Original Proposal

Field Survival Manual

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Preamble

You are about to write an original proposal on a topic in chemistry. Find an area of research that you find interesting. Read about that area. Then propose some experiments to do that will forward the field of research- or create a new field of research. The area of your proposal can be anything within the broad definition of chemistry. Your proposal cannot be in an area you are currently working, such as your undergraduate or graduate school research.

Being able to devise ideas for original research to perform will be one of the biggest scientific skills you take away from Purdue University. You will look at the science around you from a different perspective once you begin looking for new areas to work in.

For the amount of work to include in the proposal, consider that you have a complete laboratory available to you and graduate students working for you full time. What you propose can be, at a minimum, work that may take 1 graduate student 1 year to complete. At a maximum, maybe 3 graduate students working for 3 years. This time frame is only a guideline. Your experiments, regardless of the results, *must* yield one or more papers in peer reviewed journals. If your big idea turns out not to work (e.g., "Ooops, I did not cure cancer with my cleverly designed compound.") you probably do not have a publication. Keep this point in mind: Your work must yield a paper.

Consider this proposal as a document you will submit to a funding agency such as the National Science Foundation or the National Institute of Health. These days funding is painfully difficult to obtain. Proposal funding rates are often below 10%. So you must convince the reviewers of your proposal that you are working in a worthwhile area, your proposed experiments are going to work, you know everything you need to have the experiments succeed, your work is significant, and everyone should be excited about it.

Expected length of the written proposal is about 10 pages single spaced, including figures, but not references. Feel free to make it longer. A little shorter might be OK. Too short and you did not do a thorough job. Five quick pages will not cut it.

Coming up with the idea for an original proposal is often the most stressful aspect at this stage in your career. It is totally normal to be worried about getting your good idea. With many of the ideas you come up with, you will later find to have already be done by someone else, in the literature. Or the ideas are just not worth pursuing.

That's OK. Keep going. This exercise will help you think about relevant research that is novel and interesting.

One of the most fun parts of being a scientist is having the ability to come up with new areas to explore and then pursue them. So be creative. Have fun with this proposal!

Why We Are Having You Write a Proposal

-Coming up with your own research ideas changes your perspective on science.

At your current stage, for the most part, you may be running projects and doing experiments that someone else thought of. But you will look at the world differently once you have to come up with the ideas. Rather than reading a paper passively, you may then start to think what *you* would have done differently. Or where you might take that work next. Or you may have a spark of an idea for a new project that is only slightly related. Provided you put solid effort into this proposal, I promise that you will think about science very differently afterwards. Your thoughts will shift from passive to active. You will be a more mature scientist.

-With a Ph.D., you are always writing proposals.

Be it in industry, government, or academics, you always need to justify what you are doing, at the very least. Or more likely, you will find yourself always writing proposals to try and gather the resources needed to accomplish your research. Resources are tighter each year, so writing proposals is a higher and higher percentage of what we each do.

-The more proposals you write, the better you will get at this.

Your second proposal will be much better than your first. Unbelievably better. You will see. My proposal writing continues to improve even today.

-The more proposals you write, the less stressful they become.

Writing this proposal will be a pain. But I guarantee that your future proposal experiences will be less stressful because of this OP effort.

-In the real world, very few proposals are funded. You want to get good at doing this, very quickly.

Recently I served on a grant panel. We had 65 proposals to review. We could fund only 5. That works out to be less than 8% funded, or about only 5 people from your entire graduate student class in chemistry. In that pile of proposals, there were 2 that I found to be weak. The remaining 63 were all totally solid science. Nothing major to complain about. So how do you get your proposal to be among the 5 that are funded? By having very good ideas, writing about them very well, and conveying excitement for your proposed science. Start getting good at these skills now.

-No one told me any of these things.

As a principal investigator, a huge percentage of my time is spent writing grants. I had to figure out all of these things on my own. It would have saved me a lot of heartache if I knew all of this information ahead of time.

A Recommended, But Not Required, General Format for a Proposal

-Abstract

A summary of everything in the proposal. About 1 paragraph, maybe 1 full page at most.

-Specific Aims

The 2-4 specific things you are trying to achieve with your proposed work. About 1 paragraph up to 1 page. These days the Abstract and Specific Aims are often combined or the same thing.

-Background

Explain what area you will be working in, what is known and what is not known in this field, etc. Maybe 2-3 pages. Use a funnel approach- start with all of science and then focus down toward the topic of your proposal. Note: Some things need less of a sales pitch than others. You do not need 2 pages saying how bad of a thing cancer is and why we must cure it.

-Significance

Why people should care about the work you want to do. You can mention applications that may come from your work, fundamental insights that will be gained, etc. About 1-3 paragraphs.

-Preliminary Results

Work you have already accomplished to help support the feasibility of your work. As funding gets tighter and tighter these days, you need to show people that your project is already working. Great ideas with no supporting data do not really get funded. For your OP you do not have any preliminary results. But if you did, here is where they would go.

-Research Design and Methods

Exactly what you will be doing in the laboratory. Provide explanations of all the experiments you will do, exactly how the work will be carried out, the type of data you will obtain, ways to interpret the data, etc. Here you must convince the reader that you know what you are talking about and that you will be able to make everything work successfully. Subdivide this area to a given category of experiments (e.g., synthetic models versus work with a protein, both of which will be performed). Within each area of experiments, you may want to subdivide the <u>Design</u> (i.e., the thinking behind these experiments) and <u>Methods</u> (i.e., what you will actually do in the laboratory) portions. You cannot simply say you will use a method from a reference. Explain what you will actually be doing. This

approach shows the reviewers you actually know what you are talking about. About 6-12 pages.

-*Future Directions*

An optional section. Most proposals do not include this part, but I like to. A place to show the reader that you have ideas beyond the exact experiments presented in the proposal. To convince the reader that you have lots of good ideas, that your proposal is the start of many great things, is an area of research with a great future, and funding your current grant is an investment in a bright future. About 0-2 paragraphs.

-*References*

You need to cite all of the prior work in your area. A full NSF or NIH proposal may cite 100-250 references. Provide a citation to every sentence that is not your own thought. For examples of how often you should be citing the literature, have a look at a few full papers (not communications) in the *Journal of the American Chemical Society*. References need to list all authors and the title of the article. There are many different formats that you can use. Here is a good example:

(10) Kamino, K.; Odo, S.; Maruyama, Y.; "Cement Proteins of the Acorn Barnacle, *Megabalanus rosa*" *Biol. Bull.* **1996**, *190*, 403-409.

Proposal Abstract

Typically, a proposal abstract is a one paragraph summary of your whole proposal. (Abstracts for NIH proposals are a full page.) Here is a rough outline or format that you may (or may not) want to use:

A) Some background on what area of science you are working in.

B) What some of the pressing questions are in this area.

C) How you will answer these questions. What you will be doing on your laboratory. The experiments you describe in the abstract might be general mentions of the type of experiments you plan, but need not be too specific.

D) What all your efforts will tell us after you are done. How you will save the world, foster world peace, etc.

A few literature citations for an abstract can always be nice. But they are not required here.

All proposals and abstracts need to have titles.

Figure are nice to have in abstracts. I see them only rarely but everybody likes a pretty picture and they help explain your ideas. Plus no one loves reading big, solid, intimidating blocks of text.

Some Things That You SHOULD Do With Your Proposal

-Make your proposal hypothesis driven

Think along the lines of "I hypothesize that..." You are proposing something based upon a solid background. Then you go and study what you think is a good, logical, solid direction as a result of this prior information. Many agencies require proposals to be "hypothesis driven." Sometimes they will say that "exploratory research" is OK. But even when they say that exploratory research is OK, it often is not. You do not want your proposal to be called "a fishing expedition." Present a clear thought process and logical place to go, via a starting hypothesis.

-Make it exciting for the reader.

You are trying to convince the reviewer that your proposal should be funded and that the other 9 s/he is reading should not be funded. So you'd better make an excellent presentation.

-Show lots of pictures.

People like to look at pictures. No one loves having a package of solid text describing someone else's science dropped onto their desk for a thorough reading and critique. Reading page after page of solid text gets painful. Especially when the reviewer has to read ~30 proposal at once. Also, pictures are worth many words. (I forget the going rate- inflation, you know.)

-Provide backup plans.

Your experiments seldom work exactly as planned. If you are stuck, then what? Convince the reviewer that you are completely on top of things. If Experiment A is inconclusive, that is not a problem. Because we can get the needed information by using a different technique with Plan B…

-Make it easy for the reviewer to read.

Use lots of big headings, lots of pictures, break up the text, use subheadings. An example of a recent proposal that I wrote is provided at the end of this packet. Do not make the reviewer have to flip back and forth to figure things out. If you make the reviewer work to get the needed information, your proposal will not be funded-guaranteed. By contrast, if your proposal is a pleasure to read, a warm, fuzzy feeling is generated and your odds of being funded go up. Reviewers are humans and resources are limited. Generating the warm fuzzies plays a big role in science.

-Remember that reviewers have little time to read your proposal.

Sure, you poured your heart into writing this thing. The reviewer is also pouring his/her heart into writing his/her own proposals to keep their lab surviving. Reviewing proposals is something we have to do, but we do not get release from any other responsibilities to do it. So we might take all ~65 proposals needed to be reviewed and churn through them all on one, rainy Sunday. If the reviewer spends 5-15 minutes on your proposal, you really want to make it easy to follow along (e.g., headings, figures, not having pages and pages of solid text, etc.)

-Think about your proposal from the reviewer's perspective.

Really, it only matters what the reviewers think. That will decide the fate of your proposal. So as you are formulating your research ideas and as you are writing, keep asking yourself how a reviewer might think about it. That's why having one of your peers review your proposal is a good idea. On a related note: "Write your own review." Think about what the reviewers are looking to extract from your proposal for their review. Tell them exactly what they are looking for and what nice things they should be saying about your proposal.

-Make a system that does something unique.

Nobody needs a new drug that works the same as an established one but takes 5 extra steps to synthesize. Go after something different, unique, and interesting. It's more fun that way- for you and the reviewer. And if it's more fun to you, make sure that enthusiasm comes across. If you are bored with it, that will come through.

-Maybe pick an end goal and work back from there.

Avoid forcing a system to do something it's not good at. Rather, think about things from an unbiased perspective of what you are trying to do/design/learn. What would the ideal approach be? Take that route. Forget about the compounds or methods that are already known.

-Provide your research plan with focus.

Your new compounds may have the potential to do many things. But you need to pick something of particular interest. Just saying that your compounds will be good for many things (anticancer, antiviral, antibacterial, antiboredom, etc.) is not very satisfying to read. We want to see something done. We want to see that the work has been given thought. That there is a specific end goal. That you want to reach that goal. You are making new compounds for a reason, not just for the sake of making them.

-If the method you need does not exist, invent it.

Many exciting new methods were developed by people who needed them- not by people who just like to make new methods or instruments. You can make a great proposal by trying to answer a question with a new technique.

-Pick a topic that fascinates *you*. No need to save the world.

If you think that some aspect of some scientific problem is fascinating, go with it. You do not need to cure a disease to make a good proposal. If you really are excited about a research topic, that enthusiasm will come through. If you are not excited, that also will come through. Your idea probably won't cure cancer, anyways. So it's likely more fun to read an enthusiastic proposal about a very narrow topic than a proposal aimed at curing a disease but the author and reviewers know that it will never work.

-Imagine that you have unlimited resources.

Dream a little. Does your proposal require DNA from the toenails of *Tyrannosaurus rex*? Fine, you've got it. Do you need a team of 100 sherpas to collect your plant samples from the side of a mountain? Or maybe the creatures you want to study are 1,000 feet below the surface of the ocean. No problem. For the purpose of your first proposal here, let's say that you can get whatever samples, equipment, people, supplies, space, and funding you need. For the moment, your creativity has no practical limits. Note, however, that this opinion is mine and other faculty may want to see something very practical and less dreamy. See the next point, below.

-High risk, high reward versus low risk, low reward.

The ideal proposal would be guaranteed to work and of extremely high impact. Such ideas are scarce. So we end up existing somewhere on the spectrum between high risk, high reward, highly creative to low risk, low reward, not very creative. So where should you land on this spectrum? This question is difficult to answer. Personally, I love to see a student really step away from the crowd and propose something really creative. I will cut her/him a lot of slack in terms of whether or not the idea would actually work if there is a lot of creativity there. But many of my colleagues think that a proposal with a high chance of crashing and burning is bad, regardless of how creative it might be. Subdisciplines within chemistry can view this topic differently. If you are trying to decide where on this spectrum to be, it might be worth having a chat with your committee members to feel them out and get their opinion on the matter. That said, you are who you are. If you have a particular passion for a topic, that enthusiasm will carry you far in everyone's eyes, including your own.

If you pick a boring topic just to please others, the process and outcome will not be good for anyone.

-Write your proposal backwards.

Write the Research Design and Methods section first. Then you will really know what the Specific Aims are going to be. Which then gives you the context for the Background. And then you will know which aspects of Background, Significance, and Preliminary Results to emphasize. If you write from the beginning to the end, you may begin writing with how to you think that the proposal will progress. However, the context and specifics will change a bit when you are working out the real details in the Research Design and Methods section. So write the proposal backwards.

-Relax. And have some fun. At least a little. Just try. Please.

Stop hyperventilating. The majority of students do a great job for their first proposal. And pass their OP. I am placing this proposal in the context of real world grant writing because that is where you will be after you get your Ph.D. So start thinking about these things now, with your first major effort. But unlike the real world, more than 10% of you can pass. Now have fun with this. Science is creative. The coolest projects are those that you are most excited about- those that you created yourself.

Some Things That You Should NOT Do With Your Proposal

-Do not copy figures or schemes from another source.

Even if you cite the source it does not look terribly professional to just paste in what someone else drew. It makes you look lazy. Doing so may be technically correct, but it pisses people off.

-Do not make hypothetical, theoretical, or anticipated plots of data you expect to obtain.

Although it may be a good visual (and good visuals are usually excellent to include), reviewers do not respond well to such plots. Maybe the impression comes too close to fabrication of data. Use regular text to describe correlations in the data that you anticipate. I have seen people include hypothetical data plots that are the perfect line (or curve) and also with expected noise in the data. But in every case reviewers have not responded well. Again, it may be technically correct but based on what I have seen, it is a bad idea to do it. As you are starting to see, much of science has nothing to do with experiments and data. Successful science requires a great deal of interaction with other people.

-Do not cite web pages in your references.

Come on people, science is serious stuff. You read primary research papers and learn from them. That's where the real, cutting edge science is. You do not Google for a while and think that you know a field. You are trying to give the reviewer the impression that you are a serious scientist and that you have a good command of all relevant literature in the field. Especially when you are asking for a million dollars. Cite actual papers. Do not cite any paper that you have not actually read. You can get in trouble that way. When I used to have proposal writing as part of a graduate course, here were some special grading considerations:

For every web site you cite, you lose half a letter grade.
For every Wikipedia citation you lose a full letter grade.

-Do not cite only ~5 review papers and think you are done with references.

You need to convince the reviewers that you have a good command of the primary literature in your field. If you do not, they will not be convinced that you know what you are talking about. As mentioned earlier, a 15 page NSF proposal can have well over 100 references.

-Do not start out thinking that you are such a genius that no one has ever thought about your research topic before.

Read the literature. A lot. Go back in time. It turns out that there are decades and decades worth of very rigorous research published by really smart, hard working people. Who knew? Just

because you guess that it's an original idea or that you don't see it on Google does not mean that it was not done. Many young students ignore all papers that are older than the internet. Us old folks from the days of paper (and stone, hammer, chisel, dinosaurs) spot that a mile way. Do not fall into that trap.

-Do not propose trendy work just because it is trendy.

In the 65 proposals I had to read once, nearly 20 of them were focused on some aspect of nanoparticles. They broke down into two camps: Solar energy capture and sensors. All those proposals just blended together. I could have exchanged parts of one proposal for another and even the authors may not have noticed a difference. I got the impression that even the authors did not really have any passion for what they were proposing. They just needed an idea and nanoparticles were in front of everyone's face at that time. Be creative! Stand out from the crowd! Propose something exciting and original!

-Do not be arrogant.

Although it is not common, some people really come across as a horse's ass in their proposals. One recent example: I was reviewing a proposal wherein the author stated "I will completely change the prevalent paradigm of this field by…" Oh really, buddy? You are such a genius and everyone else working in this field for decades is a dolt? Not on my dime you don't.

-Do not copy part of your proposal from another grant.

(Or if you do, do not make it obvious.) I have reviewed proposals where the author was blatant in copying forms from a different agency's proposal, to fulfill the information required for the current proposal. If you are asking for $500,000 and only 1 in 10 proposals are going to be funded, I need to see that you are taking this submission seriously. Copying and pasting looks lazy and will not get funded.

-Do not be lazy and think "Oh, they will figure it out" or "Oh, they will understand."

No they will not. Definitely not. With a funding rate of, say, ~10%, you have to reject many, many proposals that are top notch and perfect. If there is anything at all wrong with your proposal, you are out of the running. Perhaps more importantly, the reviewers simply do not have the time to work through problems with your proposal. If it takes too long to read or understand, you are rejected. If a reviewer has to read a paragraph twice to understand it, they will not take the time. If everything throughout the whole proposal is not clear upon a quick reading, you are out. Make it perfect or it is rejected.

-Do not assume that reviewers will give you the benefit of the doubt.

They most certainly will not. Because only very few proposals can be selected for funding, reviewers look for ways to destroy proposals. One (of many) ways is to take a "guilty until proven innocent" approach. They will assume that you do not know what you are talking about- unless you can show them otherwise. You may be a young, hot shot faculty member at a high class place like Purdue and think that the reviewers will figure you must be pretty bright and have access to the best of facilities. Nope. If you do not explain to them how to do every experiment that you propose, they will operate on the assumption that you do not know. Or maybe that you plan to figure it out only when you get there. Not good enough. You need to show them that you have thought through everything. For example, do not simply state that you will use a literature procedure to obtain your goal. Give a brief explanation of the methods involved. And then tell them about the backup plan you have in place in case you run into problems. Also tell them that you have access to all of the required equipment. Only then will they believe that you have thought things through, that you know what you are talking about, and you can actually get the work done. Then they might consider being impressed.

-Do not propose the next, logical step from the current literature.

If you think it's the next, obvious thing to do from that last paper you read, the people in that lab probably have the same idea. Maybe they've done it already and are writing up their paper now. How do you know if it's really the obvious next step…? If you have read enough of the literature and if you are honest with yourself, you will know. Try to do something different.

-Do not have interdependent aims.

If Specific Aim #1 does not work, you still need to be able to carry out the work of Specific Aim #2. Otherwise your whole proposal collapses. Having interdependent aims will bother some reviewers more than others, but avoid them if you can.

Some Help with How to Pick a Proposal Topic

Getting the kernel of that idea you will work with is the most difficult part, at your stage. It's normal to be anxious about this part. Once you have a viable topic and experiments to do, it's simply reading the literature, devising your experiments, and writing. But getting that idea can be tough. Some tips that may help:

-Start finding your idea now.

You cannot rush this one. It's not like an exam where you can cram all the material into your brain in one coffee-crazed night. (Come to think of it, that never works, either.) You need to think a lot, read a lot, think some more. You will get an idea, think it's amazing, then think it's horrible, then realize it's wonderful. After that idea dies a tortured death, the cycle will repeat with others. A good idea comes with time and thought. It's more like wine and less like milk. If you leave this stage until the last minute, your stress level will increase and your ability to actually come up with a worthwhile idea will then decrease.

-What research area do you think is simply exciting?

You will be spending a lot of time working on this proposal. Why not make it enjoyable? So pick a topic that you are excited about. Sometimes fun experiments come from combining two (or more) research areas that have never been combined before. Could be fun, eh?.

-What research area have you always wanted to learn more about?

Is there some topic that you have wanted to learn more about? Life gets busy and you may not have the time later to just sit down and read about science. So use this proposal as a chance to immerse yourself in a given research area.

-Think about your hobbies.

I like to scuba dive. And now my whole lab works on marine organisms and how they stick to rocks. It's not a coincidence. Your hobbies are things that you like so much that it's where you spend your free time. Why not bring them into the lab? You are then guaranteed to really like your research projects. Plus you will stand out from the crowd of your peers for being particularly creative.

-Start by reading review articles.

After you pick a few topics that you simply like or want to know more about, start reading review articles. They will give you a good idea of the current state of knowledge. They might even tell you what is still not known.

-Make it exciting and fun.

We all have different tastes with regard to what science we find most interesting. But if you are excited about it, that enthusiasm will come through. Then you will have the reviewers on your side. If you think what you are proposing is boring, I guarantee that the reviewers will also think so. Nobody enjoys reading a boring proposal. And when funding is so scarce, nobody gives $500,000 to a bored principal investigator for undertaking a boring study.

-Your proposed work has to be interesting and significant.

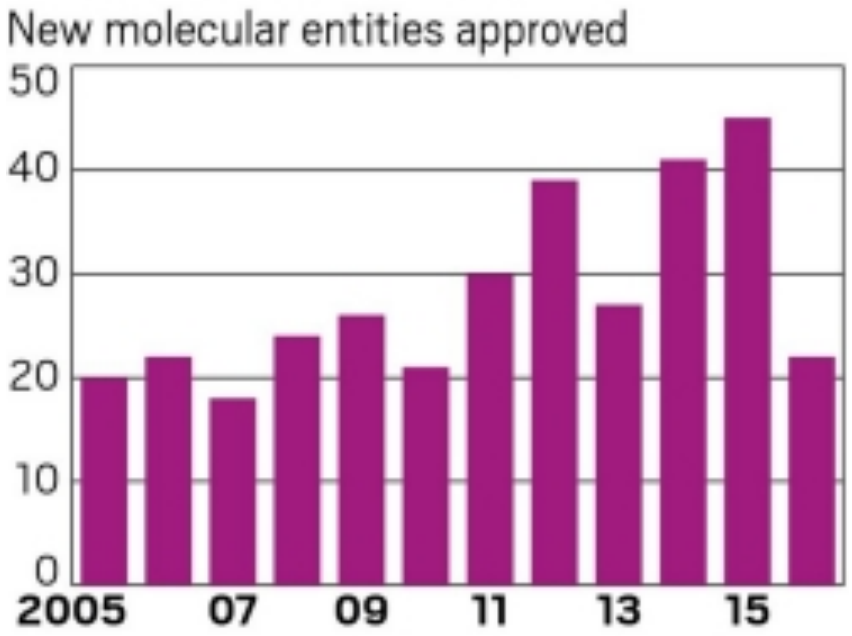
If you pick something really specific and really small in focus and really boring… Just because it has not been done before does not mean that it should be done. You need to convince the reviewers that your proposal is worth going in the lab and doing. Think like a reviewer and ask yourself "why bother with that experiment?" Also: Keep in mind what you will be writing for your Significance section of the proposal.

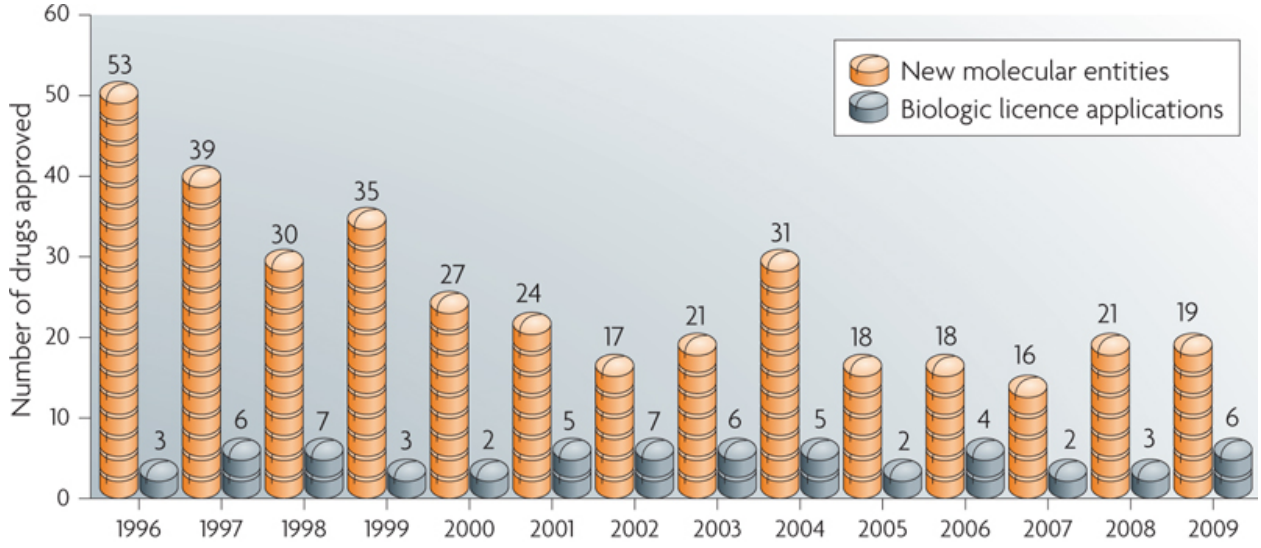
-Do not focus only on one compound.

If you are making a new drug, enzyme inhibitor, etc. you cannot focus on only one compound. No matter how clever and well designed it may be, what are the odds that it will work? If it was that easy, most diseases would have already been cured, right? There are many, many super smart people working in drug companies right now trying to come up with new lead compounds. The success rate is very, very low. See the figure on the next page. A common student proposal is to take two molecules with different properties and combine them into a single compound for a new drug. In reality, that approach rarely works to make new drugs. What do you do if that one compound you designed does not work as planned? Instead: Focus on a family or series of compounds. Vary properties and test many things.

-Consider selectivity and/or specificity.

If you are making a series of compounds to kill cancer cells/bacteria/viruses/parasites/fungus, etc. you also need to do controls with healthy cells. Cyanide, CO, thallium, lead, H_2O_2, bleach, mercury, nitric oxide, etc. are ways that we already know how to kill all cells quite well. If your new compound kills healthy cells just as well as the target cells, you have accomplished very little. Your innovation will come from attacking your target selectively.





Nature Reviews | Drug Discovery

Ethical Considerations

None of your writing can be copied from other sources. Even if a citation is provided, copying from other sources is plagiarism. Don't do it.

Cheating or in any way submitting work that is not your own, considered cheating and/or plagiarism. Under no circumstances may you copy text from the literature or a classmate and include it in your writings (e.g., your proposal). You are not allowed to use literature text even if it is placed in quotes and the original source is cited.

For a proposal, the work you propose to do must be your own ideas. You cannot use someone else's ideas for experiments to perform. Even if you provide a citation for your source, you are still not allowed to use their ideas for your future work.

The purpose of this exercise is to have you think of your own, new, and creative project to do. The work cannot have been performed by anyone in the past. The work cannot have been proposed for the future by anyone else.

If you have never written an essay, paper, or proposal before, feel free to discuss this matter with us. In the past, we have had students copy text from the literature and they claimed they did not know this practice was unacceptable.

Now you know. No copying. No excuses.

Can I recycle an older proposal that I wrote from a class?

The Ethicist June 2, 2013

New York Times

By CHUCK KLOSTERMAN

DECISIONS AND (NO) REVISIONS

When I was in college, I'd sometimes write a single paper that would satisfy assignments in more than one course. For instance, I once wrote a paper on how "The Love Song of J. Alfred Prufrock" expressed satire; I submitted it for assignments in both my poetry course as well as my completely separate satire course. I did not disclose this to either professor. When I share this with people, half call the practice cheating, and the other half call it genius. My niece told me it would certainly be grounds for expulsion at her college. In my mind, I was adding a level of intellectual complexity to my studies. Was this an ethical practice, or was I cheating? JOE, CONNECTICUT

As I read and reread this question, I find myself fixated on the idea that this *must* be unethical, somehow. I suppose my knee-jerk reaction could be described like this: Every professor is operating from the position that any assignment she makes is exclusive to that particular class, even if she doesn't expressly say so at the onset (in other words, it's simply assumed that work done for a specific class will be used only for that specific class). It's as if you were breaking a rule that was so over-the-top obvious it may not have been overtly outlined. But you know what? The more I think this over, the more I find myself agreeing with your position. I don't think this is cheating. I wouldn't say it qualifies as "genius," and it might get you expelled from some universities. Yet I can't isolate anything about this practice that harms other people, provides you with an unfair advantage or engenders an unjustified reward.

I look at it like this: You were essentially asked two questions that shared a common answer. The fact that you could see commonalities between unrelated intellectual disciplines is a point in your favor. Some might call your actions self-plagiarism, but the very premise of stealing your own creative property is absurd. You're not betraying the public's trust. It seems strange only because the assignments involve a degree of creativity. If this had been a multiple-choice physics test you failed to study for — yet were still able to pass, based on knowledge you acquired from an applied-math class taken the previous semester — no one would question your veracity.

It's possible to argue that you were "cheating yourself" and wasting your own academic experience — but that's not an ethical crossroads. That's more of an existential dilemma over the purpose of a college education that (in all probability) you paid for. In the abstract, the notion of using the same paper twice *feels* wrong — and if you contacted your old school and told them this anecdote, it would most likely cite some rule of conduct you unknowingly broke. But fuzzy personal feelings and institutional rules do not dictate ethics. You fulfilled both assignments with your own work. You're a clever, lazy person.

E-MAIL queries to *ethicist@nytimes.com*, or send them to the Ethicist, The New York Times Magazine, 620 Eighth Avenue, New York, N.Y. 10018, and include a daytime phone number.

Some Relevant Proposal Resources

-Searching the literature.

Many different computer databases are available. Purdue has access to them all. We pay for them so you will need to go through a campus computer- these searches are unlikely to work from home. Each database has it's strengths and weaknesses. Do not rely on only one. I recommend SciFinder Scholar, the Web of Science (start at www.isiknowledge.com), and Medline. Google (or Google Scholar) can be helpful but is still not as complete as the others mentioned.

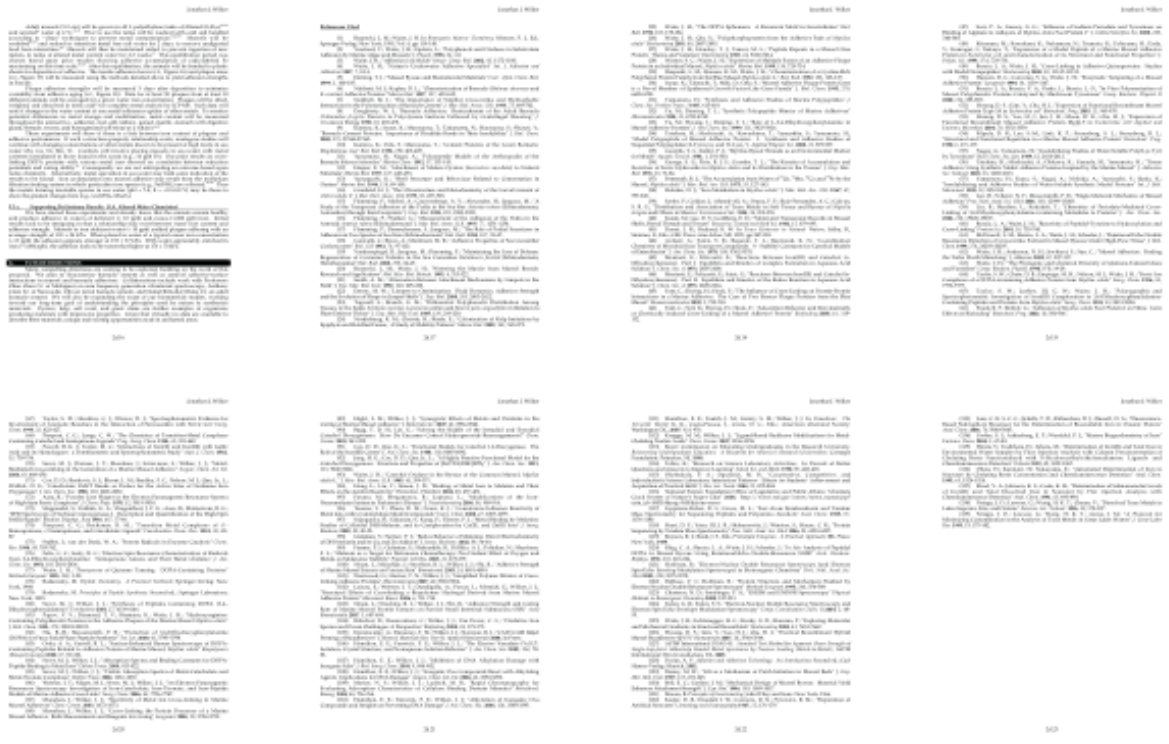
-Use the Chemistry Library staff.

People like David Zwicky are great. They love teaching students how to dig though the literature and do searches that are complete. Bring them some cookies or beer and you're sure to find all of the relevant literature on your project. OK, the cookies and beer are optional.

-Excellent books on how to write a proposal.

There is a workbook by Stephen Russell and David Morrison titled "The Grant Application Writer's Workbook. Guide to a Successful Proposal. The National Institutes of Health." They also have one titled "The Grant Application Writer's Workbook. Successful Proposals to Any Agency." Both are available from www.grantcentral.com. They may be available on campus. I think that these books are overkill for an OP. However, they really are excellent. The books are especially good for a few things. First, they will scare your pants off in regard to how important it is to get all your ideas across clearly. Second, they provide a super organizational approach to writing a proposal. Third, they show you how to make a very clear presentation of your ideas to the reviewers. However, these books will not help you come up with a proposal idea.

For your reference, here is an NSF proposal that I wrote.



-Note the layout.

-See all of the pretty figures.

-Notice the lack of huge blocks of text.

-Note all of the references.

A Suggested Process for Getting Your Core Proposal Idea into Shape

You can come up with an idea and refine it any way that you like. But this process might help you at this stage.

1. Think up a good idea or, preferably, several ideas.

2. Describe your ideas to a friend or two. Even if it seems clear in your head, having to use actual words to describe it to someone else is very illustrative. Things that you thought were solid suddenly do not seem to be so anymore.

3. Get feedback from your friends on whether or not your idea is any good. Get suggestions for where to take it next.

4. Have your friends explain their ideas to you. Being on the other side feels very different. And it will help you see what it is like when someone is hearing about your ideas.

5. Go away and think some more. Refine your idea(s). Or, if needed, get some more.

6. Write an abstract for your proposal. (Instructions are provided above.). How are things looking now?

7. Outline your whole proposal. Just a bulleted list of sections and what will be in there. Nothing that anyone else will read. But outlining will help clarify things for you. Now how is it looking?

8. Write the whole thing. A complete draft is fine. No need for it to be perfect yet.

9. Give your draft to a friend for feedback. If you want to be fancy, have your friend write a review of maybe a full page.

10. Read your friends' proposal drafts and write a page long review. You will learn how reading someone else's proposal will teach you how others are going to view your proposal. And you will learn where you need to work on your own presentation more.

11. Take the feedback and revise your proposal into the final form.

12. Start getting ready for the oral defense. More on that below.

How to Prepare for the Defense

Here are some ideas to make it go more smoothly for everyone.

Do not worry about being stressed.

This day will be stressful for you. We understand. That's OK. There are only two types of students I have seen who were not stressed during their OP: Students who really did not care if they passed or not and students so arrogant that they knew they were the smartest person in the room. This second type is very rare. If you are stressed, you care. That's a good thing. As long as it does not cripple you.

What should you know for the defense?

Think about what you would want to see from someone asking you for lots of money to work on a completely unproven idea. This list is not exhaustive, but here are some things that you might want to know:

-Who all of the labs in your field are and what they are working on.

-Where your work fits in and how it is unique.

-All of the relevant work that has been done already (i.e., background).

-What is known already versus what is not.

-How all of the experimental methods that you will use work and the underlying theories.

-How to synthesize all of the compounds that you will use, even if they are commercially available. Sometimes compounds go off the market.

What to include in the presentation (and what not to).

Make up a presentation that, if uninterrupted, will take you about 25 minutes to go through, maybe 20 minutes. We will ask lots of questions, so your 20-25 minutes will turn into over an hour.

Make your presentation as if the faculty have not read your proposal. Many faculty will not have time to read the document you submitted. I have had 3 OP's in 2 days. Amidst everything else in the job. So do not be surprised if we walk into the room knowing nothing. Make the presentation to include all of the most relevant information. But no more.

Skip a lot of the background. We do not need to see three slides on why cancer is such a problem and needs to be addressed. One or two slides of background to tell us what area you are working in. And what some pressing, unanswered questions are. Then get right to the core of your work, what is new that you are proposing and will work on.

Anticipate questions.

There are a lot of things that we may ask you about. You might even be able to anticipate what some of those questions are going to be. So make backup slides to answer those questions in case they do come up. When the committee asks a question and the student says “I have a backup slide on that,” all of the faculty get impressed and smile. You look like you have your act together and just paved your way toward a smooth pass.

How to deal with questions.

You do not know everything and neither do we. It can be OK to say “I don’t know.” Part of the faculty job here is to determine where the boundaries of your knowledge are. We will keep asking questions until you do not know the answers. Not always having all of the answers is fine and to be expected.