

Writing successful research proposals

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Outline

- Who needs proposals?
- Funding landscape - who funds?
- Proposal format
- Preparation
- Key elements & timeline
- The audience
- Enhancing chances for success (initial data, format, deadlines...)
- Evaluation and preparation for project management



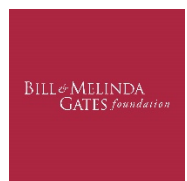
Why would you need to write a proposal?

- To secure funding for conducting research
- To persuade various funding agencies to support your ideas
- To solicit consulting work for your office or company
- To compete for calls to provide services to agencies/clients
- To support graduate students and collaborators
- To purchase new instruments and equipment
- To generate new opportunities for your career



Who funds research proposals?

- Government research agencies – CNPq (Brazil), SNSF (Switzerland), DFG (Germany), NSF, NIH (US), ERC and EU, etc.
- Other branches of government - EPA, DOE, NASA (US), ESA(EU),
- Topical areas (US) – health (NIH), agriculture (USDA), space and earth (ESA, NASA)
- Private endowments and foundations – Gates, Rockefeller
- Industry funding – Nestle, Syngenta, Petrobras,
- Each have different objectives, formats, procedures and outcomes
- Differentiating competitive vs. non competitive funding



Scientific proposal – *general aspects*

- Proposals are often written to secure research funding, to win a consulting contract – the primary objective here is to persuade or convince the evaluators to grant you funding to solve the problem
- **Primary difficulty in proposal writing** - you imagine a solution to a problem and write about the steps towards the anticipated solution (*this is not something we know...*)
- **Proposal format** – proposals often require adherence to strict format for uniform evaluation and content (*and testing whether you are organized and can follow instructions*)
- **Funding landscape and “politics”** – have you addressed the scope of the call? Is the topic and proposed work appropriate for the call? Is the collaboration appropriate?
- **The audience** – management look at costs, feasibility, timeline; technical types look at science, innovation (*both groups must be persuaded for successful funding*)

What makes a proposal competitive?

Overall Quality of the Research

- **Good research question**
- **Appropriate research design**
- **Rigorous and feasible methods**
- **Qualified research team**

Quality of the Proposal

- **Informative title**
- **Self-sufficient and convincing abstract**
- **Clear research questions**
- **Pertinent background and rationale**
- **Relevant previous work**
- **Appropriate methods**
- **Quality control**
- **Sound analysis plan**
- **Tight budget**
- **Realistic timetable**

Quality of the Presentation

- **Clear, concise, well-organized**
- **Helpful TOC and subheadings**
- **Good diagrams and tables**
- **Neat and error free**

What makes a proposal competitive?

What Makes a Proposal Competitive?

- Compelling - clearly spells out the novel and exciting elements and general scientific importance
- Well-written and organized
- Knowledge of subject area, relevant literature
- Experience in essential methodology
- Succinct, focused project plan with sufficient detail
- Logical experimental design
- Sound scientific rationale and theoretical context
- Realistic amount of work
- Critical approach (considers alternatives)
- Likelihood of high impact

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Valued aspects (*US NSF not universal!*)

Valued Aspects

- Integrative:
 1. Approaches (i.e., interdisciplinary)
 2. Scales
 3. Conceptual frameworks
- Risky – but feasible
- Broader impacts
- Quantitative
- Theoretically driven

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Developing competitive proposals

- Survey the funding landscape
 - Identifying research topics
 - Establishing timeline
- } preparation steps
(months in advance !)
- Formulation of content (introduction, statement of problem, importance, what is known, what is proposed (objectives and path), steps and timeline, who is doing the work, how much will this cost,
 - Specify experience and infrastructure
 - Attractive proposal “packaging”

Preparation steps

1. Define your project early (*focus, scope, who will benefit, draft timeline*)
2. Identify the right funding sources (*web, databases, contacts*)
3. Contact funding agencies (*inquire about suitability, funding limits*)
4. **Acquire and study proposal guidelines** – *this is the number one rule for writing a successful proposal* (*submission deadlines, eligibility, funding goals and priorities, format: forms, margins, page limits; evaluation process and restrictions, review timetable, budgets, funding levels, contact*)
5. Know the submission deadline
6. Identify personnel (*collaborators*) and equipment needs
7. Update your timeline



GRANT PROPOSAL GUIDE

NSF 03-041

June 2003

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Proposal style *(1 – for engineering design proposal)*

1. Title (*orient the audience*)
2. Project overview (*abstract*)
3. Introduction and problem statement
4. Assertions to set up proposed solution (and their support)
5. Proposed solution is pitched (*does solution make sense from technical point of view? Does it make sense from management point of view? Can the team do it?*)
6. Objectives (*concise, clear and logical*)
7. Plan of work (*how to accomplish objectives? outline solution*)
8. Management plan (*timeline, budget, Q-A, collaboration*)
9. References
10. Appendices (*facilities, qualifications, CV*)

Proposal style (*2 – general scientific proposal*)

1. Title
2. Project Overview
3. Background Information/Problem Statement
4. Project Detail
 - *Goals & Objectives*
 - *Clientele*
 - *Methods*
 - *Staff/Administration*
5. Available Resources
6. Needed Resources
 - *Personnel*
 - *Facilities*
 - *Equipment/Supplies/Communication*
 - *Budget*
7. Evaluation Plan
8. Appendices

Proposal title

- Similar to scientific paper, an attractive and informative title is needed (think of it as a mini-abstract)
- Title should be clear and unambiguous (*don't try to make it "cute"*)
- The words should clearly reflect the focus of your proposal (the most important words come first)
- The two titles below use similar words but in a different order - **title #1** seems to focus on *Red Haired Musicians*, whereas **title #2** seems to focus on *Musical Style Preference* (yet the projects are the same !)
 - **Title #1** - *Red Haired Musicians and their Preference for Musical Style*
 - **Title #2** - *Music Style Preference of Red Haired Musicians*

Project overview/abstract/executive summary

This is an executive summary (most would only have enough time to read this part - not the entire proposal) – similar rules as paper abstract (except future tense! *Remember, you are trying to persuade*)

- **Project Overview** should "paint a picture" of your proposal in the mind of the reader and establish a framework (context)
- Show your knowledge of the funding organization by briefly highlighting relations to key concerns of the funding source
- Let the **Overview** be your last piece of writing
- The **Project Overview** will probably form a strong impression in the mind of the reviewer - **make sure to avoid giving the impression of:** *not an original idea, rationale is weak, writing is vague, uncertain outcomes, does not have relevant experience, unimportant problem, unfocused proposal, project is too large*

Project overview (*example - student project*)

(1) Memory management is a crucial factor in operating system and application performance. (2) The purpose of this project is to study the relative merits of the best fit and worst fit selection algorithms used in memory management. (3) The first goal of the project is to produce a reference table with the test sets and results for software developers using algorithms. (4) The second goal is to develop a very specific set of rules for when to use each algorithm. (5) The results will be valuable to software developers when choosing between the best fit and worst fit selection algorithms. (6) While the first goal can be attained in the ten week period, attaining the second goal will depend on the results of the data. (7) Consequently, the second goal may be unreachable, or require further research. (8) The cost for the ten week period is \$7500.

Project overview *(previous example cont.)*

1. The *first* sentence gives some context by defining terms. It could be improved by adding the simple word "**computer**" to separate this study from something in cognitive ergonomics
2. The project's goals are clearly stated in the *second, third and fourth* sentences
3. The value of the project is outlined in sentence *five*
4. Limitations or scope of the work is presented in sentences *six and seven*
5. The cost is explained in the *last* sentence. Note that the cost is for ten weeks regardless of whether the second goal is attained
6. This summary does not include the writer's qualifications (degree, position), presumably because the writer is a student with no prior experience in this field

Background and problem statement

- Background provides perspective and demonstrates that you are familiar with what has been done before - position your project in relation to other efforts and show how your project will: *extend the work that has been previously done; avoid the mistakes and/or errors that have been previously made; serve to develop stronger collaboration between existing initiatives; or is unique and does not follow the same path as previously followed*
- You want the background to be concise, yet persuasive!
- First assemble all arguments and present them in a logical sequence that will convince readers that your proposed project is clearly needed and should be funded (*what are the pressing problems addressed? why these problems are important? Who else identify these issues as major needs?*)
- Preliminary data or small development steps can help secure support (*this team is serious...*)
- Highlight unique strengths and suitability for such a project

The “HOOK”

- The **HOOK** tailors the description of the idea to the interest of a particular funder
- The **HOOK** aligns the project with the purpose, and goals of the funding source
- This is a critical aspect of any proposal narrative because it determines how compelling and persuasive your proposal for a funding agency and the reviewers



Problem statement and need for study (1)

1. Decide which facts or statistics best support the project - be sure data you present are accurate and not too generic. The use of irrelevant information will cast doubts on the entire proposal
2. Give the reader hope - the picture you paint should not be so grim that the solution appears hopeless. Here's an example: "*Breast cancer kills. But statistics prove that regular check-ups catch most breast cancer in the early stages, reducing the likelihood of death. Hence, a program to encourage preventive check-ups will reduce the risk of death...*" Avoid overstatement and overly emotional appeals
3. Is it reasonable to portray the need as acute – you ask the funder to pay more attention to your proposal because either you address more significant problem than others or your solution makes more sense. Here is an example of a balanced statement: "*Drug abuse is a national problem. Each day, children all over the country die from drug overdose. In the South Bronx the problem is worse. More children die here than any place else. It is an epidemic. Hence, our drug prevention program is needed more in the South Bronx than in any other part of the city.*"

Problem statement and need for study (2)

1. Demonstrate that your project addresses the need differently or better than preceding projects - it is difficult to describe the need for your project without being critical of the competition. *But you must be careful as it may cause closer inspection to see why you felt you had to build your case by demeaning others (today's funders are very interested in collaboration).* At the least you need to describe how your work complements, but not duplicate, work of others
2. Avoid circular reasoning - in circular reasoning, you present the absence of your solution as the actual problem. Then your solution is offered as the way to solve the problem. **For example**, the circular reasoning for building a community swimming pool might go like this: "*The problem is that we have no pool in our community. Building a pool will solve the problem.*" A more persuasive case would cite what a pool has meant to a neighboring community, permitting it to offer recreation, exercise, and physical therapy programs. The statement of need should be short with concise information

Project Detail - *Goals and objectives*

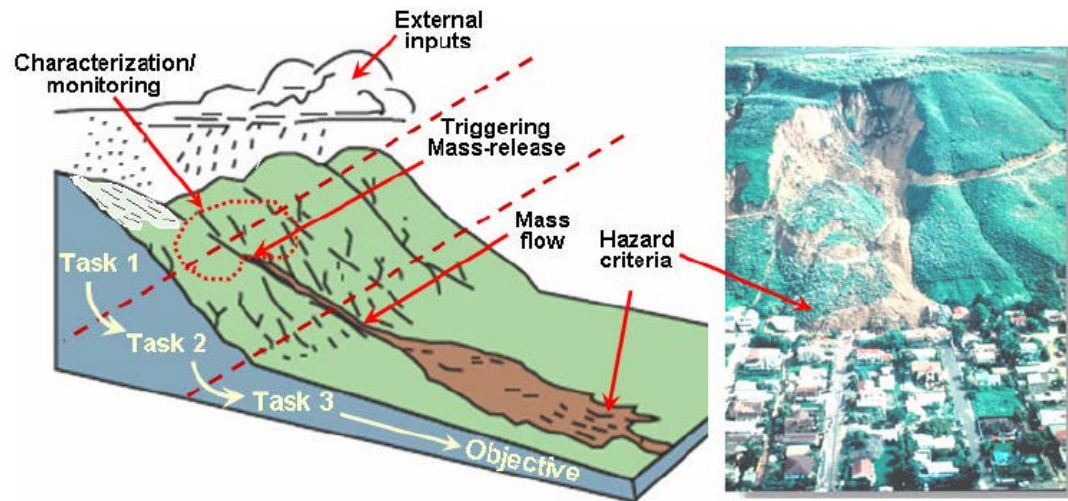
- Differentiate between goals and objectives - and include both:
 - *Goals* are the large statements of what you hope to accomplish but usually aren't very measurable. They create the setting for what you are proposing
 - *Objectives* are operational, tell specific things you will be accomplishing in your project, and are measurable
- Your objectives must be: tangible, specific, concrete, measurable, and achievable in a specified time period



Project Detail - *Goals and objectives*

For example, a proposal on hillslope mass release processes states as a **goal** “to provide new numerical tools for predicting physical behavior of rapid mass flow processes” with the specific **objectives**:

- To develop constitutive models that consider links between biotic factors, physical properties, and geotechnical processes related to hillslope rapid mass movements
- To develop realistic flow models that describe two-dimensional motions of an avalanching mass (soil, debris or snow) over irregular topography



An illustration of the projects' primary tasks sequence and their physical setting.

Project Detail - *Methods*

- There should be a clear link between the methods in this section and the objectives you have previously defined
- Describe the specific activities that will take place to achieve the objectives, that is what will occur from the time the project begins until it is completed
- Enable the reader to visualize project implementation
- Provide the order and timing for the tasks
- Defend your chosen methods, especially if they are new or unorthodox



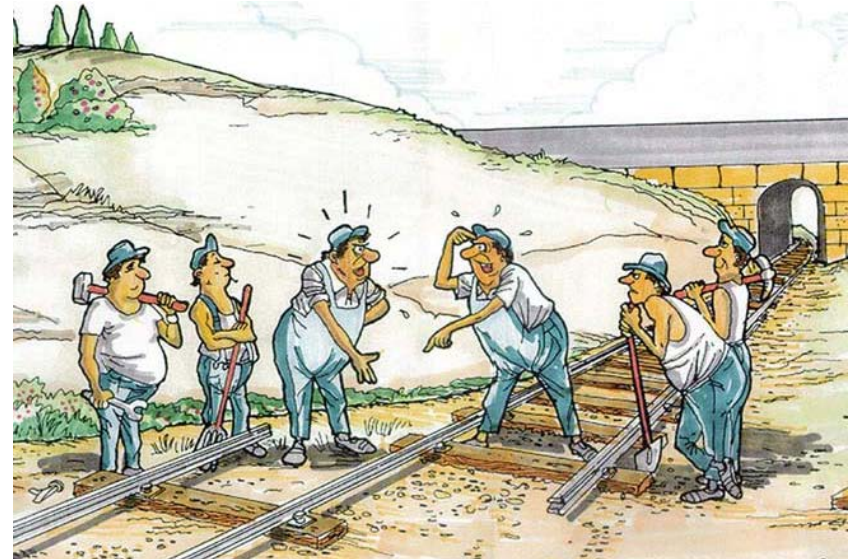
Project Detail - *Methods*

- How will the methods encourage groups to join together in dealing with the issues/concerns your project addresses?
- Be realistic and address potential pitfalls
- Show preliminary results
- Sufficient preliminary data should be included to demonstrate the viability of the proposed methodology



Project Detail - *Staff/Administration*

- Use this section to describe the roles of the different people associated with your project and the importance of each
- Make sure to clarify how each of the roles are essential to the success of the project and each role clearly relates to operationalizing the methods you have described
- The success of your proposal is directly related to the people who will work on the project
- Try formulating and presenting your project as a team effort



The budget

- Strike a balance among scope of activities, agency and your institution guidelines, and proposed budget
- Justify expenditures and importance for the project (*ensure clear timeline with project progress*)
- Leverage existing infrastructure to enhance chances for support

Budget per year

		1 st year	2 nd year	3 rd year	Total
5.1.	Equipment	13'052	-	-	13'052
5.2.	Consumables	3'000	6'500		9'500
5.3.	Field expenses	2500	4'000	8'000	14'500
5.4.	Miscellaneous		3'000	3'000	6'000
6.1..	Salaries	67'200	73'200	79'200	219'600
6.2.	Social security	9'408	10'248	11'088	30'744
7.	Total	95160	96'948	101288	293'396

The budget (2)

Budgetary Guidelines

- Amounts
 - Reasonable for work - Realistic
 - Well justified - established needs
 - Consistent with program guidelines
- Eligible costs
 - Personnel
 - Equipment
 - Travel
 - Participant Support
 - Other Direct Costs (subawards, consultant services, computer services, publication costs)

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Project timeline and tasks

- A realistic timeline outlining sequences of activities inspires confidence in the attainment of proposal's goals
- Illustrate parallel activities, building on progress, individual tasks, and collaborative activities

Project timeline

	Year	2007				2008				2009				
		Quarter	IV	I	II	III	IV	I	II	III	IV	I		
<u>Tössegg</u>	monitoring													
<u>Vispa-Valley</u>	instrumentation													
	sampling													
<u>Illgraben</u>	monitoring													
	additional instrumentation													
<u>Vallée de la Sionne</u>	monitoring													
	additional instrumentation													
<u>Davos-Chörbschorn</u>	measurements													
	installation													
PhD hill-slope characterization	sampling													
	monitoring													
	IGT, GEOLEP, LMS													
field site characterization	instrumentation/monitoring													
surface elevation	measuring (seasonal)													
properties of samples	sampling													
	laboratory analysis													
deterministic modeling	implementing/adapting													
PhD bioengineering/roots	MHT, LASEP, IGT													
root strength (bond)	modeling													
	sampling													
	laboratory													
	field													
PhD soil mechanics	LMS/GEOLEP/IGT													

Evaluation steps (SNSF)

- Format and submission deadline
- Institutional review
- Expert/external reviews
- Panel evaluation (is this good for Switzerland?)
- Recommendation
- Project management



SWISS NATIONAL SCIENCE FOUNDATION



Student proposal example (1)

A Proposal to Research the Storage Facility for Spent Nuclear Fuel at Yucca Mountain

Roger Bloom
October 1997

Introduction

Nuclear power plants produce more than 20 percent of the electricity used in the United States [Murray, 1989]. Unfortunately, nuclear fission, the process used to create this large amount energy, creates significant amounts of high level radioactive waste. More than 30,000 metric tons of nuclear waste have arisen from U.S. commercial reactors as well as high level nuclear weapons waste, such as uranium and plutonium [Roush, 1995]. Because of the build-up of this waste, some power plants will be forced to shut down. To avoid losing an important source of energy, a safe and economical place to keep this waste is necessary. This document proposes a literature review of whether Yucca Mountain is a suitable site for a nuclear waste repository. The proposed review will discuss the economical and environmental aspects of a national storage facility. This proposal includes my methods for gathering information, a schedule for completing the review, and my qualifications.

Student proposal example (2)

Statement of Problem

On January 1, 1998, the Department of Energy (DOE) must accept spent nuclear fuel from commercial plants for permanent storage [Clark, 1997]. However, the DOE is undecided on where to put this high level radioactive waste. Yucca Mountain, located in Nevada, is a proposed site.

There are many questions regarding the safety of the Yucca Mountain waste repository. Researchers at Los Alamos National Laboratory disagree over the long-term safety of the proposed high level nuclear waste site located in Nevada. In 1994, Charles Bowman, a researcher at Los Alamos, developed a theory claiming that years of storing waste in the mountain may actually start a nuclear chain reaction and explode, similar to an atomic bomb [Taubes, 1995]. The stir caused by theory suggests that researchers have not explored all sides of the safety issue concerning potentially hazardous situations at Yucca Mountain.

Bowman's theory that Yucca Mountain could explode is based upon the idea that enough waste will eventually disperse through the rock to create a critical mass. A critical mass is an amount of fissile material, such as plutonium, containing enough mass to start a neutron chain reaction.

incomplete...

Student proposal example (3)

Objectives

I propose to review the available literature about using Yucca Mountain as a possible repository for spent nuclear fuel. In this review I will achieve the following two goals:

- (1) explain the criteria for a suitable repository of high-level radioactive waste; and
- (2) determine whether Yucca Mountain meets these criteria.

steps/justification

After explaining the criteria, I will assess how well Yucca Mountain meets those criteria. In this assessment, I will not assign a numerical score for each criterion. Rather, I will discuss qualitatively how well Yucca Mountain meets each criterion. In some situations, disagreement exists among experts as to how well Yucca Mountain meets a criterion. In such cases, I will present both sides. In this assessment, only Yucca Mountain will be considered as a possible site. Although many sites in the United States could meet the DOE's established criteria, I will consider only Yucca Mountain because the DOE is considering only Yucca Mountain [Taube, 1995].

Student proposal example (4)

Plan of Action

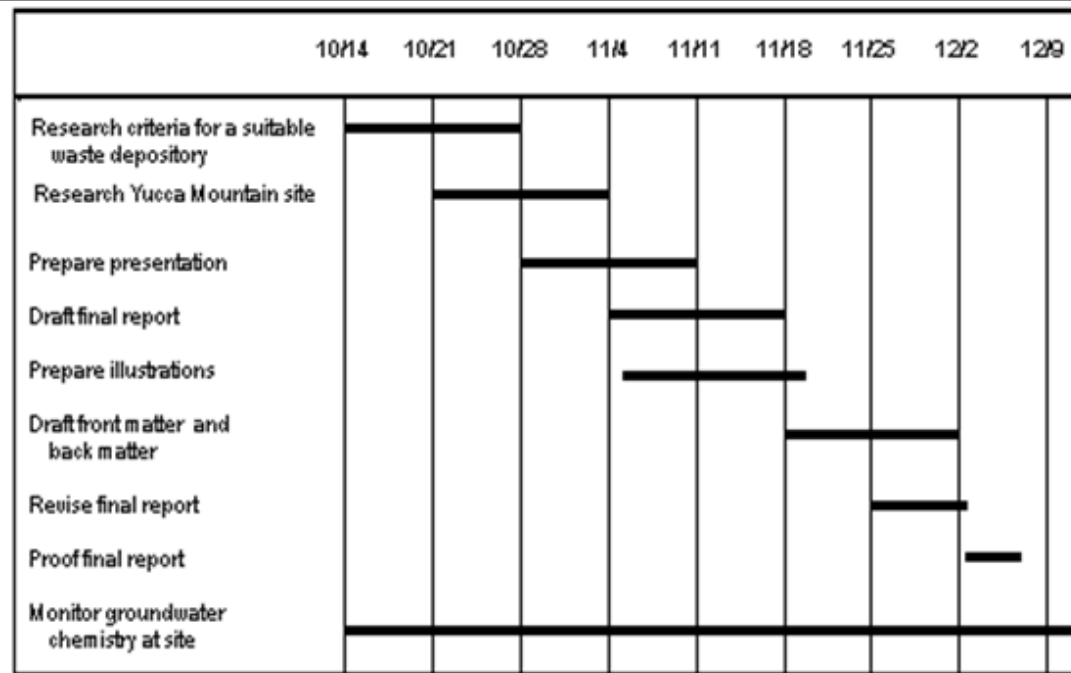
This section presents my plan for obtaining the objectives discussed in the previous section. There has been an increase of interest in the nuclear industry concerning the Yucca Mountain site because of the January 1, 1998, deadline for the DOE. Several journal articles and papers discussing the possibility of Yucca Mountain as a spent fuel repository in our near future have surfaced as a consequence of that interest. These articles and books about the dangers of nuclear waste should provide sufficient information for me to complete my review. The following two paragraphs will discuss how I will use these sources in my research. The first goal of my research is to explain the criteria for determining whether a nuclear waste repository is suitable. For example, will the rock structure be able to withstand human invasion in the future [Clark, 1997]?

incomplete...

Student proposal example (5)

Management Plan

This section presents my schedule, costs, and qualifications for completing the proposed research. This research culminates in a formal report, which will be completed by December 5, 1997. To reach this goal, I will follow the schedule presented in Figure 1. Since I already possess literature on the subject of Yucca Mountain as a nuclear waste site, most of my time will be spent sorting through the literature to find key results, and presenting those results to the audience.



Note – no costs...

Student proposal example (6)

Conclusion

More than 30,000 metric tons of nuclear waste have arisen from U.S. commercial reactors as well as high level nuclear weapons waste, such as uranium and plutonium [Roush, 1995]. This document has proposed research to evaluate the possibility of using Yucca Mountain as a possible repository for this spent nuclear fuel. The proposed research will achieve the following goals: (1) explain the criteria necessary to make a suitable high level radioactive waste repository, and (2) determine if Yucca Mountain meets these criteria. The research will include a formal presentation on November 11 and a formal report on December 5.

References

Clark, Raymond L., "Background on 40 CFR Part 197 Environmental Radiation Protection Standards for Yucca Mountain," *Proceedings of the 1997 Waste Management Conference* (Washington, D.C.: U.S. Environmental Protection Agency, 1997).

Kerr, R., "New Way to Ask the Experts: Rating Radioactive Waste Risks," *Science*, vol.274, (November1996), pp. 913-914.

General aspects of scientific writing apply here

- be consistent (also in tense, ...)
- use active form (simpler, easier, stronger)
- no contractions (e.g., it's, can't, ...)
- all images, figures, tables are labeled and referenced in the text
- all images, figures, tables, ... must have a caption describing their purpose
- All references are mentioned in the text (and reference to previous work in the text clearly cited in the list of references)
- no paragraph should have only one sentence
- use a spellchecker (however, do not rely on the spellchecker, it does not find every mistake)
- use simple and short sentences (break a sentence if needed)
- avoid abbreviations (except: i.e., e.g.) or clearly define early on

Packaging your proposal

Don't forget the little things

- Follow formatting requirements carefully
- Compliance check before submitting
- Be available by email to fix compliance problems
- Suggest reviewers as appropriate
- Include all conflicts of interest in your CV
- Respond explicitly to previous reviews
- Emphasize readability, avoid verbiage
- Read the GPG and program solicitation
- When in doubt, contact the Program Director

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Research proposal competition (*not this year*)

- General research area (*Environmental Engineering*):

“Sustainable strategies for biofuel production”

- Potential specific topics for research proposals:
irrigation and nutrient management strategies; life cycle analyses; agronomic and tillage operations; land use and expansion strategies; ecological consideration in crop and rotation management, *more...*
- Funding CHF 100,000 for 1 year (**only two top proposals will be selected !**)
- Group project – one written proposal per group (4-5 pages)
- Make formal presentation (~ 8 min) to persuade a review panel (class) to fund your research proposal (expect questions from colleagues/committee)
- Grading - presentation & overall proposal quality (class), written (instructor)

Format for proposal competition

- **Title**
- **Project overview/summary**
- **Statement of problem**
- **Design or research objectives**
- **Plan of action (design emphasis):**
 - Identifying specific need
 - Establishing target specifications
 - Generating and selecting design concept
- **Management plan**
 - Schedule
 - Budget
 - Qualifications
- **References**

Presentation – keep short, simple and try to be persuasive