Once you have started your career as an independent scientist, have put your laboratory in order, and perhaps have hired some people, an important next step if you would like to have an international career is to find international funding for your work.

It is beyond the scope of this book to address funding in all of the countries of the South, since the funding situation is different everywhere and in some places can change quite quickly. Instead, this chapter will concentrate on international funding sources and how best to present your work so that you may tap into these sources. This chapter also uses the U.S. NIH funding process as an example of a two-level peer review system. Not all international funders use the same system—in fact, each major funding body has a system that is distinctly its own. But the example used here will give you a good idea of the how’s and why’s of peer review, which we hope will give you insight into how to prepare the strongest grant application you can, no matter what funding body you are approaching. This chapter includes advice on how to turn your concept into a solid research plan, and discusses what to do if your application is not funded.

UNDERSTANDING THE REVIEW PROCESS

EXAMPLE OF PEER REVIEW: FUNDING A U.S. NIH R01 RESEARCH PROJECT GRANT

Though the U.S. NIH is sometimes an international funder, it is (as are your own country’s government agencies focused on health) an organization whose mission primarily focuses on the health of its country’s citizens. For this reason, its spending on many problems of interest in other parts of the world is relatively small.

There is no grantsmanship that will turn a bad idea into a good one, but there are many ways to disguise a good one.

William Raub, former deputy director, U.S. NIH

The quote above: Descartes, in the second rule of his Method, says to break each difficulty down into smaller resolvable component parts.
Peer review committees:
- Are managed by a scientific review administrator (SRA), a professional NIH employee at the M.D. or Ph.D. level with a scientific background close to the study section’s area of expertise.
- Have 12-24 members recruited from active scientists, generally people who have (or have had) R01s themselves. Most members are academics. Some have long-term appointments to the study section and others are temporary members.
- Will review as many as 60-100 applications per meeting.
- Usually assign three reviewers to very closely review each application, though the whole panel should read all of the applications.

Study section meetings:
- Are closed—the discussions are not made part of the public record and spectators are not allowed.
- Include a discussion of general business, provisional approval of the list of applications which are declared uncompetitive and thus not scored, and discussion of the remaining applications. Reviewers who have a conflict of interest with a given applicant are asked to leave the room when that applicant’s grant is discussed.

Discussion of applications includes:
- The three reviewers most closely linked to each grant providing discussion of that grant’s strengths, weaknesses, and their preliminary scores.
- Other members discussing scientific and technical merit.
- All members stating their scores, which are recorded.
- Any recommendations for changes in the budgets of individual grants.

After each meeting, the SRA documents the results in a summary statement, which is forwarded both to the appropriate institute or center that would support the grant (if budget is available) and to the principal investigator. These summary statements, which are often called “pink sheets” because they were once given back to the applicant as the pink layer from a multi-sheet carbon-paper form, are the key to understanding what was said about your grant during the review.

Summary statements may vary somewhat depending on the SRA, but all contain:
- Overall résumé and summary of review discussion (for applications that were discussed and scored).
- Essentially unedited critiques by the assigned reviewers.
- Priority score and percentile ranking.
- Budget recommendations.
- Administrative notes (e.g., comments on human subjects or animal welfare).

The major grant that funds most U.S. health scientists’ work is called an “R01.” There is no special reason these grants are called R01—it is not an abbreviation for any longer term. The letter R conveys that it is a Research Project Grant, but there are other types of NIH research grants that begin with other letters.

R01 grant applications are usually investigator-initiated—that is, the researcher proposes a topic to study rather than the agency indicating what kinds of topics it would like to see. Other approaches are also common among large funders. Many funders (including NIH) use Requests for Proposals (RFPs), Requests for Applications (RFAs), or Program
Announcements (PAs) to alert researchers to grant opportunities that will fund research around particular topics.

Applications to NIH are submitted to the agency and then immediately sent to a division that specializes in managing the review of applications—the Center for Scientific Review (CSR). There the grant is reviewed on two levels: one is a peer review level meant to evaluate the proposal’s scientific and technical merit, the other is review by staff members from a few of the agency’s many institutes and centers to determine where the grant might best fit into the agency’s interests. For example, a grant that focuses on atherosclerosis would face peer review by a panel of experts in heart disease and, after review by the institutes and centers, would likely find its way to the institute that focuses on heart disease. Within the overarching agency NIH, that is a section called the National Heart, Lung, and Blood Institute. A grant you might write with an American collaborator to fund research on Chagas disease (a parasitic infection with considerable impact on the heart) might make its way to that institute, or to the NIH institute that focuses on infectious diseases, or, if it is a Fogarty International Research Collaboration Award (FIRCA), it might be funded by the Fogarty International Center, which is also a section of NIH. The Fogarty Center’s work focuses on global health and international partnerships.

At NIH, the level of review that focuses on scientific and technical merit is carried out by one of many “study sections,” each of which is organized around a general scientific area. Each study section has a specific scientific focus. Individual reviewers who are members of the study section review a grant application for scientific merit. Each rates it with a numerical score, and then the whole committee comes to agreement on the proposal’s final score, a three-digit number. In this system, 100 is the best possible score, and 500 is the worst. After reviewing the proposal as individuals, proposals that the committee members agree are not of high enough quality to be competitive are often not even discussed at the peer review meeting, and will not receive a numerical score.

**Q & A**

**Where do research funds come from?**

**Answer**

- National governments, including both that of the country where you will work and those of other nations that have taken an interest in supporting work in your area of science or your geographical region.
- Non-governmental organizations—a very broad group of national and international organizations.
- Multinational organizations such as the United Nations and its agencies (for example, UNICEF), the World Health Organization, etc.
- Public-Private Partnerships such as the Global Fund to Fight AIDS, Tuberculosis, and Malaria, the International AIDS Vaccine Initiative, etc.
- Private foundations such as the Wellcome Trust, the Bill and Melinda Gates Foundation, the Howard Hughes Medical Institute, etc.
- National and multinational corporations such as mining companies, oil companies, etc.
WHEN POOR SCORES ARE GIVEN

Applications may receive poor priority scores for any number of reasons, including:

- Lack of original ideas.
- Absence of an acceptable scientific rationale.
- Lack of experience in the essential methodology.
- Questionable reasoning in experimental approach.
- A diffuse, superficial, or unfocused research plan.
- Lack of sufficient experimental detail.
- Lack of knowledge of published relevant work.
- An unrealistically large amount of work for the given time frame or funding level.
- Uncertainty about future directions.

PREPARING A STRONG GRANT APPLICATION

GETTING STARTED

Successful grant applications begin with a good idea. See page 102 for the sequence of steps that can guide you from your good idea through the submission of an application to the final decision about funding. You can send the same application to multiple funding sources, but you must disclose your multiple applications to each potential funder. If two or more funders agree to support the same application, you must let them know that the work has already found support. This may cause some funders to withdraw their support, but others will only ask you to propose some new work that will go beyond the original proposal. Although it may be tempting to keep both, you do not want your supporters to find out later to their surprise that they have “bought” the same work as another funder.

Once you have a good idea, you can get started in two realms: your own institution and an appropriate funder. Information about potential funders is contained in the Resources section of this chapter.
Seek input at your own institution. If no one at your institution has been successful at getting funded, look for others as close to you as possible who have gotten international grants. In some places this may mean approaching people who are across the country from you, or even in another country in your region. Colleagues from farther away may be able to give you helpful insight on scientific issues and the overall logic of the work you are proposing, but get as much input as you can from people who face the same kinds of funding challenges that you will.

Keith Yamamoto, a well-known cell biologist, recommends this to his younger colleagues: ask three colleagues who have written fundable grants to serve as a “grant committee” to help you get your own work funded. If you have found a group of colleagues who are willing to help you this way, set a time to talk with them, as a group if possible, about your research goals, aims, and ideas. Prepare yourself beforehand—you should be able to brief them on your specific goals, grant ideas, and potential funders in approximately two hours—not two days.

After you have sharpened your thinking by preparing for the conversation and talking with your grant committee, read the grant solicitations that seem to fit you best and choose one on which to focus. List three to five specific aims, and explain in writing for yourself why each aim is important. Then discuss this limited group of aims with the same small group of experienced colleagues, and then refine your aims according to their comments. Again, this conversation or group of conversations should be short—on the order of two hours—because you will have focused on what is important and will not be discussing other topics. Once you have finished, you are ready to write a grant. The specific aims are the hardest part and are the true heart of a grant, and at this point, you have them well in hand.

In general, a good grant application will answer for a reader:

- What do you want to do?
- Why is it important?
- Why do you think you can do it?
- Has this area been studied before? If so, what has been done?
- What approaches will you use, and why?
- Why do you think it is feasible?
- What will you do if your initial approach does not work as planned?
- What resources and expertise are available to you from your institution?

Keep in mind that your reviewer may pick up your proposal after reading tens of others. You need to do a very good job of writing and of arguing for your ideas, because your reader may be distracted, disinterested, grumpy, hungry, or in a bad mood by the time he or she begins looking at your grant. Start working on the writing well ahead of the deadline so that your grant will put your work forward well. Prepare your application with care—use your computer’s spell check but also read your work over many times and give it to others to get “fresh eyes” looking for simple errors. Do not try to evade the page limit by using small type or narrow margins. Do not feel you must write up to the full page limit; you get points for strength, not length.

In the specific aims, be specific about reagents and quantify whenever possible. You may be trying to leave your options open, but a reviewer may see a lack of detail as a lack of knowledge on your part. At the same time, be brief—try to keep your specific aims to two or three sentences each.

Use language and formatting to create signposts for overworked reviewers, for example:

- The long-term objectives of this project are...
- The general strategy of the proposed research is to...
- The specific aims of the present study are...
- Four goals are envisioned:...
- In these experiments, molecular genetic, biochemical, and structural approaches will be used to...

Do not put anything that is critical for reviewers to read, such as key graphics, in an appendix, because reviewers are not required to read
appendixes. Do include clear tables, figures, and diagrams (along with legends). Put them in the body of the text, not in pages following it as you might when submitting a paper.

The particular format of a given grant may vary, but just like scientific papers, scientific grants have predictable structures. Draft an abstract, research design section, and methods section. Then draft the section on your current relevant work, and the sections on the background and significance of what you propose to do. Conduct a thorough literature search and cite all relevant literature (omissions here are often a source of criticism). Be sure to discuss your work in the context of these published results. Conclude each section in the research plan with a few sentences stating what you will learn and why that information is important—for example, “These experiments are important because nothing is known about X, and they will enable us to distinguish between two controversial models that are widely discussed in the field.”

Reviewers will look for your record of getting related work done, so if you do not yet have published work showing your success with the required methods, do some preliminary work and present a short summary of the results in your grant application. Re-read the funder’s instructions very carefully, paying particularly close attention to whether you have done everything the application requires and whether your work matches well with any criteria for selection listed.

If you will be using human subjects, collecting human samples, or using animals, make sure to give yourself time to discuss the project with the people who will be responsible for approving the project’s ethics and determining that your use of animals is in accordance with international standards.

If new data become available after you have submitted the application, contact the appropriate program officer to see whether you will be allowed to submit this additional information, and if so, how to do so.

The Application: From Concept to Submission

- **In the beginning: have a good idea.**
- **Find a home for your research; investigate funding agencies that may support the kind of work you propose.**
- **Seek input at your own institution.**
- **Write an abstract describing your proposed work in clear language suitable for an educated layperson.**
- **Contact program officers at the agencies you would like to approach for support.**
- **If the conversation is encouraging, send an abstract to the program officer.**
If the conversation is discouraging, and if it is a large agency, contact another program officer and have the same kind of conversation with a different person. If you are discouraged a second time, your idea is likely not a good fit for the agency.

Prepare your application; refer frequently to any instructions on what will determine which grants are funded.

Draft a one-page cover letter in which you express why you believe your application fits the agency or the particular solicitation to which you are responding. Suggest potential reviewers for your work, and mention your conversation with a supportive program officer.

The Application: From Submission through Funding Decision

Submit your application on time; follow instructions carefully.

Check by email to make sure the application was received.

After peer review, carefully read any feedback given by the review committee. At some agencies, this feedback may come before funding decisions are made.

If revision and resubmission are recommended, consult colleagues at your institution and program officer for guidance, address all critical comments thoroughly, and resubmit your application. Learn from the summary statement and the program officer: negative comments will contain information that could help you write a stronger proposal in the future.

If appropriate, consult the program officer about challenging a review you think is flawed, especially if the reviewers’ comments seem to miss the point of your proposal.

If the application is funded, first, celebrate. Find out when and how the grant will be paid, and then wait expectantly—soon, you can begin the proposed work!

If the application is not funded, consult your program officer for guidance and either revise and resubmit the application, or apply what you have learned to write a new application.

### Components of a Generic Grant Application

**Abstract**

**Research Plan**
- Specific Aims
- Background (like a review article)
- Significance or Relevance
- Preliminary Results

**Research Design and Methods**

**Resources and Facilities**
- Including description of your lab and the equipment in it, as well as shared equipment and equipment you have access to at nearby facilities

### Tips on Writing an Abstract

The abstract should convey the big picture—the general hypothesis and aims, the methodological approach, and the significance of the research. Try to avoid technical jargon, and write the abstract in language an educated layperson can understand.

### Reviewers Focus on the Four Cs

**Clarity.** Cross-reference current literature in laying out your premises.

**Content.** Organize your ideas around associated aims linked to your central hypothesis. (The mission statement of each funding institute or review committee sets forth its areas of emphasis.)

**Coherence of concepts.** Present a coherent set of ideas predicated on previous work.

**Cutting edge.** Be ready to take legitimate risks, preferably based on preliminary data, to move the science forward.
Direct costs comprise those expenses that are directly related to conducting a research project. They include salaries, employee benefits, equipment and scientific instruments, consumable supplies such as printer paper and pipettes, reagents, laboratory computers, and postage. Indirect costs (informally termed “overhead”) comprise the expenses that are paid to your institution by the funding organization to support your research but cannot easily be charged directly to a specific grant. These include administration, utilities, computer infrastructure, building maintenance, security, and custodial services. These items can add significantly to the cost of doing research. Generally, an institution’s administrators, on behalf of the investigator, will negotiate indirect costs with funding organizations that allow these costs. The organization then provides funds for indirect costs to the institution, along with funds to cover direct costs charged to the research grants.

Some organizations, especially foundations, do not allow indirect costs, but often will allow many of the items listed above to be included as direct costs of the grant.

Criteria for Rating. Here are some questions that reviewers will ask about your proposal:

- **Significance**: Does it address an important problem? Will it advance scientific knowledge? Will it affect concepts or methods in this field?
- **Approach**: Are the experimental design and methods appropriate to the aims? Does it acknowledge problem areas and consider alternative tactics (in other words, is there a thoughtful backup plan)?
- **Innovation**: Does it employ novel concepts, approaches, or methods? Does it challenge existing paradigms or develop new methodologies?
- **Investigator**: Is the investigator appropriately trained to carry out the proposed work? Is the work appropriate to the experience of the principal investigator and collaborators?
- **Environment**: Does the institutional environment contribute to the probability of success? Is there evidence of institutional support?

**THINKING ABOUT A GRANT’S BUDGET**

The budget is a categorical description of the proposed costs. Generally, it explains staffing and supply/service consumption patterns, the methods used to estimate/calculate these items, and other details such as lists of items that make up the total costs for a category. The budget should address each of the major cost categories, such as:

- **Personnel**
- **Number of positions and level of expertise for each position**
- **Percent effort for each position**
- **What each member of the proposed research team will be doing**
- **Equipment**
- **Why you need this piece of equipment**
- **What equipment you used to get preliminary data**
- **Why the above equipment is not sufficient to support R01-level effort**
Occasionally, mistakes are made during the review process. If you believe that the reviewers criticized you for information they overlooked in your application, or think the review was flawed for other reasons, consult the program officer about the possibility of appealing the study section’s decision. Although this action is sometimes appropriate, it is usually better to address review comments and resubmit your application. Follow the program officer’s guidance on this matter.

If the reviewers thought your starting hypothesis was seriously flawed, do not waste your time revising and resubmitting the application. Instead, learn as much as you can from the summary statement and discussion with the program officer and your colleagues, reconsider your project and approach, and write a stronger application the next time.

If the program officer thinks it is worthwhile for you to revise the application, keep these points in mind:
- Reviewers of amended applications get to see the summary statement from the previous reviews.
- Always treat review comments respectfully.
- Respond to all suggestions and comments, even if you do not agree with them.
- Be explicit about changes. Mark each section of the revised application where you have addressed reviewer critiques.
- Provide any additional data that are now available, and update your publication list if necessary.
- Resubmit the revised application by the due date. Your revised application now begins its journey through the review process all over again, along with the next batch of new submissions from other applicants.

- Cost sharing for new equipment is advisable
- Supplies
- Categorize
- Explain large expenses
- Travel
- Describe proposed meetings, travelers, and estimated cost/trip
- Justify any foreign travel
- Other
- Detailed description of animal per diem costs
- Categorize other expenses

---

The most important challenge for a scientist in my country is that funding for research is limited. Although new private foundations and business companies have started to offer grants for scientific research, there are fewer sources of funding than in developed countries. Additionally, salaries at universities are relatively low. The most important way of facing this challenge is, first, to learn how to apply for grants as early in one’s career as possible. It does not matter if the applications are not successful, but starting to learn the process is very valuable.

Gilbert Brenes Comacho, Costa Rica
RESOURCES


Online

Example of a Funded RO1:

GrantsNet (http://www.grantsnet.org), maintained by the American Association for the Advancement of Science, is a well-maintained database of funding opportunities worldwide.

Other Sources of Funding Information:
FedBizOpps, an evolving database of all U.S. federal government granting programs of more than $25,000: http://www.fedbizopps.gov.

Major Sources Of International Funding:
The Fogarty International Center produces and updates its Directory of Grants and Fellowships in the Global Health Sciences, which lists international funding opportunities from all over the world. It can be found at www.fic.nih.gov.