<u>Research Proposals</u>

This document is a brief introduction to research proposals. A more complete discussion may be found by either talking to your mentor or visiting the WebGURU website and searching "research proposals."

Research proposals are essentially requests for financial or material support of a project. The author writes down an idea, why s/he thinks it is sufficiently important to receive support, and how the proposer intends to bring the idea into reality. Each of these concepts must be present for a proposal to receive support.

<u>The Idea</u>

The research proposal revolves around an idea: we propose to make compound X, we propose to measure the absorption spectrum of compound Y, we propose to determine the mechanism by which compound Z increases the likelihood of diabetes, and so on. Originality is central to the idea, i.e. it hasn't been done before. So either compound X has never been prepared before or the method is new. If the spectrum of Y is known, then maybe the proposal is to acquire it on the most dilute sample ever, thus demonstrating a new technique or sample preparation method. Early in the proposal, the author must convey to the reader the ultimate goal of the research. It is also important to discuss the context of the work within the realm of prior work. That is, a proposal should also include a discussion of how this idea fits into work done previously. NSF calls this part "Intellectual Merit" in its proposal guidelines.

<u>Its Importance</u>

Once there is an idea, the next question is "who cares?" or more specifically, why should the potential funder care enough to give you the resources you request rather than to someone else who is asking for them? That something is novel does not make it inherently interesting. If one knows how to make toluene from benzene by a Friedel-Crafts alkylation, making ethylbenzene by the same mechanism might be new, but would not be that interesting because the general path is already known. Ideas are important if they solve major problems. For example, catalytically splitting water into hydrogen and oxygen by sunlight would provide energy at very low cost or discovering the mechanism of a reaction could lead to the invention of new reactions. NSF calls this part "Broader Impacts" in its proposal guidelines.

<u>How will it work?</u>

Finally, you must convince the reviewer that what you propose will work. Generally speaking, the more innovative the idea, the more difficult this is to accomplish. Provide a description of the experimental pathway that will lead to completion of the goal of the research. Consider that the proposed path might not work and provide one or more alternative paths. This demonstrates that you are able to anticipate potential problems. This isn't necessary for all parts of the proposal, but rather the riskiest parts.

Inevitably, there will be more applicants seeking more support than funding is available. This means that you must convince the reviewers, and ultimately the funding source, that you have one of the best proposals and for that to happen you must address each of these questions at least adequately. There are several additions points to consider as you write the document:

1) *Do your homework*. Each claim should either be self-evident to a reviewer or referenced from the literature. 'Self-evident' claims are those that any reasonable reviewer would know (e.g. sodium ions always carry a +1 charge). If you propose to be the first person to measure the infrared spectrum of a molecule, you probably won't find a statement to that effect, but you may find references to unsuccessful attempts. In that case, you reference the attempts (and explain why your proposed method is better). Also use standard format for references. For chemistry that is ACS format (ACS Style Guide).

2) *Use all necessary references*. There is not a fixed number of references for any proposal or research paper, but this is not a minimalist activity. That is, the goal **is not** to find one reference and move on, it is to find **all** relevant references. There are few things in research sadder than spending time on working a project only to find out someone has already published the work.

3) *Do not use internet references*. You are proposing to do new science and scientific results usually go into journals. Reviewers expect journal references. On rare occasions, referencing something from the internet may be acceptable. (e.g. "For a general understanding of scanning electron microscopy, please see [Wikipedia link or a link to an SEM manufacturer or a course website, etc.]

4) *Be succinct*. This is different from writing something short and the distinction is important. Each sentence should have a purpose and extra words or flowery prose should be avoided. Avoid parenthetical/offset comments midsentence because they are distracting. It is better to write "However, the solution turned green after only 5 minutes." Than "The solution, however, turned green after only 5 minutes." Going back to extra words, the "only" should be there only if that time is unexpected and the reader would realize that. Frequently reviewers will read many manuscripts and they don't like reading unnecessary text. They may begin to skim and that could mean not catching something important written later.

5) *Use spell and grammar check*. If you want to aggravate a reviewer, misspelled or incorrectly used words are a very good place to start. Also, check for homonyms, which spell check will always miss. 'Except' and 'accept' mean very different things.

6) *Usually, abbreviations and acronyms should be defined the first time you use them*. There are exceptions, such as NMR which any chemist would recognize, but these are rare. Likewise, if an unusual word will appear only once sometimes it is better to use the definition in place of it. For example, instead of "All materials will be handled employing standard Schlenk techniques." say "All materials will be handled under nitrogen using standard airless techniques."

7) *Use your own 'pre'-reviewer*. Give your proposal to someone else who isn't an expert in your field to proofread. (i.e. If your project is in analytical chemistry don't give it to someone who is working in an analytical lab) Ask the person for feedback. If s/he says it is fine ask them to explain what you are trying to accomplish, how it will be accomplished, and why it is worth doing. If their answer doesn't mirror your intention, the proposal should be rewritten.