Workshop: Writing Successful NSF Doctoral Dissertation Improvement Grants  
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Contents:

Introduction: nuts and bolts, can/should you do this?.................................2-4

Sage advice: what makes a good DDIG? what makes a bad one?......................4-9

Merit review criteria: mock panel summaries for competitive .........................10-13  
and non competitive grants
Introduction
The National Science Foundation (NSF)’s Division of Environmental Biology (DEB) and Integrative Organismal Biology (IOB) offer PhD candidates a great opportunity to apply for research money while starting a relationship with NSF. Through its Doctoral Dissertation Improvement Grant (DDIG) program, NSF awards up to $13K (direct costs) for 24 months to students meeting eligibility requirements. In this document we first provide a brief overview of the process and proposal organization, then focus most of our attention on what differentiates successful from unfunded proposals. How can your DDIG be one of the 20-35% of successful proposals? DDIG proposals are reviewed by panels composed of scientists who read, rate and debate the proposals, and ultimately recommend the best for funding. After having served on separate DDIG panels for DEB (Spencer and Heather for Ecology in 2012, Irene for Evolution in 2013), we have compared our experiences and compiled the advice below (see several similar points also raised by Skelly 2003):

Why consider writing a DDIG

DDIGs are intended to fund an avenue of research/training that wouldn’t have been possible without the funding. DDIGs are NOT intended to fund your core thesis research; rather they are intended to “value-add” by funding enhancements to thesis research that is already well underway and for which substantial preliminary data exists. Consistent with the intent of the DDIG for research enhancement, beginning graduate students do not qualify for submitting a DDIG. From the NSF website: “Allowable items include travel to specialized facilities or field research locations and professional meetings, use of specialized research equipment, purchase of supplies and services not otherwise available, the hiring of field or laboratory assistants, fees for computerized or other forms of data, and rental of environmental chambers or other research facilities.” Importantly, you CANNOT use the DDIG funds for stipends or tuitions.

Likewise, if your PI already has a grant on your DDIG topic that could reasonably fund your proposed DDIG research, you are not likely to be funded; if “existing funds” are available for the proposed work, you are disqualified. The important point being that DDIG grants are intended for enhancements to your thesis research that do not have existing sources of support.

Why else consider writing a DDIG? The fame …The glory…The practice and most importantly…Excellent odds (25-30% funding rate)

Are you eligible to submit a DDIG?

You must be a senior PhD student (that is, you must have passed your qualifying/preliminary exams and have been accepted into the program by the time that you submit the application). Funded research must fall under the purview of either of two different NSF sections: 1) The Division of Environmental Biology (and any cluster
within it) or 2) the Behavioral Systems Cluster of the Division of Integrative Organismal Systems (IOS). Read more about these sections here:

http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504676

When in doubt as to whether or not your project would be attractive to these panels, talk to your PI and then, if still concerned, contact the program officer and ask before getting started on the grant. It is their job to talk to you and guide you to funding opportunities so don’t be shy!

In your phone call, introduce yourself by your name, your institution, and your PI’s lab. Have a short elevator talk prepared that covers your proposed research and how you think it may fit in to that cluster/program. These clusters review an extremely broad range of proposals so don’t be discouraged until you hear from the top.

Contact information:
DEB Program Officer, telephone: (703) 292-8480, email: ddig-deb@nsf.gov
IOS Program Officer, telephone: (703) 292-8423, email: ddig-ios@nsf.gov

**Nuts and Bolts:**

DDIG submissions are usually due in in the Fall and this year they are due **October 10th at 5PM**. Have your documents prepared well ahead of time – the office of sponsored research requires 7-10 days lead time, and you will want to contact that office well before then (at least a month is recommended) to be assigned a grant officer who will assist you with the paperwork logistics of submitting your proposal.

**Timeline:**

- TODAY, Sept. 9: Project Summary - draft and revise
- Sept. 11: ORA deadline
- Sept. 17: Project Description - draft, revise, and perfect
- Oct. 10, 5PM: DDIG Due

<table>
<thead>
<tr>
<th>Project Summary - draft and revise</th>
<th>Context for improvement</th>
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<tr>
<td>Ask your PI and Program chair for Candidacy Letter</td>
<td>Budget, biosketch, draft and revise</td>
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Sections of the proposal:

a. Biosketch. Use your advisor's and biosketches from recently funded DDIGs in your field as a model, and don't worry if you don't have anything relevant to list for many of the sections – you are young yet. Check the relevant instructions in the current Grant Proposal Guide (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg) to make sure you get the format correct.

b. Project Summary. A new format has been adopted for this section (which you will cut/paste into text boxes on the FastLane website submission form). It contains three sections (character limited): Overview, Intellectual Merit, and Broader Impacts. To get a sense of what is required for these sections, check out the criteria for review at the end of this document.

c. Project Description. The meat and potatoes, or tempeh and noodles, if you will, of the proposal; 8 pages only. This is where you describe your proposed project, and how it enhances your dissertation. You will therefore need to introduce your existing data/project as context for your proposed enhancement, being sure to lay out the big picture conceptual framework for your research program. Just be careful not to make your core thesis the center of your proposal (once again, the DDIG is for enhancements to your core research, but does not fund the core research itself). Remember to include a delineated section on broader impacts.

d. Cited references. Make sure you used the correct NSF-style format specified in the Grant Proposal Guide.

e. Context for Improvement. This supplemental document is essential to the DDIG. This is where you highlight how the DDIG will lead to IMPROVEMENT of your dissertation. This means that 1) you must present the pre-existing research and 2) explain how your proposed project seamlessly ties into this, allows for independence from your PhD mentor, and improves the quality of your work. Also explain in this document that no other funds are available for this work.

f. Statement of Candidacy. A supplemental document generated by the chair of the graduate program stating that you have passed your qualifying exams and are now officially part of the program. There is specific language required in this letter so make sure to read the DDIG funding opportunity announcement (FOA).

g. Data Management Plan. This is now required for all research proposals, and although it may make no sense in the context of your project, you are required to submit one. How will you store and make available data collected as part of the project? Who will manage databases long term? Ask your PI if you've not seen one before and work off of that document as well as those of recently funded DDIGs in your field as models.

h. Supporting Documents. If you are collaborating with anyone else, here’s where their letters of collaboration go. They are required to follow a very specific template that is available on the DDIG FOA.
As always, make sure you thoroughly read the FOA and the NSF GPG. If you submit your materials to the office of sponsored research with enough lead time, they are extremely helpful and catch many errors but it is up to you to prevent rejection without review.

**Some useful links:**
Please use directions and links from IU Biology’s DDIG Guide page: [http://www.bio.indiana.edu/graduate/resources/DDIG_guide.shtml](http://www.bio.indiana.edu/graduate/resources/DDIG_guide.shtml)
to find the program announcement, summaries of instructions, deadlines, etc. Look in particular for:

- ORA_DDIG_tips  **explicit instructions on various sections from ORA**

Link at Stony Brook of successful DDIGs
[http://www.anat.stonybrook.edu>IDPAS/student_grants/NSFDDIG%20past%20applications%20idpas.html](http://www.anat.stonybrook.edu>IDPAS/student_grants/NSFDDIG%20past%20applications%20idpas.html)

From Joan Strassman’s blog

**Some Sage Advice:**

1. **Read the directions:**
   Roughly 10% of proposals are returned without review because they are lacking major components required (such as the Data Management plan) or because they don’t follow the directions outlined in the NSF GPG. Read the program solicitation and the GPG line by line and make sure you follow all instructions. Additionally, make sure you coordinate with the Office of Research Administration ahead of time (they like 2 weeks lead time on the budget for approval – we recommend contacting someone there at least 1 month ahead of time; 1.5-2 months lead time is even better).

2. **Know your reviewers and your panel:**
   Your reviewer is tired. Your reviewer has read at least 20 other proposals during this exhausting process. Your reviewer (largely) couldn’t care less about you or your project but is trying to quickly get through this stack of proposals before the review submission deadline. It is your job to make them care. Here are some tips to accomplish this:

   - Write assuming that your reviewers are tired and not experts in your subdiscipline.... It is important to appreciate that three panelists will read
your proposal and many (15-25) others, sometimes at the last minute (even on the airplane!), and often on subjects with which they are familiar but not experts. This situation sets a very high premium on clear, concise writing aimed at a broad audience. Proposals aimed narrowly at a targeted subdiscipline often fail, and nuance often gets proposals nowhere.

- *but* be prepared for an expert to review your proposal. Occasionally, a panelist’s dissertation or current research overlaps with a student’s proposal. In these instances, a student who includes shallow or murky methodology runs into trouble. So, this means that proposals must be written for a general audience but must also be technically sound.

### 3. What are the traits of funded proposals? Successful DDIGs:

- Ask conceptually cutting-edge, often risky questions. The best proposals usually pushed conceptual boundaries and challenged the status quo. This aspect of DDIGs made them very fun to review. NSF invests relatively few dollars per DDIG ($10K compared to, say, $300K) and therefore is willing to fund exciting proposals that might not work. On the other hand, we have seen proposals fail which seemed solid and technically sound but did not excite panelists.

- Clearly demonstrate the ability to *improve* the dissertation. Panelists look to see that the dissertation is well in progress, since it is a dissertation improvement grant, not a dissertation grant. In most cases, this means that some compelling data are needed to win over panelists.

- Are a deviation from what has been previously done by the Primary Investigator (the advisor).

- Broadly pitch the conceptually-motivated introduction on the first page. The reviewer must know what the proposal is about – and want to know more about it – by the end of the first page. Set that hook early; waiting until page three or four is too late.

- Test clearly stated hypotheses which naturally stemmed from the Introduction.

- Smoothly integrate background material to place those hypotheses into context. This background material helps to establish the promise of the dissertation as a whole.

- Very clearly explain methods that obviously relate to the hypotheses and strongly argue that the proposed research will answer the questions raised. Another tip here: if you can, make your methods a schematic (if complicated sampling regimes are being explained in text, for example, it is much easier to convey in visual form). Also, it will reduce the total number of words the panelists have to read, and for that they will thank you. While panelists are willing to fund risky proposals, they do want to know that the proposed work is logical and feasible.
• Exhibit at least some degree of independence from the advisor’s work and grants. DDIG panelists are not interested in funding the advisor – they want to fund exciting work of promising students. It may be good to strive for some degree of independence from your advisor’s program anyway; it is particularly important for successful DDIGs. This aspect of your DDIG is highlighted in a “Context for Improvement” section.

• Are visually pleasing and easy on those tired reviewer eyes. Use clear titles and subtitles, consider judicious use of gray toned shading to highlight major sections, and include well-placed figures and tables. All of these elements act to break up long chunks of text and make it easy for the reviewer to assimilate the information and help to keep them engaged.

4. A note on broader impacts:
The Broader Impacts section offers the student applicant an opportunity to highlight aspects of the research that can appeal to audiences beyond those who will read the student’s papers. You must make an effort to establish the broader implications of your research, whether they are in education and training (especially of underrepresented groups), broader scientific outreach and/or dissemination, establishing scientific partnerships, or societal benefits (e.g. applied goals, such as managing natural, cultivated, or urban ecosystems; promoting human health; etc.).

As a matter of course, all DDIG proposals have built in broader impacts. This is because they are targeting training of graduate students. Be aware, however, that most successful DDIG’s go beyond this automatic broader impact and make an effort to describe societal benefits beyond the basic training of a graduate student. This term ‘broader impacts’ refers to other societal benefits that will accrue as a result of funding the proposal. They can be direct outcomes of the proposal (such as “we are studying the cause of Colony Collapse Disorder in honey bees, the most important agricultural pollinator”; “through this proposal, an underrepresented minority will be funded”) or they can be indirect but have a benefit on societal outcomes (such as “we will actively recruit and train undergraduate women to learn bioinformatics as part of this project and as a result, will hope to increase the number entering STEM fields” or “we will create a website for the general public to follow bumble bee decline in the United States”).

Here are actual examples of good broader impacts (in no way exhaustive):

• Undergraduate training
• Significant engagement with the public throughout
• Seamless integration/incorporation of outreach into your proposal
• Software developed from this proposed project will be freely accessible to the community, and useful
• Development of a website to inform public about results.
• Participating in outreach to underprivileged students (via an existing university program)
• Community outreach featuring high school biology classes
• Outreach to managers of natural or agricultural systems

Your broader impacts should make sense in the context of your proposal. Go with something that feels natural to you. Don’t propose to work with kids if you don’t like ‘em! Don’t go crazy. Reviewers can sense when the broader impacts are overwhelming (either in time or commitment from the student) or when they aren’t well integrated into the proposal.

5. Why proposals don’t get funded (or receive poor scoring reviews)
• Work that was sound but not terribly exciting. Solid but boring = no funding. Often the problem here is the failure to place research into a broader intellectual and scientific context, or to overemphasize description rather than hypothesis-driven science.
• Lack of pilot data. Preliminary data establishes both that your methodology is sound and appropriate, and that you have the necessary skills to complete the research. The panel must be confident that the research can be done, even if the specific outcome is not yet known. We noticed that proposals with little or no prior data were rarely funded. If you do not have compelling data yet, consider submitting your proposal in a year.
• Overemphasis on Methods, and/or question and inquiry that are not conceptually rigorous. We have noticed that this problem seems especially acute with proposals involving newly emerging genomic/high-throughput or sequencing or molecular methods. Yes, these methods are exciting and can open intellectual doors that were formerly closed. However, if your proposal relies heavily on these methods, heed this warning: methods are just means to an end. The end must be feasible, logical research that asks and answers conceptually compelling questions. Poorly framed questions addressed with (meta)genomic sequencing or cutting-edge molecular technology were typically denied funding. Also, if your proposal will rely heavily on newer methods, especially those for which your laboratory is not known, make sure that you have demonstrated that you can do the work. And/or include a letter of collaboration from someone expert in the field.
• Poor scholarship, especially large gaps in knowledge of the literature directly related to the project. One obvious red flag for this problem is the ‘first time ever’ claim. This claim reads something like, “to our knowledge, this is the first study to examine adaptation in the wild”. Do not make a ‘first time ever’ claim unless you are certain that your study and/or approach is truly unique.
Better yet, why not instead emphasize the burning need to answer the question you have raised in your proposal? Panelists are often much more inspired by (and motivated to fund) proposals emphasizing the importance to solve critical problems than those making claims to novelty alone.

- Poor grantsmanship, sloppy presentation. Do we really need to say it? Always do a spell-check before submitting. Better yet, read your proposal aloud so that you can catch typos, grammatical errors, or problems in the flow of the prose, and have a friend or colleague whose editing skills you respect review your proposal.
- Minimal or non-existent broader impacts. This section will generally not kill a scientifically impressive proposal but can sink a proposal on the borderline between Fund and Do Not Fund.
- Poorly justified or non-existent ‘context for improvement’. As with broader impacts, a poor job in this section can kill a proposal – even one that is well liked may suffer.

Some more advice:

6. Do not start writing the proposal at the last minute. It shows and it does not impress.
7. Find examples of successful proposals and use them as a model for your own. You may find it useful to review a number of successful proposals to find the style and content strategies that are best suited for you.
8. Multiple modes of inference are good if integrated. Panelists seem to love work that combined multiple avenues of inference, especially modeling with data collection. We suggest that you highlight this aspect if it applies to your work. However, do not emphasize components that are not well integrated with the rest of your proposal.
9. Make sure that your advisor reads it. It is obvious when students do not get good feedback from their advisors and/or labmates.
10. Make sure that others read it, especially those who do not study similar problems. If you study plants, give it to a plankton person. If you study disease, give it to someone who works on nutrient cycling. They can note places where the proposal is not clear and does not make sense to the generally informed reader in your overall discipline.
11. Produce high-quality figures. One well thought-out diagram or graph can simultaneously show preliminary data, demonstrate your research skills, and save a substantial amount of text. It can also really help panelists if your proposal involves complex interactions (species, populations, or genes).
12. Note on resubmissions. If your DDIG is not funded the first time around, you should submit it during the following year if possible! Many DDIGs are successful on the second try. (This means that you should prepare to submit a DDIG as soon as you can in your graduate career). The second time around, indicate that the proposal is a resubmission in the text and explain how the proposal incorporated feedback from the previous review. Reviewers explicitly look for this and criticize
proposals that ignore previous comments. Reviewers know which proposals were resubmitted, and they access prior reviews.

13. Know what NSF wants to know from panelists: As panelists, we are asked to address questions in the attached review template. Make sure that someone reading your proposal would favorably review each of these criteria.

Literature Cited
If this a resubmission, how have previous criticisms been addressed?
N/A

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

1. What is the potential for the proposed activity to
   a. advance knowledge and understanding within its own field or across different fields (Intellectual Merit) and
   b. 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 sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or institution to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home institution or through collaborations) to carry out the proposed activities?

CRITERION 1: In the context of the five merit review elements, please evaluate the strengths are weaknesses of the proposal with respect to intellectual merit:

Intellectual Strengths: The panel agreed that the project was exciting with the potential to be transformative in the field of biology and evolution. The PIs propose to explore the tradeoffs between Unicorn horn size and fecundity, suggesting they are coevolved and linked across the many species of Unicorn. The system is quite neat but results will be applicable to other research systems and of broad import.

Intellectual Weaknesses: None observed.

CRITERION II: In the context of the five merit review elements, please evaluate the strengths are weaknesses of the proposal with respect to broader impacts:

Broader Impacts Strengths: The PI and student propose to involve a local elementary school in their research, taking the students out on field trips to learn about unicorn biology. The fact that Unicorns are an endangered species also increased the importance of this work, in the eyes of the committee.

Broader Impacts Weaknesses: None observed.

ADDITIONAL CONSIDERATIONS:
Please evaluate the strengths and weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if applicable:

**Context for Improvement:**
The proposed work was seen as independent of the adviser's research focus (which has largely investigated unicorn behavioral genetics). The project will expand beyond the original thesis plan (which initially began as a project to create a phylogeny of the unicorns) to now include sampling from sites around the US, Asia and Europe to enlarge the database of species used for population and evolutionary analyses.

**Data Management Plan:** The data management plan is adequate.

**SYNTHESIS AND RECOMMENDATION:**
The project will expand the co-PI's thesis project to include an evolutionary component and include international sampling to broaden its database. The project plan is supported by comprehensive modeling and a sound experimental plan is described. The Broader Impact activities are unexceptional and include continued mentoring of undergraduates in the PI's laboratory and outreach to K-12 students. The panel agreed that this study would yield results that would be of interest to many parties and may be used as a base for understanding the evolution of horns across many species. The experiments are well developed. The data management plan is adequate.

The panel recommendation is: *Competitive*

This summary was read by the assigned panelists and they concurred that the summary accurately reflects the panel consensus.
If this a resubmission, how have previous criticisms been addressed?
Although this is a resubmission the PI does not directly address previous concerns (such as the quality of writing) that persist in this submission.

The following elements should be considered in the review for both criteria:
1. What is the potential for the proposed activity to
   c. advance knowledge and understanding within its own field or across different fields (Intellectual Merit) and
   d. 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 sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or institution to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home institution or through collaborations) to carry out the proposed activities?

CRITERION 1: In the context of the five merit review elements, please evaluate the strengths and weaknesses of the proposal with respect to intellectual merit:

Intellectual Strengths: The panel agreed that the proposal addresses a compelling question in Dragon biology and evolution.

Intellectual Weaknesses: This proposal is not very well written and therefore difficult to follow the logic behind the project and design. The panel questioned the ability to generate relationships between Dragons and Dinosaurs (that is, ancestral-extant relationships) based on morphology alone for these groups of mythical creatures. Additionally, there seems to be little support at the institution for this kind of work: no Dragon rearing facility, no expert in the methods being used consulted or involved.

CRITERION II: In the context of the five merit review elements, please evaluate the strengths and weaknesses of the proposal with respect to broader impacts:

Broader Impacts Strengths:

Broader Impacts Weaknesses: Beyond the casual mention of potential undergraduate involvement, no other broader impacts are incorporated into this proposed project. Additionally, the safety of the undergraduate around these dangerous animals was not
Not competitive proposal panel summary

adequately addressed.

ADDITIONAL CONSIDERATIONS:
Please evaluate the strengths and weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if applicable:

Context for Improvement:
It's unclear how this project fits into the entire dissertation of the student – no clear delineation between previous data and how this project extends previous work was presented. Additionally, the project is very much in line with the PI’s previous publication records (although, admittedly, not involving Dragons) and does not represent a novel deviation from their research thrust.

Data Management Plan: The data management plan is adequate, although sparse. For example, how will the morphological data collected be stored and shared?

SYNTHESIS AND RECOMMENDATION:

A compelling question addressed with methods that were not deemed reasonable by the panel members. Involvement of collaborators with expertise in Dragon evolution would benefit the project and the student. Additionally, a clear delineation of previous work vs. proposed work in the context of the PhD would’ve allowed this panel to better assess the context for improvement. Finally, broader impacts could have been stronger, as could have the grantsmanship.

The panel recommendation is: not competitive

This summary was read by the assigned panelists and they concurred that the summary accurately reflects the panel consensus.