Applying for grant funds: there’s help around the corner

Liane Reif-Lehrer

Scientists should know where to get help when they write grant proposals. Books, videos, consultants and colleagues can all be useful. The World Wide Web is an excellent resource for finding competitors, collaborators and a wealth of other useful information such as funding agencies, available grant money, pertinent articles and form pages for grant applications. Software is available to help you make an outline of your proposal, prepare the required figures and tables and build a database of references from which to create a bibliography. This article will point you in the right direction for a plethora of information and resources.

Many scientists engaged in research today are faced in their professional lives with having to write grant applications. Although highly skilled in their field of research, many of these researchers have had little training in some of the skills needed for this sometimes seemingly daunting task. Such shortcomings can present a significant barrier to career advancement. At the top of the list is training in writing – in particular, expository writing. The result is that scientists often fail to communicate accurately, clearly and convincingly to their readers, who – in the case of grant applications – are the reviewers. Moreover, some scientists are not aware of the many resources that are available to facilitate the completion of their grant applications or other writing projects.

Getting started

There is a lot to think about and do before you begin to write a proposal. If you are unable to answer most of the questions in Box 1 in a positive way, there is no point in starting to write the proposal. Books and articles on expository writing abound and some deal specifically with how to write good grant applications (Ref. 5; Ref. 6 and references listed in Appendix XI therein). In addition, granting agencies such as the National Institutes of Health (NIH) sometimes provide specific information/instructions for potential applicants about how to prepare the application. For those who prefer to obtain information in other ways, videos are available (see Box 2). These tend to be expensive but can sometimes be borrowed from or viewed at university libraries.

If you learn best from an interactive classroom environment, there are workshops on proposal writing. In a university setting, it is sometimes possible to arrange with a funding agency such as the NIH to send an official to speak to a group of scientists about the grants process at that agency. Such speakers sometimes provide only very general information, often from the perspective of the agency rather than from that of the applicant. The backgrounds of such speakers vary quite a lot. Some may be long-term NIH administrators who have never written a competitive proposal; others, who are ‘converts’ from academia, and might even have served on a study section, might have a lot of experience in proposal writing from ‘both sides of the fence’.

A number of organizations sponsor workshops (see Box 2) on proposal writing and a variety of ancillary topics. Some of these focus on proposals to foundations, others specialize in applications to government agencies. In addition to the larger organizations, many individual consultants run workshops on these subjects. It is important to obtain information and references about potential speakers before contracting with them. If possible, it is wise to attend one of their workshops before deciding whether a given speaker is right for your intended audience. You might be invited free of charge as a ‘prospect’, or you might be asked to pay a fee to attend. The consultant is generally contracted by a private organization and might need to obtain special permission from the host institution to have a visitor at the workshop, so leave ample time for these negotiations.

Another source of help is a community of private consultants who are available to work with you, on an individual basis, on your proposal preparation. These consultants range from people in your field who can comment on the science as well as the writing to those who take no responsibility for the content but can offer substantive help with the presentation. Again, some of these people specialize in either foundation or government applications. Before you sign on with a consultant, obtain references from several previous clients, try to ascertain whether you are likely to work well with this person and agree in writing about the fee for the required level of service. Keep in mind that it is not appropriate for a client to ask a consultant to put in more time on a project than was agreed upon. If you want the consultant to do extra work as the project develops, you should expect to pay for the extra time involved. A conscientious consultant will probably be inclined to give you more time than agreed upon because your success is, in effect, also his or her success.

For a more low-budget approach, try to find a mentor or colleagues who can help. Ideally, a mentor should be someone who has been awarded several grants and has served on a study section. But watch out for mentors who are too senior and have been funded for many years. They often have a certain immunity against following some of the instructions of the funding agency and might not recall that such allowances are not necessarily made for younger investigators.
A bright colleague at your own stage of career development can also be a big help with your application if he or she is a reasonably good writer and is conscientious enough to spend some serious hours reading your proposal. Do not be fooled by the person who agrees to read your proposal but does so quickly and superficially and assures you that you’ve done a ‘great job’. Reviewing a proposal does so quickly and superficially and assures you that you’ve done a ‘great job’. Reviewing a proposal is not a trivial task if done well, so an ‘I’ll read yours if you read mine’ agreement with someone you respect and can trust is often a good solution. The optimal approach for your application is to ask three people to read your application: first, someone who is in your specific field and can critique the science; second, someone who is in science but is not in your specific area of research (this person often simulates the funding agency’s second reviewer for your proposal and can generally spot the places where the application is not clear to someone who is not familiar with the terminology of your specific field); and finally someone who is a good editor and can help to make your application easier to read and understand.

Other resources

A number of helpful resources are available for the various stages of proposal preparation (Table 1). For example, the CRISP (Computer Retrieval of Information on Scientific Projects) database, which contains descriptions of all projects funded by the NIH, can be useful at the very start of your project to ascertain that you are not ‘re-inventing the wheel’ and to give you a sense of who your competitors are and who is doing what in your field. However, searching the CRISP database is not a substitute for keeping up to date with the literature in your field.

Much of the task of keeping up to date can now be managed via the World Wide Web. For example, Current Contents, which is still available in print form, is also available on diskette, CD, FTP and on the World Wide Web, making it much easier to search by topic. A subscription is required and is expensive, but many institutions have a site licence, which provides free access to staff members.

PubMed is the National Library of Medicine’s search service and provides access to over 10 million citations in MEDLINE, PreMEDLINE and other related databases, with links to participating online journals. PubMed (MEDLINE) is free, and the complete versions of refereed articles are available online from PubMed Central. Whole current issues of some journals are available online, including the Proceedings of the National Academy of Sciences and Molecular Biology of the Cell.

For articles that are not available online, Research Associates can generally provide a reprint of an article within 1–3 days for a fee of $10–20 per article. INFOTRIEVE is another research portal offering – for a fee – document retrieval and delivery, awareness alerts, databases on the web and a variety of tools to simplify the process of identifying and retrieving published literature.

Once you have obtained references that are of interest to you, you will no doubt want to store them.
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<thead>
<tr>
<th>Resource</th>
<th>URL</th>
<th>Comments</th>
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<tr>
<td>Current Contents</td>
<td><a href="http://connect.isihost.com">http://connect.isihost.com</a></td>
<td>Available in print form. Also on diskette, CD, FTP and on the Web, making it easier to search by topic. Subscription is required for use and is expensive but many institutions have a site license, which provides free access to staff members</td>
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<tr>
<td>CRISP (Computer Retrieval of Information on Scientific Projects) Database</td>
<td><a href="https://www-commons.cit.nih.gov/crisp">https://www-commons.cit.nih.gov/crisp</a></td>
<td>Contains descriptions of all projects funded by NIH</td>
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<td>PubMed Central</td>
<td><a href="http://www.pubmedcentral.nih.gov">http://www.pubmedcentral.nih.gov</a></td>
<td>Complete versions of refereed articles available online</td>
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<td>Research Associates</td>
<td><a href="http://www.researchAssociates.com">http://www.researchAssociates.com</a></td>
<td>Provides reprints of an article within 1–3 days for a fee of $10–20 per article</td>
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<td>INFOTRIEVE</td>
<td><a href="http://www3.infotrieve.com">http://www3.infotrieve.com</a></td>
<td>Offers document retrieval and delivery, awareness alerts, databases on the web, and tools to retrieve published literature for a fee.</td>
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<td>EndNote</td>
<td><a href="http://www.isiresearchsoft.com">http://www.isiresearchsoft.com</a></td>
<td>Flexible bibliographic data base of your own using a software program that allows you to format your bibliography in the style of your choice</td>
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<td>PROCITE</td>
<td><a href="http://www.isiresearchsoft.com/pc/pcreviews.html">http://www.isiresearchsoft.com/pc/pcreviews.html</a></td>
<td>Bibliographic data base–provides you with basic database management techniques</td>
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<td>Community of Science (COS)</td>
<td><a href="http://www.cos.com/main">http://www.cos.com/main</a> COS Home Page; <a href="http://fundingopps2.cos.com/">http://fundingopps2.cos.com/</a></td>
<td>Worldwide funding opportunities database; available only to researchers at COS member institutions. Weekly email Funding Alerts keep researchers abreast of new opportunities in their disciplines.</td>
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<td>COS</td>
<td><a href="http://www.cos.com/services/">http://www.cos.com/services/</a></td>
<td>Database of researcher profiles from over 190 leading universities. Available only to researchers at COS member institutions.</td>
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<td>InfoEd International</td>
<td><a href="http://www.infoed.org">http://www.infoed.org</a></td>
<td>Maintains database of funding opportunities and numerous other services to subscribers</td>
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<td>Grantsnet</td>
<td><a href="http://www.grantsnet.org">http://www.grantsnet.org</a></td>
<td>Website for young biomedical scientists (undergraduate to just beyond post-doctoral training). Is part of Science’s ‘Next Wave’. Grantsnet has a large database of fellowships, links to websites of funding organizations, and information about – and tips from – previous recipients of funding.</td>
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<td>Grantsnet ‘Global Links’</td>
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<td>For scientists working in the UK. connects to funding databases around the world. ‘Next Wave’ has sites for the United Kingdom, Canada and Germany.</td>
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<td>Science’s ‘Next Wave’</td>
<td><a href="http://www.nextwave.org">http://www.nextwave.org</a></td>
<td>Provides career information and reviews of useful resources for young scientists</td>
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<td>International Grants Finder</td>
<td><a href="http://www.nature.com/nature/grants/">http://www.nature.com/nature/grants/</a></td>
<td>Database, maintained by Nature, for locating grants available in scientific fields worldwide. Updated annually using information extracted from Macmillan Reference Ltd UK’s Grant’s Register</td>
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<td>The Medical Research Council (MRC)</td>
<td><a href="http://www.mrc.ac.uk/r_s_s1.html">http://www.mrc.ac.uk/r_s_s1.html</a></td>
<td>Common source of funding for British scientists</td>
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<td>The Wellcome Trust</td>
<td><a href="http://www.wellcome.ac.uk/en/1/grf.html">http://www.wellcome.ac.uk/en/1/grf.html</a></td>
<td>Maintains a database of UK organizations supporting biomedical research</td>
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<td>The European Science Foundation</td>
<td><a href="http://www.esf.org/programm/active_p.htm">http://www.esf.org/programm/active_p.htm</a></td>
<td>Has funding programs in many scientific fields including medical, life, and environmental sciences</td>
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<td>The Biotechnology and Biological Sciences Research Council (BBSRC)</td>
<td><a href="http://is.bbsrc.ac.uk/">http://is.bbsrc.ac.uk/</a> <a href="http://www.bbsrc.ac.uk/opennet/structur/stg/bcb.html#5">http://www.bbsrc.ac.uk/opennet/structur/stg/bcb.html#5</a></td>
<td>UK’s leading funding agency for academic research in the non-medical life sciences</td>
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<td>Funders Online</td>
<td><a href="http://www.fundersonline.org/">http://www.fundersonline.org/</a></td>
<td>Allows searches of Europe's OnLine philanthropic community (foundations and corporate funders)</td>
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<td>NIH website</td>
<td><a href="http://grants.nih.gov/grants/forms.htm">http://grants.nih.gov/grants/forms.htm</a></td>
<td>Originally: Texas Research Administrators Group; now: Research Administrators Group site. TRAM has interactive PDF versions of the NIH forms and a search engine (updated daily) for funding opportunities</td>
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<tr>
<td>TRAM</td>
<td><a href="http://tram.east.asu.edu/forms/index.html">http://tram.east.asu.edu/forms/index.html</a></td>
<td>Commercial programs. Are costly but provide better-looking forms and various kinds of help/support for filling out the application</td>
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<td>GrantForms</td>
<td><a href="http://www.grantforms.com">http://www.grantforms.com</a></td>
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<td>GrantSlam</td>
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<td>GrantBuilder</td>
<td><a href="http://www.scipoint.com">http://www.scipoint.com</a></td>
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<tr>
<td>Inspiration</td>
<td><a href="http://www.inspiration.com">http://www.inspiration.com</a></td>
<td>An outline processor. Such programs can also be found within Microsoft Word and Word Perfect. Outline Processors are incredibly helpful tools for proposal writing</td>
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in a flexible bibliographic database of your own. Software programs such as EndNote allow you to format your bibliography in the style of your choice; PROCITE also provides you with basic database management techniques.

Finding a funding agency
Finding the right funding agency can be difficult and time consuming, but it is important to ensure you are applying to an agency whose mandate matches your proposal topic and whose level of enthusiasm for your particular project matches yours. Do not be afraid to call a potential agency and discuss your project in relation to the agency mandate with the relevant programme officer. It also helps to determine what the review criteria are. Government agencies generally publish these criteria, but some private foundations consider this privileged information.

US funding agencies
There are several resources to help identify possible sources of grant money. The Community of Science (COS), a spin-off company of Johns Hopkins University, publishes a worldwide Funding Opportunities database as well as a database of researcher profiles for over 190 leading universities. Both databases are searchable and available on an unrestricted basis to all researchers at COS member institutions, along with a weekly e-mail Funding Alert that keeps researchers abreast of new opportunities in their discipline. InfoEd International provides a database of funding opportunities and numerous other services to its subscribers. InfoEd, based in New York State, has a branch in Manchester, UK.

Grantsnet is a website for young biomedical scientists (from undergraduates to those just beyond postdoctoral training) that was created as a joint venture by the Howard Hughes Medical Institute and the American Association for the Advancement of Science. Grantsnet, part of Science’s ‘Next Wave’, has a large database on fellowships, links to websites of funding organizations and information about – and tips from – previous recipients of funding. Next Wave also provides career information and reviews of useful resources for young scientists.

UK funding agencies
For scientists working in the UK, the Grantsnet ‘Global Links’ connects to funding databases around the world. Next Wave has sites for the UK, Canada and Germany. Nature maintains the International Grants Finder, which is a database for locating grants that are available in scientific fields worldwide. The database is updated annually using information extracted from the UK Grants’ Register of Macmillan Reference Ltd. The Medical Research Council (MRC) is a popular source of funding for British scientists. The Wellcome Trust maintains a database of UK organizations that support biomedical research. The European Science Foundation has funding programmes in many scientific fields, including medical, life and environmental sciences.

The Biotechnology and Biological Sciences Research Council (BBSRC), established in 1994, is the UK’s leading funding agency for academic research in the non-medical life sciences. Funders Online allows you to search Europe’s OnLine philanthropic community (foundations and corporate funders). The agencies mentioned here are just a few of the funding sources that are available in the UK.

Dealing with the form pages of the application
Once you have identified an appropriate funding agency for your project and your needs, you will be ready to prepare the grant application. Form pages for a number of grant applications are available on the web (Table 1). For the NIH, grant forms are available on the NIH website, as well as at the TRAM (originally, Texas Research Administrators Group; now, Research Administrators Group) site. TRAM says it is the only site with interactive PDF versions of the NIH forms. TRAM also contains a search engine for funding opportunities (contents are updated daily).

Some universities also put grant forms on their home page. Some of these require both a word processing program and a spreadsheet program (e.g. Microsoft Excel). Some online forms do a less than perfect simulation of the NIH grant application pages. Always check that the forms are the latest version (currently Revised 4/98 at the NIH) for the agency to which you plan to apply. Commercial programs such as GrantForms, GrantSlam and GrantBuilder (Table 1) are costly but provide better-looking forms and various kinds of help/support for filling out the application.

Writing the research plan for the proposal
It is a good policy to follow a series of defined steps (Box 3) when preparing a grant application. When it comes to writing the research plan, you will save yourself much time and effort if you make an outline before you start to write. First, outline the agency instructions. Then intercalate your responses into the instructions. Outline processors (such as Inspiration or those in Microsoft Word and WordPerfect) are incredibly helpful tools that are

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**BOX 3 – STEPS FOR CREATING A GOOD GRANT PROPOSAL**

- Research topic
- Formulate ideas/hypotheses for proposal
- Plan project
- Do preliminary studies
- Make an outline of the proposal
- Revise outline until all necessary information is included and all is in a logical order
- Convert outline to prose document
- Proofread and revise document (proposal)
- Send to three readers to evaluate content (accuracy), clarity, consistency, brevity and style (emphasis, tone, presentation)
- Incorporate appropriate suggestions from readers
- Do final revisions, proofread, finalize proposal

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often overlooked or under-utilized. Good writers might use two-thirds of their total project time to prepare the outline. Do not convert to prose until you are completely satisfied with your outline.

You can get help from various software programs when making figures and tables, and be sure to avail yourself of the grammar and spell checkers on your word-processing software, but bear in mind that spell checkers will not spot differences between valid spellings (e.g. ‘there’ and ‘their’). Thus, a ‘human’ proofreading – done when you are wide awake – is essential. Such thorough checking procedures help to give the reader/reviewer the impression that you ‘cared enough to send the very best’.

**Bringing it all together**

Make sure to keep up to date by perusing the pertinent literature, exchanging information with colleagues and searching the Web for other resources that are relevant to preparing a good grant application; you will undoubtedly find additional useful resources to help you do a better job in a shorter time. Internet resources, in particular, are burgeoning. Most important of all, find reliable ‘pre-reviewers’ for your application. Also keep in mind that it is quite common not to get funded in response to a first application. Don’t be discouraged. Re-apply, responding to all the comments of the reviewers. If you start with a good idea that is within the mandate of the funding agency and you do all your homework carefully, there is a good chance that you will get funded on the second or third try. Writing a good grant application requires lots of hard work and patience, but the rewards are generally worth the effort.

**References**

1 Strunk, W., Jr and White, E.B. (1979) The Elements of Style (3rd edn), Macmillan

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**Biological information in colours**

**Flow Cytometry and Cell Sorting**

*edited by A. Radbruch, Springer-Verlag, 2000. £51.50 (355 pages)*

ISBN 3 540 65630 8

Flow cytometry was developed in the late-1960s and has become a very powerful tool in many areas of biological and clinical investigations. Novel fluorescent probes and specific antibodies are becoming available, and innovative experimental protocols in this area have been designed. Today, one can detect quantitatively different receptors and cellular compartments, intracellular structures or macromolecules such as nucleic acids or proteins, all in a single cell and in real time. Applications of flow cytometry include measurements of cytosolic or lysosomal pH, membrane potential in functional mitochondria, oxygen radicals, cytosolic free Ca$^{2+}$, transfected reporter genes and endocytosis, to name just a few possibilities.

The literature is abundant in this regard, but experimental procedures are frequently complicated, in both the handling of biological samples and the technical set-up of the flow cytometer. In addition to difficult-to-operate machinery, statistical analysis of the results requires dedicated and sophisticated software. Therefore, the need has arisen for a detailed guide written by specialists. This is the scope of this laboratory manual. It contains more than twenty chapters in a useful brochure format organized into different topics, each presented by a research group specialized in the respective field. The manual starts out with a brief historical review of flow cytometry, and an introduction to operating a flow cytometer, including the mechanics, electronics, light sources (mostly lasers) and optics involved, illustrated by many schemes and diagrams. The chapter also includes some pertinent properties of the most commonly used fluorescent probes.

The major field of application of flow cytometry is probably immuno-fluorescence. In this particular aspect, the authors excel in terms of extensively covering and illustrating practical aspects such as cell fixation, direct and indirect staining, including multicolour labelling, and surface or intracellular staining. There is also a discussion on data analysis and presentations on particular subjects and even adaptations of classical techniques, such as Scatchard analysis. In contrast to the above-mentioned chapter, the one covering the cytometrical measurement of DNA and cell proliferation is disappointing. Although describing classical techniques for measuring DNA content and synthesis, it makes no mention of new nucleic acid stains with enhanced brightness1 or more recent approaches to detecting DNA replication2.

The next section deals with biochemical and metabolic aspects of cellular function and describes diverse protocols, including detailed methods to measure cytosolic pH and free Ca$^{2+}$, membrane potential, oxidative burst, ligand acidification by endocytosis and reporter gene expression. A sophisticated methodology called fixed-time flow cytometry is also worthy of mention; it allows the measurement of fast transient cellular responses upon exposure to external signals.

The last part of the manual is dedicated to cell sorting, either by the classical method of fluorescence activated cell sorting (FACS) or by a new methodology known as magnetic cell sorting (MACS). Beginning with a careful description of how to set up the equipment for effective cell sorting,