exam committee members) to be "informed strangers." You must include enough detail to convince them your hypothesis is sound and important, your aims are logical and feasible, you understand potential problems, and you can properly analyze the data. Begin by focusing on the big picture. **A good proposal begins with a clear idea of the goals and objectives of the project.** In addition, a good project begins with a sense of why it will be a significant improvement over current practice.

Before You Begin

- How well do I know the field and its literature?
- Did I check the literature to make sure the project I'm considering has not been done before, or has been done and its methods judged inadequate?
- Did I brainstorm ideas with colleagues and mentors?
- Am I giving myself plenty of time to write the proposal? Good writing takes time & practice!

Developing the Hypothesis

- Most reviewers feel that a good grant application is driven by a strong hypothesis. The hypothesis is the foundation of your application. Make sure it's solid. It must be important to the field, and you must have a means of testing it.
- Provide a rationale for the hypothesis. Make sure it's based on current scientific literature. Consider alternative hypotheses. Your research plan will explain why you chose the one you selected.
- A good hypothesis should increase understanding of the topic of your grant.
- Your proposal should be driven by one or more hypotheses, not by advances in technology (i.e. it should not be a method in search of a problem). Also, avoid proposing a "fishing expedition" that lacks solid scientific basis.
- It is recommended by many reviewers that you state your hypothesis clearly as part of your research plan at the beginning of your proposal.

Step 2 - Writing the Proposal Narrative

Good writing takes TIME and PRACTICE. Do not think that your first draft will be perfect (and please do NOT give your first draft to your thesis advisor expecting she/he will say it is ready to defend....as a general rule - faculty should never be given papers that are still in rough draft form. Make sure at LEAST one other colleague, such as a senior member of the lab, has read your paper before you ask a faculty member for their comments). You will need to write, edit, write, edit, write and edit some more before your proposal is ready for your advisor to review. This is the normal process of proposal writing. Don't forget that a good proposal is always readable, well-organized, grammatically correct, and understandable (there is NO excuse for a grant that is not proofread). Your project description must contain specifics including details of experiments and/or applications. The narrative should be specific about the proposed activities. Careful writing should allow you to describe, in the limited space available, enough about your project to give the reviewers a clear idea of exactly what you plan to do and why your plan is a good one.

General Writing Tips

- Try to use the active rather to the passive voice. For example, write "I/We will develop a cell line," not "A cell line will be developed."
- Keep related ideas and information together, e.g. put clauses and phrases as close as possible to - preferably right after, the words they modify.
- Simplify and breakup long, involved sentences and paragraphs. In general, use short simple sentences; they are much easier on the reader. **Your goal is communication, not literature.**
- Edit out redundant words and phrases. Edit and proofread thoroughly. Look carefully for typographical and grammatical mistakes, omitted information, and errors in figures and tables. Sloppy work will definitely suffer in review. Reviewers feel that if the application is sloppy or disorganized, the applicant's research may be as well.
- Don't be afraid to ask for help! For many students this will be their first grant proposal – so if you feel you are not making any progress – and are suffering from writers block or need some direction – ask for help well before the deadlines for submission arrive!
- Write for a period of time (1-3 hours) and then put it down for a while and do something else. Not many writers can sit at a computer for 12 hours a day and continue to write clear, concise thoughts. This is not an assignment you should start thinking about in Oct/Nov. – you should begin the getting your thoughts on paper at the start of semester to give yourself enough time to revise your text/ figures before the deadlines outlined above arrive.
- Remember, although you will be working on this assignment - you are also still expected to work on your research – it is not appropriate (nor necessary) to take a month off to work on your proposal – doing little at time, over the course of the semester will create a much better end product. Time management is important for this assignment – plan ahead.

D. ANATOMY OF AN NSF-STYLE PROPOSAL

There is no magic formula for writing a successful grant proposal – however, you can do things that will hurt your chances of writing an excellent application. Throughout your scientific career you will write dozens (if not hundreds) of research applications and over time, you will develop your own writing style. Below we have provided a general outline that is recommended to junior faculty writing their first NSF proposal. These are general guidelines based on a **15-page** proposal but keep in mind that different scientific fields require different grant styles (how many aims, location of hypothesis statement, level of detail of the methods description...).

For additional information, see the ADDITIONAL WRITING RESOURCES section for more information – including examples of group A, group B, and group C faculty-authored NSF proposals.

1. Title

The title of the project must be brief, scientifically or technically valid, intelligible to a scientifically or technically literate reader

2. Abstract (Summary) (~250 words 0.5 page)

This is a summary of your ENTIRE proposal – and should be written LAST. Make sure that your proposal has a good abstract that succinctly states what the problem is, why it is important, and how it will be solved. In real life - many reviewers will refer to the abstract before they write a review of your proposal - so it is important that this summary is clear and well-written as it will influence the way reviewers approach your proposal. In your abstract you should: state the problem and long-term goals, specific aims of the current project, describe the methodologies proposed and the significance of the work.

3. Hypothesis statement – should be clear and well written (1-3 sentences)

4. Specific Aims (typically 2-4 specific aims; 1-2 pages)

- Your specific aims are the objectives of your research project, what you want to accomplish. The project aims should be driven by the hypothesis you set out to test. Make sure they are highly focused.
- Begin this section by stating the general purpose or major objectives of your research. Be sure all objectives relate directly to the hypothesis you are setting out to test. If you have more than one hypothesis, state specific aims for each one. Keep in mind your research methods will relate directly to the aims you have described.
- State alternatives to your hypothesis and explain why you chose the one (or more) you selected.
- Choose objectives that can be easily assessed by the review committee. Do not confuse specific aims with long-term goals.

5. Background & Significance (2-3 pages; keep it brief)

Helps the reviewer to understand the problem being addressed. Avoids jargon that only experts will appreciate. Shows your understanding of the important issues in the discipline. Presents knowledge gap to be addressed and shows the uniqueness of your approach.

Review the relevant literature objectively – but this is not a ‘review article’ – be careful of making this section too long. Restrict yourself to using materials needed for YOUR grant topic. State how your research is innovative, how your proposal looks at a topic from a fresh point of view or develops or improves technology. Show how the hypothesis and research will increase knowledge in the field. Justify your proposal with background information about the research field that led to the research you are proposing. The literature section is very important because it shows reviewers you understand the field and have a balanced and adequate knowledge of it. Use this opportunity to reveal that you are aware of gaps or discrepancies in the field. You can show familiarity with unpublished work, gained through personal contacts, as well. Identify the next logical stage of research beyond your current application.

6. Preliminary Data (2-3 pages; length will depend on how your research is going):

- Preliminary data should support the hypothesis to be tested and the feasibility of the project.
- Explain how the preliminary results are valid and how early studies will be expanded in scope or size.
- Make sure you interpret results critically. Showing alternative meanings indicates that you've thought the problem through and will be able to meet future challenges.
- Preliminary data may consist of your own publications, publications of others (evidence from the literature – make sure you cite this work properly), unpublished data from your own laboratory or from others, or some combination of these.
- Include manuscripts submitted for publication (if you have any). Make sure it's clear which data are yours and which others reported.
- Summary of data collected – NOT all the data you have collected

7. Research Design and Methods (6-8 pages approximately ½ your total proposal length is a good guide for length of this section)

Overview: Describe the experimental design and procedures in detail and give a rationale for their use. Organize this section so each experiment or set of experiments corresponds to one of your specific aims and is stated in the same order. Even holding to this structure, the experiments still must follow a logical sequence. They must have a clear direction or priority, i.e., the experiments should follow from one another and have a clear starting or finishing point.

Convinces reviewers that the methods you chose are appropriate to your specific aims, that you are familiar with them, and that, unless innovative, they are well established. If your methods are innovative, show how you have changed existing, proven methods while avoiding technical problems. Also, describe why the new methods are advantageous to the research you propose to do.

Describes how you will evaluate success in achieving your aims. Provides a flow chart of logic for each experiment's results and the subsequent steps in the research plan. Addresses sub-optimal methodologies and offers rationale for their use (controls and potential problems; do you have a plan B?). Often includes a time-table to help make organization apparent.

Approach

- State why you chose your approach(es) as opposed to others.
- If you are choosing a nonstandard approach, explain why it is more advantageous than a conventional one. Ask yourself whether the innovative procedures are feasible and within your competence.
- Call attention to potential difficulties you may encounter with each approach. Reviewers will be aware of possible problems; convince them you can handle such circumstances. Propose alternatives that would circumvent potential limitations.
- Consider the limitations of each approach and how it may affect your results and the data generated.
- Spell it out in detail. While you may assume reviewers are experts in the field and familiar with current methodology, they will not make the same assumption about you. It is not sufficient to state, "We will grow a variety of viruses in cells using standard in vitro tissue culture techniques." Reviewers want to know which viruses, cells, and techniques; the rationale for using the particular system; and exactly how the techniques will be used. Details show you understand and can handle the research.
- Make sure any proposed model systems are appropriate to address the research questions and are highly relevant to the medical problem being modeled.

Results

- Show you are aware of the limits to - and value of - the kinds of results you can expect based on current knowledge of the subject. State the conditions under which the data would support or contradict the hypothesis and the limits you will observe in interpreting the results.
- Show reviewers you will be able to interpret your results by revealing your understanding of the complexities of the subject.
- Many applications benefit from statistical analysis. The early involvement of a statistician to determine the amount of data to collect and the methods for analyses will favorably impress reviewers.
- Describe your proposed statistical methods for analyzing the data you plan to collect. Define the criteria for evaluating the success or failure of a specific test.

Figures

- Include supporting data. Where appropriate, include well-designed tables and figures. Use titles that are accurate and informative. Label the axes and include legends. Reviewers will look for discrepancies between your data and text.

8. Conclusion /Summary (0.5 page)

A conclusion summarizing why this research needs to be done, how it will help the community, why you're excited to do this... end on a high note. This is your chance to remind the reviewer about why they should be so keen on your proposal.

9. References (unlimited pages)

Pertinent literature referenced within the project description. It is strongly suggested that students use Refworks (free to Tufts students) or Endnote (as you do your background reading you will create a reference library that you will use during your tenure at Tufts –

typing out a reference sheet by hand is NOT something you should do). The references should be in proper citation format (use an appropriate journal format that you PI suggests. It is helpful to use “in line” author citations for text.

ALL FIGURES, DIAGRAMS, CHARTS, PHOTOS (ETC) ARE INCLUDED AS PART OF THE PAGE LIMITS. NOTHING OVER THE 15 MAXIMUM PAGE LIMIT (EXCEPT THE REFERENCE) WILL BE ALLOWED. THUS, MAKE SURE EACH FIGURE HAS A PURPOSE AND IS WELL THOUGHT OUT – A WELL DESIGNED FIGURE CAN BE CRITICAL TO A GRANT PROPOSAL – A POORLY DESIGNED FIGURE IS NOT ONLY CONFUSING BUT IT WASTES IMPORTANT SPACE!

E. ADDITIONAL GRANT WRITING RESOURCES

NIH Website (annotated grant):

The National Institute of Allergy and Infectious Diseases (NIH NIAID) has kindly posted an annotated and outstanding basic science R01 Research Plan and Summary Statement that was written by a new investigator (Dr. Mark Smeltzer). Although this is a different style grant than the NSF applications – the general themes are similar. This is a good reference for folks that want to really see the rationale of each section of a real grant.

<http://www.niaid.nih.gov/ncn/grants/app/default.htm> (as of Aug. 16, 2008 this document was still available)

Graduate Survival Guide binder (located in main office Dana120)

Annotated Group A, and pdf files of Group B, and Group C NSF-style proposals donated by faculty can be found in the grad. binder. Sometimes it helps to see a final grant before you start the process.

Common problems cited by peer reviewers from the National Institutes of Health

- Study not likely to produce useful information.
- Studies based on a shaky hypothesis or data.
- Alternative hypotheses not considered.
- Methods unsuited to the objective.
- Problem more complex than investigator appears to realize.
- Too little detail in the research plan to convince reviewers the investigator knows what he or she is doing, i.e., no recognition of potential problems and pitfalls.
- Issue is scientifically premature.
- Over-ambitious research plan with an unrealistically large amount of work.
- Direction or sense of priority not clearly defined, i.e., experiments do not follow from one another and lack a clear starting or finishing point.
- Lack of focus in hypotheses, aims, and or research plan.
- Lack of original or new ideas.
- Proposed project a fishing expedition lacking solid scientific basis, i.e., no basic scientific question being addressed.
- Rationale for experiments not provided, i.e., why they are important or how they are relevant to the hypothesis.
- Experiments too dependent on success of an initial proposed experiment (i.e. if Aim 1 doesn't work then Aims 2 and 3 can't be done). Lack of alternative methods in case the primary approach does not work.
- Proposed model system not appropriate to address the proposed questions (transgenic humans).
- Relevant controls not included.
- Proposal lacking enough preliminary data or preliminary data do not support project's feasibility (background from literature if preliminary data doesn't exist).
- Insufficient consideration of statistical needs (how do you know if your data means anything).
- Not clear which data were obtained by the grant writer and which reported by others (make sure you cite things that are not your ideas).

F. Appendix

Please note: Copies of the Appendix can be found in the – “GUIDE TO GRADUATE STUDENT SURVIVAL” binder (a.k.a. blue binder) located in biology main office – it is not permitted to place copies of these NSF-applications on the website (like we do with other documents available to graduate students) and are only available in hardcopy. They are not for distribution without permission of the authors. Please be considerate to your fellow students and do not remove them from the binder.

This appendix contains three examples of NSF-style grant applications created by faculty members of our department who kindly agreed to allow them to be included in this binder:

1. **GROUP A** - NSF-Career style application (annotated by K.M.; author Dr. Mitch McVey)
2. **GROUP B** - NSF-style grant application (author Dr. L. Michael Romero)
3. **GROUP C** - NSF-style grant application (author Dr. Sara Lewis)