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How Do You Write a Successful Grant Application

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Importance of Getting Grants

- Research needs
- Promotion needs
- Satisfaction

Grant Writing is Different From Manuscript Preparation

- In a manuscript, the objective is to present a scholarly summary of what has already been done, with arguments by the author to support the arguments for the validity of the conclusions reached
- The primary objective of a grant applicant is to convince a target funding agency, with persuasive arguments, that a body of work needs to be done and why the proposed methodologies would be valuable.

Scholarly pursuit vs. Sponsor goals

How a Grant is Reviewed

- Careful preparation and an understanding of how your application will be reviewed can help you build a solid application. During the peer review process, a panel of scientists are convened to review your application. Although a number of factors contribute to whether your application will be funded, there is a great emphasis on the review of scientific merit.

Overall Impact

- Reviewers will provide an overall impact score to reflect their assessment of the likelihood for the project to exert a sustained, powerful influence on the research field(s) involved, in consideration of typical review criteria, and additional review criteria (as applicable for the project proposed).
  - Significance
  - Investigator(s)
  - Innovation
  - Approach
  - Environment

Significance

- Does the project address an important problem or a critical barrier to progress in the field?
- Is there a strong scientific premise for the project?
- If the aims of the project are achieved, how will scientific knowledge, technical capability, and/or clinical practice be improved?
- How will successful completion of the aims change the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field?

Investigator(s)

- Are the PD/PIs, collaborators, and other researchers well suited to the project?
- If Early Stage Investigators or New Investigators, or in the early stages of independent careers, do they have appropriate experience and training?
- If established, have they demonstrated an ongoing record of accomplishments that have advanced their field(s)?
- If the project is collaborative or multi-PD/PI, do the investigators have complementary and integrated expertise; are their leadership approach, governance and organizational structure appropriate for the project?

Innovation

- Does the application challenge and seek to shift current research or clinical practice paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions?
- Are the concepts, approaches or methodologies, instrumentation, or interventions novel to one field of research or novel in a broad sense?
- Is a refinement, improvement, or new application of theoretical concepts, approaches or methodologies, instrumentation, or interventions proposed?

Approach

- Are the overall strategy, methodology, and analyses well-reasoned and appropriate to accomplish the specific aims of the project?
- Have the investigators presented strategies to ensure a robust and unbiased approach, as appropriate for the work proposed?
- Are potential problems, alternative strategies, and benchmarks for success presented?
- If the project is in the early stages of development, will the strategy establish feasibility and will particularly risky aspects be managed?
- Have the investigators presented adequate plans to address relevant biological variables, such as sex, for studies in vertebrate animals or human subjects?
- If the project involves clinical research, are the plans for 1) protection of human subjects from research risks, and 2) inclusion of minorities and members of both sexes/genders, as well as the inclusion of children, justified in terms of the scientific goals and research strategy proposed?

Environment

- Will the scientific environment in which the work will be done contribute to the probability of success?
- Are the institutional support, equipment and other physical resources available to the investigators adequate for the project proposed?
- Will the project benefit from unique features of the scientific environment, subject populations, or collaborative arrangements?

Innovation vs. Impact

- Note that an application does not need to be strong in all categories to be judged likely to have major scientific impact. For example, a project that by its nature is not innovative may be essential to advance a field.

Resources

- Applicants should clearly state that they have the appropriate resources to conduct the research, such as adequate equipment and laboratory space. When possible, include letters of commitment for these resources.
  - Understand the level of resources needed to compete.
  - Conduct an organizational assessment.
  - Determine what resources and support your organization has and what additional support you'll need.
  - Consider whether the available equipment and facilities are adequate and whether the environment is conducive to the research.

Independence and Institutional Support

- This is important for all investigators, but particularly for new and early stage investigators or those who are early in their independent careers:
  - Provide reviewers evidence that you have the appropriate experience and training to lead and manage the research project.
  - Letters of reference and institutional commitment are important.
  - Mention any start-up funds, support for a technician, etc. This is a positive indicator of institutional commitment to the peer reviewers.

Collaborators and Consultants

- Determine the expertise needed for your research study team (individuals, collaborating organizations, resources, etc.). Most scientific work requires collaboration among researchers, and funding agencies would encourage such relationships.
  - Include letters of commitment in your application that clearly spell out the roles of the collaborators. The grant application should contain a signed letter from each collaborator to the applicant that lists the contribution he or she intends to make and his or her commitment to the work. These letters are often the primary assurance the reviewers have that this work will in fact be done.
  - For consultants, letters should include rate/charge for consulting services.
  - If you are planning to apply with multiple-principal investigators, then take the following into consideration:
  - The format, peer review and administration of applications submitted with multiple PIs do have some significant differences from the traditional single-PI application. Therefore, it is essential to consider all aspects of the funding mechanism before applying, regardless of the type of research proposal to be submitted.
  - All applicants proposing team science efforts are strongly encouraged to contact their program officials at the earliest possible date to discuss the appropriateness submitting with multiple-PIs for the support of their research.

Are you a New or Early Stage Investigator

- It is to your advantage to identify yourself as a new investigator because reviewers are instructed to give special consideration to new investigators. Reviewers will give greater consideration to the proposed approach, rather than the track record.
- First-time applicants may have less preliminary data and fewer publications than more seasoned investigators, and reviewers understand this. Reviewers instead place more emphasis on how the investigator has demonstrated that he or she is truly independent of any former mentors, whether he or she has some of his or her own resources and institutional support, and whether he or she is able to independently lead the research.

Your Research Plan

- The research plan describes the proposed research, stating its significance and how it will be conducted. Remember, your application has two audiences: the majority of reviewers who will probably not be familiar with your techniques or field and a smaller number who will be familiar.
- All reviewers are important to you because each reviewer gets one vote.
- To succeed in peer review, you must win over the assigned reviewers . They act as your advocates in guiding the review panel's discussion of your application.
- Write and organize your application so the primary reviewer can readily grasp and explain what you are proposing and advocate for your application.
- Appeal to the reviewers and the funding agencies by using language that stresses the significance of your proposed work.

Writing in a Logical Sequence

- Create a provisional title
- Write a draft of your Specific Aims
- Write your Research Strategy
- Start with your Significance and Innovation sections
- Then draft the Approach section considering the personnel and skills you'll need for each step
- Evaluate your Specific Aims and methods in light of your expected budget
- As you design experiments, reevaluate your hypothesis, aims, and title to make sure they still reflect your plans
- Prepare your Abstract (a summary of your Specific Aims)
- Complete the other forms

Craft a Title

A punchy title should include the important information to distinguish your project within the research area, your project's goals, and the research problem

- Title should be specific, indicating at least the research area and the goals of your project
- It is within the character limit
- Use as simple language as possible.
- State the research problem and, possibly, your approach to studying it.
- Make sure the title has appropriate keywords

Draft Your Aims

- Your project should tackle important research within your niche: it must be able to move your field forward. Beware of concepts that can’t be strongly supported with your own preliminary data or published data from other laboratories.
- Thinking high level, ask yourself what objectives you could reasonably achieve within the timeframe of a grant. Start broadly with an emphasis on significance, and then focus on generating experiments with clear endpoints reviewers can readily assess.
- Limiting your application to a few Specific Aims keeps you clear of the very common mistake of being overly ambitious. It's much better to think small and propose less than to do the opposite.

Form a Gestalt between Aims and Experiments

- Staying in your niche, propose a project that addresses a highly significant problem
- Is innovative—can create new knowledge
- Is unique
- Outline draft Specific Aims and one or more hypotheses
- Outline experiments
- Assess feasibility
- See whether you have access to all needed resources and expertise
- Make sure the project is not growing too big for your targeted time and budget
- If you hit a roadblock, go back to the failure point and revise your plans

Assess Your Specific Aims

- Would my reviewers see my proposed project as tackling an important problem in a significant field?
- Would they view my Specific Aims as capable of opening up new discoveries in my field?
- Would my reviewers regard the work as new and unique?
- Would they view my Specific Aims as likely to exert a significant influence on the research field(s) involved?
- Are my Specific Aims written clearly and are they easy to understand?

Seek Advices

- You'll want to get outside opinions for a fresh perspective. Don't assume others, including your reviewers, will consider a research area to have the same priority that you do.
- Also discuss your draft aims with colleagues who aren’t in your field. If they can understand your project and get excited about it, you have a better chance your reviewers will as well.
- It is particularly useful to have your application reviewed by a colleague who has been successful in getting funding, or better yet, has served on a study section of the same funding agency
- At this point, you may want to go back and reconsider your Specific Aims so you can be as certain as possible that the committee will appreciate your research plans.

How to Handle Innovation in Your Application

- As you scrutinize your Specific Aims, make sure your reviewers will view them to be reasonably close to the scientific mainstream.
- If your proposal challenges commonly held beliefs, be sure that you include sufficient evidence in your preliminary data to convince the reviewers that these beliefs may not be scientifically valid. If your research is high risk, it is likely to be highly innovative. Your job is to make the reviewers feel confident that the risk is worth taking.
- So the research you propose should be new and unique and able to push forward the frontier of knowledge just ahead starting from what's known.
- When you write your application, you'll put the information about your project's importance and innovation in the Significance and Innovation sections.
- Never forget that reviewers also look at the feasibility of the proposed research. Novelty alone will not help you if the proposed studies are not feasible given the available time, funds, and resources to do the work.

Successful Research Strategy

- When writing your Research Strategy, your goal is to present a well-organized, visually appealing, and readable description of your proposed project. That means your writing should be streamlined and organized so your reviewers can readily grasp the information.
- Your application's Research Plan is the map that shows your reviewers how you plan to test your hypothesis. It not only lays out your experiments and expected outcomes, but must also convince your reviewers of your likely success by allaying any doubts that may cross their minds that you will be able to conduct the research.

The Big Three

- When reviewers read your application, they'll look for the answers to three basic questions:
  - Can your research move your field forward?
  - Is the field important—will progress make a difference to human health?
  - Can you and your team carry out the work?

Add Emphasis

- Write yourself an insurance policy against human fallibility: if it's a key point, repeat it, then repeat it again
- Add more emphasis by putting the text in bold, or bold italics
  - While describing a method in the Approach section, state your or collaborators' experience with it.
  - They point out that they have access to a necessary piece of equipment.
  - When explaining the field and the status of current research, weave in your own work and your preliminary data.
  - Delve into the biology of the area to make sure reviewers will grasp the importance of your research and understand your field and how your work fits into it.

Anticipate Reviewer Questions

- Will the investigators be able to get the work done within the project period, or is the proposed work over ambitious?
- Did the PI describe potential pitfalls and possible alternatives?
- Will the experiments generate meaningful data?
- Could the resulting data prove the hypothesis?
- Are others already doing the work, or has it been already completed?

Additional Elements Required in a Grant Application

- The following elements need to be included in the grant application as appropriate. Unless stated, these elements do not influence the rating (priority score) of the application. However, the reviewers are asked to comment on the adequacy of the information provided for each element. Any concerns the reviewers identify may negatively affect and postpone the granting of an award.
  - Bibliography & References Cited
  - Care and Use of Vertebrate Animals in Research
  - Consortium/Contractual Arrangements

Important Writing Tips

- Make Your Project's Goals Realistic
- Be Organized and Logical
- Write in Clear Concise Language
- Sell Your Idea on Paper
- Edit Yourself, but also Enlist Help
- Share for Comments

A Case Study Example

Proposal ID:	CRP26-2021-0002
Proposal Title:	Next-Generation Cell Membrane Coated Nanoparticle Platforms for Biosensing, Imaging and Treatment of Cancer and Cardiovascular Diseases

- The proposal is unfocused and has limited potential for clinical translation.
- The team should consider focusing on a single area instead of on both cancer and atherosclerosis. If the focus is on cancer, the team is suggested to involve an oncologist with immunotherapy expertise and work with animal models to demonstrate *in vivo* proof-of-concept for cancer diagnosis and treatment.
- The success of Projects 2-4 depends on the success of Project 1, and the success of Project 1 depends on the demonstration that these technologies will be efficient *in vivo* when injected into experimental animals. It is not safe to assume that cell culture performance predicts *in vivo* performance. Hence the demonstration of *in vivo* targeting in an animal model is critical.
- Projects 2 and 4 are primarily focused on the development of high-tech imaging agents and treatment modalities for atherosclerosis. These may have limited real-world impact as compared to existing clinical regimens for diagnosis and prevention of atherosclerosis using statins and other drugs to control lipid levels which are simple, inexpensive, and effective.
- Project 4 in particular is likely to have low impact, as there already exist a myriad of more efficient, cost-effective and clinically translatable methods for programming M1 to M2 polarization (for a review, see PMID: 32599709).
- There is lack of details in the methodology. Although some mention is made of *in vivo* validation, no preliminary data or description is given of what model will be used or how validation will be achieved.
- The commercialisation aspects are not well thought through. The team could bring in industry collaborators to testbed the technology.