

Notes Grant Proposal Paper – (adapted from Dr Roy Ritzmann)

Overview: As with most papers in science, the grant proposal you will be writing presents an argument. In this case, the argument attempts to convince a reader (i.e. the granting agency, a role played in this case by me) that you should be showered with tons of money. To do that you must present a well-supported hypothesis or question AND convince the reader that it is an important question for the general field. Then, you must describe how you will answer that question and convince the reader that this approach has a reasonable chance of success. Finally, you must convince the reader that the results of the proposed experiments will provide useful information REGARDLESS of how they come out. For this assignment, we will pursue a behavior in a fictitious animal called a *Zottle* and its prey, the *Dufess* that I would like you to examine. The *Zottle* has been a part of this course forever. Its advantage is that within reason, it has no limitations. All cells are big enough to record from, nerves are particularly accessible to extracellular recording and it is particularly amenable to video analysis. So, restrictions are removed, again within reason. If you indicate that you are simply going to record intracellularly from every cell in the animal while it is happily performing normal behavior that would be ridiculous. So, you have to be cognizant of the limitations of all techniques, but, for the *Zottle*, it is as good as it gets in any animal. **Please try to put out of your mind that this is a fictitious animal. It should be treated as real in the proposal; just with technical advantages.** The scenario that I will present is that you are part of a group that discovered these creatures and that in order to take advantage of their technical properties, you need to compare the behaviors of choice with more conventional model systems (leech, stick insect, cockroach, mouse, cat etc.) and repeat some of the baseline studies that were done there while pointing to new possibilities. So, your strategy should be to draw upon what you know from these systems as coming from the papers we have read in class, the studies I have described in lecture and any other papers you can locate on the behaviors you choose. I will give you more details in another assignment document that will also be posted on blackboard. Nevertheless, there are considerations that you must be aware of in writing any grant proposal and that is the point of this essay.

Before I start on the grant proposal format, I want to make one very important point. I am using these writing assignments in place of exams to evaluate your understanding of the material we are talking about in class. Therefore, it is incumbent on you to demonstrate this understanding. I don't want to completely restrict you to the papers we have read. But I recommend you use them and the points that were described in discussion and lectures. If you do not, I am left wondering whether you grasped the points that we worked with in class. The topic will emphasize things like the interaction between reflex (i.e. sensory) activity and pattern generation (which we will talk about shortly). So this should allow you to discuss the material in some depth. The depth part is also critical. Just giving a reference or saying "like campaniform sensilla" does NOT demonstrate facility. In this sense, I expect a bit more depth than might normally be in a real proposal.

Format: Most grant proposals follow a format that is dictated by NIH and NSF. One actual funded proposal will be on Canvas and you can use that as a template. The format is as follows:

Notes on Re-submission and Broader Impact: Ignore this for this assignment. It is an important part of real NSF grants, but I don't want you taking up space on this.

Specific Aims: This is kind of an executive summary and it is VERY important. It is typically about 1 page and in it you must concisely tell the reader what the question is, why it is important and what the three or so goals are that you wish to meet over the course of the funding period. If this is done well, the reader is engaged, understands pretty much where this is going and has been convinced that it is important research. If you accomplish this, the battle is half won. If at this point the reader is confused

about what you are intending to do OR questions the relevance of the project to biology in general, you are pretty much dead. It's very hard to win someone back after you blow this. So, work very hard on this part of the document.

Background and Significance: In this section, you bring the reader up to speed on the field and why the question that you are addressing is critical to progress in this area of research. You MUST NOT assume that the reader is an expert, only that she/he is intelligent. The probability that a reviewer will come directly from your field of research is highly unlikely. Therefore, this is kind of a balancing act. You are actually addressing both experts and non-experts. If you don't put enough detail in here for the non-experts they will not understand the rest of the proposal or they will not appreciate its importance. Moreover, the experts will believe that you don't know the field. However, if you put too much in, the reader will be bored and (since all granting agencies have page limitations) you will not have space to describe your experiments. So, you need to give just what is needed to support your argument that the time is right for this set of experiments and that it will result in a quantum leap of information in a critical field. Granting agencies spend a lot of time making buzzwords that are in their instructions. One that is relevant is "transformational". NSF for example says it wants to fund transformational research. So, one typically sees this word sprinkled liberally around NSF proposals. Since, in this case, you know the reviewer, you should assume that I am not an expert in the field, but that I am familiar with the basic concepts of neuroethology. **IMPORTANT: This is one section where you can work in discussion of material that we have discussed in class.** That will mean that you will probably put more detail in the background section than would be the case in a real NSF grant. That's OK, again keep in mind that this plays the role of an exam.

Preliminary data: This is part of the Background section and is becoming increasingly important in real grant writing. Since agencies now typically fund at ridiculously low rates (many NIH programs are now funding less than 10% of all fundable grants and that number is dropping), they want to make sure that their money is well invested. So, they pretty much demand that the investigator has done at least some trials of each experiment and can give preliminary data at least showing that the work is feasible, that this laboratory in particular has the expertise and facilities to perform the necessary work and that the results will answer the questions that are posed. The work is called "preliminary" because it usually does not include enough trials for publication. If it did, the work would be done and it would no longer be proposed work. In reality, a strategy that is used more and more is to hold back some data from publication and describe work in the proposal that is essentially done. The notion is to always be proposing what you have already done and then work on new stuff that you will propose in the next proposal during the resulting funding period. This may seem a bit underhanded, but it is done by a lot of successful labs. In your case, I don't expect you to have preliminary data for the first assignment but it might be useful for your argument. If that is the case, it is OK to make up some data. After all this whole assignment (including the animals you will be working on) is fictitious, so what's one more thing? Just don't **EVER** do this in a real grant proposal. That could be the end of your career. For the project proposal, you will be making some observations and some of you will actually have some preliminary data, so you should include that here. Again, if you ever are in a position to write a real grant proposal, understand that you have to have preliminary data for just about everything and you **CANNOT MAKE THINGS UP.**

Methods: In journal articles, this is always a kind of blow away section. Unless you are doing similar work and need to know exactly how the experiments were done, you only need to know enough to appreciate the data that are found in the Results. **In contrast, for a grant proposal this is the meat of the document.** This is where you describe the experiments that you plan to conduct in order to reach your specific aims. You also have to convince the reader that you have thought through the process. So, in

addition to describing each experiment, you should tell the reader: (1) What you think the results will be and why you think that, (2) What it will mean if you get those results and (3) What it will mean if you DO NOT get those results. **This last point is very important.** There are two kinds of proposals that granting agencies will not fund. First, they will not fund proposals that seek to ask questions like “the sun will come up tomorrow”. If the answer is pretty obvious, why do the experiments? So, if there is little or no chance that the experiment will come out any differently than the way you are suggesting that it will, there is really no need to give you half a million dollars to test it. The second thing that they hate is experiments that are really cool if it comes out the way you thought it would, but are a totally meaningless mess if it comes out some other way. So, the argument would be “I will do A and expect X to happen. If X happens it opens the door to further questions B, C, D etc., starts a new area of science and revolutionizes the world. If Y happens, I don’t know what it means. I will take your half million dollars and go to Bermuda for three years and think about it, then get back to you. This is not a cost effective use of tax dollars. So, you need to do what we sometimes call a “gedanken” or “thought” experiment. Basically, you work your way through the logic and expected results of the experiment in your head and then explain on paper what you think will happen both if the expected occurs AND if the unexpected occurs. Then you explain how each logical outcome would be interpreted and what that would lead to. Hopefully, either X or Y lead to important directions of new research. This is another place where you can draw upon the work that we have been discussing. It could go something like this: “I will examine the effect of load on the Zottle leg by stimulating campaniform sensilla with a pin as was done by Zill (Zill et al., 2004). In that paper the authors pushed on the dome of the cs with a pin and recorded resulting motor activity then de-activated some cs sensors by destroying the dome and repeated it. Their results indicated that one set of cs were responsible for load during stance while others fired on lift off. If a single set of cs respond to both loading and unloading, this would lead us to consider the alternate model of”. This is also a place to consider **controls**. As you do the thought experiment, think about, why a reader should be convinced that the procedure that you are planning to do will result in convincing interpretations. So, for example, if you lesion the mushroom body of an insect to see if it has a role in movement and you get a behavioral deficit, you might ask whether damage to any part of the brain would cause a similar deficit. It is not hard to believe that brain damage is a bad thing. So, you would want to propose controls where equal amounts of damage are done in other regions of the brain. You would hope that these controls do not produce similar damage suggesting that the control is specific for mushroom body.

Please organize methods into three sections. One for each Specific Aim. Give each section a heading like, “Specific Aim 1: Title”.

Conclusion: At the end you should really summarize your goals and how you hope to achieve them. You don’t want the proposal to just end. That kind of sounds like you haven’t really thought things out. It smacks of, “Well, I am at the page limit so, good-bye and I hope you give me the money.” Some proposals will also include a timeline here. You don’t really have to include this in your proposals.

3. Recommended Organization

The following subheadings are recommended:

- Introduction
- Specific Aims
- Background and Significance

- Methods
- Conclusions
- References

Telling a story: Whether you are writing a grant or a paper, you are essentially telling a story and the document should have a logical story line. So, each part and each paragraph should move logically through that story line. If you are going to maintain interest, you need to adhere to that logical progression. It is very annoying for a reviewer to have to move back and forth through the document. So, each section should be what you would expect to happen next. **This is another point. It is ALWAYS a good idea to make life easier for the reviewer.** It is critical that you put yourself into the mind of a reader or reviewer. This is not always easy, because normally you are an expert in the field you are writing about. If it's a research paper, until it is published, you may be the only person (along with any co-authors) in the world who knows about this phenomenon. If you are writing a grant, you are trying to convince the agency that you are the greatest authority in the world on this topic. So, it may be hard to put yourself into the place of a naïve but intelligent reader. But you have to do that. Think about what you would need to know to be convinced. What pieces of information are critical to that end? Also, and this is important, what pieces of information are extraneous and can be removed. Reading through paragraphs of useless verbiage is not on anyone's list of favorite ways to spend a day. So, keep things as concise as possible. If you are reading through your document, constantly ask yourself whether what you just read is really necessary to the argument that you are making. If it is not, remove it. That is sometimes hard. You will have sections that you really like and really, really want to tell the reader about. But if it's not germane to your argument, you have to remove it. Tell your dog about it (he/she will always love you and everything you do), but don't clutter up your proposal. One thing that also falls into this category is important points that you really do need to make and want the reader to understand so you repeat it ad nauseam. Did I tell you that this takes the place of an exam? Well, just in case I didn't, it does. Kind of gets annoying doesn't it? It also takes up valuable space. So, when you are reading the document over, look out for things that you have repeated over and over again. Once may be OK if you make a point at the beginning of the document and need to reinforce it later. But keep it to a minimum.

If you find yourself saying, "Didn't I just say that?" a reviewer will say "All right already, I get it! If you tell me this again, I will shred this document!!!"

This notion of concise story lines goes along with "making life easier for the reviewer". Here is how a reviewer is asked to review a grant for, say, NSF. You are sitting at your computer reading a great paper, writing a great paper that has some deadline or working on a class, or you are actually doing an experiment or analyzing data for an experiment and having a really great time doing that, when your email signal comes up telling you that you have a message. Eventually, you take a break and check it out only to find that it's a form e-mail from NSF asking you to review a 15 page proposal in the next 2-4 weeks and explaining how it is critical to the mission of NSF to fund only the best research as well as the future of civilization as a whole to get these reviewed by experts such as yourself. Of course this is all ridiculous flattery, but then you realize that you either have or will soon have a proposal in to NSF and you hope that good reviewers will do a fair and credible job of reviewing it so that you have a fair chance at funding. So, you grudgingly agree to do the review. You then download the proposal and put it somewhere on your computer and, if you are smart, add it to your already full list of tasks in your to do list. After a while you start to feel guilty about not doing what you promised to do and you take it out

and start reading. The point is, you already hate the little pipsqueak who wrote this drivel and is causing you guilt and taking you away from what you really want to do. Now, one of two things happens. Either the grant is well written, concise and logical or NOT. If it is the former, the proposal contains everything you need to know and NOTHING else and it follows a logical story line leading to a convincing argument that this is an interesting and important problem and that this investigator has thought it through very well. In that case, it actually becomes an interesting and thought provoking experience. You come around to liking the author and may even be glad that you took on the job of reading the proposal. It may actually add to your life. Alternatively, the document is not logically laid out, the experiments are not thought through and the critical arguments are not convincing. There are reams of words that are not really pertinent to anything and you spend hours plodding through terrible writing to finish it. You then take great joy in ripping the document to shreds.

Of course, the first scenario is the one you, as the writer, should be striving for. This is what I mean by “making life easier for the reviewer”. If the reviewer is happy at the end, he/she will write a positive review and you stand a better chance of getting the funds. If not, well, there is always next time. You will be sent the reviews and seethe over them. One response to negative reviews is “The reviewer just didn’t get it!!!” Well, that may be true. But there are two reasons for that happening. 1. The reviewer is an idiot. That happens, not everyone is very bright. 2. You didn’t explain yourself well enough. Unfortunately, you have little or no control over number 1. It’s kind of the luck of the draw. But most agencies send proposals to more than one reviewer. The likelihood that 5 reviewers are idiots is a bit lower and tends to push things to number 2. You do have control over that. So, it’s best to try to change things to make it clearer even to idiots (without making them feel, well, like idiots).

Effective Writing: There are some stylistic issues that I find useful to consider in making a cogent document. Part of generating a compelling argument stems from effective writing. You have been exposed to many of these points in previous courses, but may not have thought about them for a while. So, here are some suggestions.

One, please use **topic sentences** in constructing your paragraphs. Paragraphs are not simply groups of words placed between random breaks. In some documents, you can almost hear the author saying, “Well it’s been a while, I think I’ll put a break here.” Each paragraph should have a common set of ideas related to a single topic that is contained in a topic sentence, typically found at the beginning of the paragraph. In a well-constructed paper, one should be able to read the first sentence of each paragraph and have a pretty good idea of how the argument is going to go. One then goes back to the rest of the sentences to find the support for these points.

Second, as much as possible use active voice. Passive voice may sound more scientific, but it typically takes twice as many words to say the same thing in passive voice than in active voice. “A dog was patted by me on its posterior.” Becomes “I patted the dogs butt.” This may seem trivial, but over the course of an entire document, it can have a significant effect. Although, you may have received instructions in various lab courses indicting that you should use passive voice in scientific papers, I can assure you that editors of scientific journals frown on it to the extent that they may change sentence structures (oftentimes altering the meaning of entire papers by leaving out little inconsequential words like “not”). That said, some of you may have had the passive voice argument drummed into you for so long that I will not take off if you use it. I just won’t like it. But then that’s ok, except for that “making the reviewer happy” bit. Also, the active voice argument can be taken to ridiculous extremes. Sometimes, passive voice is better. So, it’s not always necessary to adhere to active voice constantly.

Third, in a scientific document, things **MUST** be backed up with data. **This point is actually nonnegotiable.** The data can come from your own experiments (preliminary data) or from already

published data (from your labs and others). In the former case, you need a figure, table or some other version of data representation. In the latter, you need to present a citation and when it's important add a copy of a figure. PLEASE refrain from using phrases like "Research shows that..." or "Scientists demonstrated that..." If you provide a citation, it goes without saying that a researcher demonstrated something. They did and published the results in the cited paper. All of these things add to the 'extraneous material' stuff that reviewers hate. In this assignment, you can also take figures from the papers that you have read and insert them, but cite the source and do this judiciously, the page limit is real. It is generally considered bad form to quote long passages from already published documents. Reviewers want your ideas not someone else's. In some cases a short quote may be effective. However, if you do this, make sure you use quotation marks and cite the person you are quoting. If you do not, the reviewer will be reading it and think "Haven't I seen this somewhere before?" If they remember it comes from the methods section of some paper (maybe his or hers) then goes back and finds you lifted it from the document word-for-word without giving a citation, you are doomed!!! This could actually go beyond not getting funding directly to sanctions, failures, or in the most extreme cases law suits. Plagiarism is a very REAL concern.

Reading the Paper Over before Turning it in: One tip you might try is to read the entire document **out loud**. True, people may think you are demonstrating some psychotic tendencies, but if you do so in a closed room, you can get away with it. Alternatively, stick an earphone in your ear and people will think you are talking on a cell phone. The advantage of doing this is that it catches all kinds of awkward structure and logic flaws. I am sure you all read papers over to yourself, but it is remarkably easy to skim over sentence structure when reading silently. It is much more difficult to ignore such problems when you read it out loud. If I find such difficult sections, expect me to suggest that you read it out loud. That can be quite humorous; tragic, grade-wise, but humorous for the reader, which is ok since in the course of reading 25 of these papers, I can occasionally use a laugh. Of course, another way to catch such things is to have someone else read it. This is ALWAYS a good practice. It gets to the point made earlier about putting yourself in the place of a naïve reader. An effective way of doing that is to ask a naïve reader to read it. However, if you do this, try to choose someone who will not simply say it is wonderful to make you feel good. It's better to get your worst enemy to read it, than your best friend, unless the latter is a good enough friend to give you criticism and understands that you are a big enough person to accept such criticism. You do have to avoid having the reader also be the writer. It's one thing to have a colleague go over your work and suggest modifications to make it more effective, but having them actually re-write the document or large sections of the document is a form of plagiarism.

Format of final document: The final document must be submitted electronically via Canvas in the Assignments tab. Best would be a PDF file. However, if you want to give it to me as a Word document, I can convert it to PDF. **PLEASE include your name in the file name**. Using "BIOL 374 paper" does not distinguish it from the other papers in the class. Having your name on it does. I really would rather not have to add names to all the files.

One last thing. **Please refrain from looking at papers that were written for a previous year's class**. This needs to be your work and I frown very deeply upon plagiarism. I assure you that I have all the papers from previous classes on my computer. I don't throw anything away; especially when it comes to digital files. I will not hesitate to compare your paper with previous documents if it reminds me of something. You might get away with it, but if I find that the document is essentially a lightly veiled copy of a previous student's assignment, you will receive a 0 for the assignment and I will send it on for consideration by the University Judicial Committee. So, to quote the great American philosopher, Dirty Harry, you have to ask yourself, "Is it worth it?" If your argument is that you just looked at the previous document and it came out the same "by accident", that's not going to fly, **since I just told you to not look at documents**

from previous classes. I am providing you with this document as well as one of my grant proposals to use as examples, so you should not have to look at other student's documents. If you have questions about format or any of my tips, please feel free to come and talk to me or send an e-mail and I will attempt to clarify things.

Good luck. I look forward to reading your assignments!