

Getting grants

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Abbreviations: BSSD, Biological Systems Science Division of the DOE; BWCo, Burroughs Wellcome Company; BWF, Burroughs Wellcome Fund; CAREER, NSF Faculty Early Career Development Program; CSR, NIH Center for Scientific Review; DARPA, Defense Advanced Research Projects Agency; DOE, Department of Energy; ECR, CSR Early Career Reviewer Program; EPSCoR, Experimental Program to Stimulate Competitive Research; IDSA, Infectious Disease Society of America; K22, NIH Research Scholar Development Award; K23, NIH Career Transition Award; K99/R00, NIH Pathway to Independence Award; NIAID, National Institute of Allergy and Infectious Diseases; NIH, National Institutes of Health; NSB, National Science Board; NSF, National Science Foundation; PA, Program Announcements; PECASE, Presidential Early Career Award for Scientists and Engineers; R01, NIH Research Project Grant; R03, NIH Small Research Grant; R21, NIH Exploratory/Developmental Grant; RFA, Request for Applications; SGER, NSF Small Grants for Exploratory Research; VA, Department of Veterans Affairs

Attracting financial support is a critical element of success in science, but we have entered a time of cost constraint with little hope of relief coming soon. For principal investigators, developing a broad base of research support is a valuable strategy for attaining financial stability for the laboratory. New investigators working on problems related to virulence and just beginning to build their careers and laboratories must attain NIH funding. But they should also look beyond that agency to the other federal organizations, state and regional agencies, and non-profits that support research. This review will discuss the general principles of how to understand funders, their intentions, and their funding programs. An investigator who grasps what drives the funders will be better able to write fundable proposals.

Investigators at mid-career and beyond are seeing well-established lines of research go unfunded, disrupting productive laboratories and potentially bringing careers to an end.^{1,2} Institutions have little margin for sustaining science without grant dollars coming in.³ For researchers just beginning their independent careers, building a diversified funding portfolio is a good strategy for keeping a laboratory financially healthy for the long-term. Researchers who have several lines of funding, even if some of those lines are small, should be more able to thrive in tough times than those who rely entirely on the National Institutes of Health (NIH).

This review is written with new investigators in mind, and when the word “you” is used in the material that follows, they are the ones being addressed. The review focuses on understanding the spectrum of funders who may support your work and on what makes a successful grant application. Understanding which

funders do what, and why, is the key to establishing multiple sources of income for your laboratory. Because the NIH is the major supporter of most researchers working on topics related to *Virulence*, grants from that agency, and particularly from the National Institute of Allergy and Infectious Disease (NIAID) will be the source for much of the information here, but opportunities and procedures found at other agencies, including other federal organizations [particularly the National Science Foundation (NSF)], private foundations, and voluntary health organizations will also be discussed. Researchers should note that while the funders of science are different in ways that are important, with few exceptions the major funders of research share the research community's commitment to peer review and to transparency in the funding process. Agencies that predominantly use non-peer review approaches, for instance, the Defense Advanced Research Projects

Agency (DARPA), are important, as well. The bibliography references several good published reviews and commentaries on the mechanics of grants^{4,5} and getting grants to support basic,^{6,7} clinical⁸⁻¹⁰ and translational^{6,11} research.

NIH itself is a particularly good source of information on gaining the Institutes' grants. The NIAID Funding Newsletter ran a well written and comprehensive set of 24 articles on designing a project and seeking funding from the Institute, *The New Investigators Series* in 2010–2011. This series has now been consolidated under the title *Strategy for NIH Funding*,¹² and is essential reading for those who hope to obtain funding from NIAID.

Ten years ago, it would have been unthinkable to define a good attempt at getting a grant as anything other than one that yielded funding. But the current scarcity of resources leaves high-quality proposals unfunded, so perhaps a new definition is warranted. The funding rate

Table 1. NIAID funding of new R01s and R01 renewals, FY2001–2010

Year	New proposals reviewed	New proposals funded	New proposals funding rate	Renewal proposals reviewed	Renewal proposals funded	Renewal funding rate
2001	1421	395	27.8%	415	234	56.4%
2002	1488	380	25.5%	440	214	48.6%
2003	1584	439	27.7%	493	258	52.3%
2004	2061	389	18.9%	518	231	44.6%
2005	2107	425	20.2%	571	215	37.7%
2006	2186	369	16.9%	640	216	33.8%
2007	2087	326	15.6%	619	174	28.1%
2008	1951	333	17.1%	628	200	31.8%
2009	1917	339	17.7%	564	176	31.2%
2010	2097	355	16.9%	521	197	37.8%

Data taken from NIH Reporter Table #206, Research Project Grants (RPGs): Competing Applications, Awards, Success Rate and Total Funding by Application Type, NIH Institutes/Centers and Activity Code Fiscal Years 2001–2010.

of new proposals has dropped over the last decade (see Table 1), but the mental work involved in creating a new funding application is valuable whether the proposal is funded or not. It is never a mistake to think hard about one's work, or to define new ways to move forward. Without claiming that an unfunded grant application is a successful one, this review will outline ways to ensure that time spent going after a grant is productive, even if there is no funding.

Building a Funding Portfolio

While some just-hired assistant professors bring postdoc-to-faculty bridging awards with them as they leave their postdoctoral training, for most new investigators, the institutional start up package negotiated as part of the hiring process serves as the equivalent of a first exploratory grant. Your startup funds provide resources for getting early data that will serve as a platform to support your first independent research project grants.

The small dollars. As you begin to build your lab group, you will take on postdocs and graduate students who themselves will eventually need to build a track record of finding funding and doing independent work. Establishing a precedent in your lab that trainees will actively seek out funding will allow you to give your students and postdocs a rare training experience. If they are successful in finding

support, your own limited funds will stretch further. A number of resources are available to help postdocs and fellows¹³⁻¹⁵ look for support of their own.

Though most research institutions today are financially stressed, your institution may have dollars available for encouraging collaboration between investigators at home, stimulating the use of core facilities, or developing new research projects. Participation in relevant centers within your institution can give you access to resources and funding. Departmental colleagues can be a good source of information about this type of funds, but so can colleagues in far-flung departments. If your appointment is in a medical school but strong research is also being done within other colleges within your institution, investigators in the non-medical departments may be aware of institutional resources that are not commonly used by your closer colleagues. Browsing your institution's internal newsletter regularly will help you become aware of opportunities, including some that are directly advertised and others that will be reported on as colleagues across the institution make use of them. Your department chair or assigned mentor can help you understand which of these small pots of money are appropriate or inappropriate for you to seek, and should help you weigh the costs and benefits of getting involved in collaborative programs and centers during your early faculty years.

Local organizations also may have small funding opportunities that can help you accomplish more. The nearby chapter(s) of Sigma Xi, the scientific research honorary society, likely runs a graduate student research day. Prizes at different chapters range from book awards to research prizes of \$1,000 or more that can cover the student's travel to meetings or reagents required for his or her project. Sigma Xi also makes available its student-focused Grants-in-Aid of Research program. This program provides up to \$1,000 that can also support purchase of specific equipment needed for a student's project, reagents and supplies that are not typically in your laboratory, or travel to and from a research site.

Local community foundations, which provide philanthropic services giving local donors the capacity to create permanent endowments in their areas of interest, also in some cases have small grants that support science. Donors who have lost a loved one to a particular disease, for example, may establish an endowment that generates money for research toward a cure. Though there is usually not a lot of money in these grants, this is a potential funding source that is overlooked by most academics, so it is well worth searching your local community foundation's database of funding opportunities to see if they list anything that will fit your work. Community foundations also frequently support scholarships. Especially in regions where scientific research and technology play an important part in the economy, there may be endowments set up by scientist donors to support graduate students for travel and participation in courses, meetings, and off-site research.

State level funding also frequently exists, particularly for technology development that could bring new industry to your region. This kind of funding can be useful as you are establishing a laboratory, supporting, for example, pilot projects on a microbial or host factor that could be useful for developing diagnostic tools. A number of strong research institutions are located in states that benefit from the National Science Foundation's (NSF's) Experimental Program to Stimulate Competitive Research (EPSCoR),¹⁶ which provides states that have lower capacity in

research and development with support meant to stimulate improvements in their capacity and competitiveness. EPSCoR supports infrastructure development and proposals from individual investigators, groups, and centers. States where you can take advantage of EPSCoR funding include Nevada, Utah, New Mexico, Idaho, Montana, Wyoming, the Dakotas, Iowa, Nebraska, Oklahoma, Arkansas, Mississippi, Louisiana, Alabama, Tennessee, South Carolina, Kentucky, West Virginia, Maine, Vermont, New Hampshire, Alaska, Hawaii, and Puerto Rico.

In many fields, there are funding organizations that support small but important projects. The National Oceanographic and Atmospheric Administration's Sea Grant network, 32 state-based programs around the coastal United States including the Great Lakes states, for example, is a potential source of funding for some work related to water-borne diseases and microbial contaminants of coastal waters. The Morris Animal Foundation supports work on animal health with young investigator awards. Pay attention to the acknowledgments in papers in your field to identify others.

The bread and butter. Investigators who are new to their faculty careers are successfully establishing NIH funding, sometimes with significant help from agency strategies that improve new investigators' chance of being funded. The Research Project Grant (R01) is the oldest of NIH's grant mechanisms. It usually supports a specific, well defined research project performed by an investigator or a small group of investigators. NIH currently sets the R01 payline, the percentile-based funding cutoff point that reflects an Institute's budget and the number of proposals expected, higher (easier to achieve) for new investigators than for those who have successfully competed for NIH support. In 2011, NIAID's R01 payline was 10% for established investigators and 14% for new investigators.¹⁷ New investigator applications are often reviewed together so they are not evaluated sandwiched between proposals written by those with more experience soliciting funding from the agency. When considering grants from new investigators, reviewers consider the applicant's potential as well as his or

her track record. All of these factors lower the barrier for getting one's first major NIH grant, usually an R01. There is no extra boost when it comes time for competitive renewal of these first R01s, so in a few years the now newly funded will face the same lower payline as other established investigators.

NSF has a freestanding program for those just starting out, the Faculty Early Career Development (CAREER) program.¹⁸ Biological science focused awards from this program carry a minimum budget of \$500,000 over five years—\$100,000/year. There is no maximum budget, but budgets must be appropriate for the work proposed and the five year term of support. CAREER awards go to junior faculty who integrate their roles as researchers and educators. These grants can support research in any of the scientific areas that the Foundation funds. NSF grant support is important to health science research in areas including developing animal models, developing molecular tools, understanding regulation of biological processes, and more. Health focused grants do not compete well for NSF grants, but in your early career it may be possible for you to develop lines of research that are broad enough to merit NSF funding and that complement the health oriented work you plan to build with NIH and other support.

NSF also has available small grants for high risk research. The Small Grants for Exploratory Research (SGER) mechanism supports pilot work, high risk/high pay-off work, transformative ideas and work that could change its field or rapidly move its field forward.¹⁹ Because innovation is a key element, it is best to discuss your ideas with the program officer before you begin writing so that you can make sure that what you are planning is appropriate for this kind of support. SEGR grants are normally for one year but can be for two. They can carry a budget of up to \$200,000 but are generally substantially smaller than the typical grant within a given program area.

Other federal agencies may also be important potential supporters of your work. Research!America counts 16 federal agencies among major supporters of health research²⁰ (see Table 2). Department of

Energy's (DOE's) Biological Systems Science Division (BSSD),²¹ for example, supports university and research institute based work in many fields including genomic science, radiochemistry, and structural biology. The agency's world-leading capacity in high performance computing makes it a valuable partner for modeling work whether at the molecular scale, the ecosystem scale, or beyond.²² DOE funding supports research at the agency's own laboratories, at user facilities where infrastructure is shared with other researchers from various sectors, and through competitive grant programs that are announced at grants.gov, the online clearinghouse that lists all federal grant opportunities.

The Department of Veterans Affairs (VA) is an important supporter of work in many significant microbial pathogens. While most VA-supported work is performed by the agency's intramural staff at VA centers around the country, some

Table 2. Federal support of health science research

Federal agency	Support per year, \$Millions
National Institutes of Health	34,829
National Science Foundation	2,914
Department of Defense	2,667
Department of Agriculture	1,265
Department of Energy	1,037
Environmental Protection Agency	596
Department of Commerce	588
Department of Veterans Affairs	581
Centers for Disease Control and Prevention	363
Food and Drug Administration	248
Department of Homeland Security	207
Department of the Interior	205
NASA	182
US. Agency for International Development	158
Centers for Medicare and Medicaid Services	27
Health Resources and Services Administration	8

Source: Research!America US. Investment in Health Research, 2010.

work offsite is also allowed when the non-VA site provides unique research opportunities for VA investigators.²³ Collaborations with VA scientists around a technique or technology that is based in your lab will not bring you grants from the VA, but may give you opportunities to develop new projects or venture into work with new microbes that may open up for you new areas of funding from other agencies.

Grant recipients and intramural scientists from 11 federal agencies including NSF, the Department of Health and Human Services through NIH, the National Aeronautics and Space Administration, the Environmental Protection Agency, the Department of Energy and a number of other agencies that support at least some life science research are eligible for the Presidential Early Career Award for Scientists and Engineers (PECASE),²⁴ a program that recognizes and honors top early career faculty who have exceptional potential to break new scientific ground and become the leaders of their fields. NSF nominees for this award come from the population supported by CAREER awards, and NIH nominees come from among funded junior faculty and from the agency's intramural staff. While the award does not bring with it any additional funding, recognition through a PECASE is arguably the top honor available to junior faculty.

Private sources of funds will also help you build a solid funding portfolio. Private foundations (see Table 3), which support research with the income from endowments or with direct donations, and public charities, which make grants with money raised from the public, are significant supporters of research. Many have programs aimed at supporting the careers of new investigators, often explicitly viewing early investment in your career as a strategy for drawing you into and keeping you engaged in work focused on the problems that the funding organization serves.

Public charities include a number of organizations known as “voluntary health agencies,” which have long histories focused on important infectious disease public health problems including tuberculosis,²⁵ polio,²⁶ AIDS²⁷ and more. The

Table 3. Largest private foundation supporters of health science research

Foundation	Support per year, \$millions
Bill and Melinda Gates Foundation	544.8
The Starr Foundation	50.2
The Lincy Foundation	46.8
Eli and Edythe Broad Foundation	35.1
Flight Attendant Medical Research Institute, Inc.	25.7
Burroughs Wellcome Fund	21.0
Wallace H. Coulter Foundation	20.0
The Simons Foundation	13.8
The John A. Hartford Foundation, Inc.	12.0
James S. McDowell Foundation	11.3

Source: The Foundation Center. Note: The Howard Hughes Medical Institute is not incorporated as a private foundation.

American Heart Association, which started as a scientific and medical professional society, became a voluntary health agency in 1946²⁸ in part so it could support research, in part to do charitable work for those afflicted with heart disease, in part to affect public policy, and in part to formalize its role as an overseer, supporter and critic of the heart disease work of public agencies concerned with the public's health.

Private foundations, like public charities, usually have particular goals for their funding. Grants from foundations can provide early flexible support that will help you start new projects before your first major federal grant or open up new lines of research once you have a federally funded main line project under way.

The Burroughs Wellcome Fund (BWF), where the author of this review is a senior program officer, is in many ways typical of foundations working in the scientific arena. The organization's programs are managed by scientists on staff. Started in 1955 as the corporate foundation of Burroughs Wellcome Co. (BWCo), a discovery-focused pharmaceutical company, BWF became an independent foundation in 1994, shortly before the takeover of BWCo's parent company by Glaxo PLC.

In its early years, BWF supported academic science, often providing early career development for junior faculty who

would become leaders in fields related to the discovery, development, and safety of new drugs—areas like pharmacology, toxicology, and experimental therapeutics. Also supported was work on understudied infectious diseases, primarily the then poorly understood protozoan pathogens that have been responsible for considerable human suffering for centuries. After its independence, BWF expanded its support of infectious disease research to include the fungal pathogens, and in 2001, expanded its support again to include work across the human pathogens through the Investigator in Pathogenesis of Infectious Disease program. BWF also supports postdoctoral training for clinician scientists; postdoctoral training for physical, mathematical and computational scientists moving into the life sciences; graduate training at the interface of the population and bench sciences; reproductive science; and training programs aimed at science teachers and students (kindergarten through college), in North Carolina, where the organization is headquartered.

Most foundations that focus on science advertise their programs on their websites, are listed in the various funding databases and services to which universities subscribe, and broadcast email program announcements to deans, department chairs, and departments of sponsored research across the country.

New foundations relevant to scientists can appear and evolve rapidly. The Ellison Medical Foundation, founded in 1997 by the co-founder of the Oracle Corporation, began funding parasitic and infectious diseases research in 2001 and discontinued support of this field in 2005. The foundation still exists and concentrates its resources on funding research on aging. In 2001, a new research-supporting foundation, the Flight Attendant Medical Research Institute, was incorporated and funded with proceeds from a tobacco lawsuit settlement. FAMRI supports research on health problems connected to second-hand smoking,²⁹ and thus is a potential funder for those working with respiratory pathogens. On the other hand, in 2008, the billion dollar Picower Foundation, a major supporter of neuroscience research, was forced to cut off funding and closed its doors, having lost

all of its money to Bernie Madoff's Ponzi scheme.³⁰

Some foundations are designed to exist for a set time: the Whitaker Foundation, incorporated by the founder of the electronic manufacturer AMP Inc., was a major sponsor of biomedical engineering research, spent out its endowment in 2006.³¹ The Louise P. Markey Charitable Trust, founded by an heiress to the Calumet Baking Powder fortune, was launched with the plan that it would cease existing 15 years after its founder's death. The Markey Trust was a major funder of health science research and developed the first postdoc/faculty bridging grant program. As the Markey Trust entered its final years, it worked with the National Academy of Sciences to set up a thorough evaluation of its programs. This evaluation, published in five parts by the National Academies Press,³² is having a lasting impact on how foundations build funding programs in the sciences.

Risk capital. NIH and NSF both have mechanisms (discussed below) that support exploratory research and pilot work on high risk/high payoff ideas. Foundations and public charities have followed the Bill and Melinda Gates Foundation's lead in creating "Grand Challenges" programs meant to stimulate development of new approaches to fundamental questions or to overcoming roadblocks to advancing human health.

DARPA's Young Faculty Award,³³ in place since 2006, supports untenured faculty and provides not only funding but also networking and mentoring toward establishing a faculty research career that includes significant attention to problems of interest to national security issues.

Which Grant Fits?

Before you start writing grants, it is important to understand how a grant proposal works and how it will be scored. Each funder has its own approach to science, its own goals, and its own mission, which is usually easily found on its website or through various grant databases. It is important to learn what drives any funding organization you hope to have support your work. Even among agencies that support the kind of work you do, not

every agency is right for every specific aim. Just as you will eventually have different collaborators for different projects, you should someday have relationships with a number of funding organizations, each supporting work that aligns with its own mission.

NIH's mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce the burdens of illness and disability.³⁴

The mission of the NSF was set forth in the National Science Foundation Act of 1950 (Public Law 81-507).³⁵ The agency works "To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense, and for other purposes." It supports research in all areas of engineering, math, and science except medicine.³⁶ The Act authorized NSF to support basic scientific research and engineering research, strengthen the nation's capacity in science and engineering, support science and engineering education and inform policy formation. Even though NSF's mission mentions the national health, during the four years it took the National Science Foundation Act to become law, the NIH extramural program expanded and developed. By the time NSF was launched in 1950, NIH had already become America's health science funder.³⁷

Though NSF is not a health science oriented funder, it is a key life science funder. New investigators who are interested in virulence may identify fundamental biological questions that will advance their work but that will not be focused on the mechanism of disease.

The missions of the DOE, VA and other agencies also tell you what you need to focus on when asking them for support. In DOE's mission, "to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions," the word "transformative" tells you something important about the scope of work that they are seeking. Likewise, the VA's mission, "To care for him who shall have borne the battle and for his widow and

his orphan," tells you that it is first the veteran, not first the disease, that is the driver of a potential VA intramural collaborator's scientific work.

Missions of private funders also tell you what to concentrate on. Some disease-focused organizations care most about finding cures; others care most about relieving human suffering. If an organization tells its own story in terms of improving the daily lives of people who suffer from a disease, it is a mistake to lead a proposal to that organization with a paragraph that is all about a molecular process. Better to look at your work through their lens and ask which projects within the reach of your laboratory could reasonably be discussed in terms of improving quality of life in the near term rather than in terms of the work leading to a better understanding of the disease.

Sometimes this is a matter of grantsmanship: it makes sense to mirror a funder's language when writing proposals. But sometimes your work is simply not right for a given funder or solicitation. The Bill and Melinda Gates Foundation, whose mission is "to increase opportunity and equity for those most in need," focuses on areas where their philanthropic investment in measurable interventions can bring about change. Important, valuable scientific work on pathogens that cause considerable suffering is often simply not ready to be turned into the kind of practical, field-testable project that the organization is seeking to fund, and application of skilled grantsmanship will not make it any readier for an opportunity that does not fit.

Each funder sets priorities, often through periodic specific planning activities that are fairly transparent. At NIH, with congressional oversight, the Director, currently Francis Collins, sets the organization's course. The NIH Roadmap, the increased focus on translational research, and Director's awards programs, are efforts that cross all of the Institutes. Within NIAID, the National Allergy and Infectious Diseases Advisory Council, usually just called "Council" serves as the advisory committee for the Institute. Council has 24 members, including 18 voting members and six non-voting ex officio members who represent the Institute, the

National Institutes of Health, the Department of Health and Human Services, the Centers for Disease Control and Prevention, the Department of Veterans Affairs and the Department of Defense, which share important interests with the Institute. Of the 18 voting members, six are laypeople and 12 are scientists who bring to Council not only technical expertise but experience in different sectors, including academia and industry. Council has four roles: providing secondary level review after study sections do the primary review; providing policy advice to the Institute, reviewing programs; and approving concepts prepared by the various NIAID Divisions. Concepts are the earliest stage of new initiatives: they are the ideas around which new requests for applications, program announcements, and requests for proposals are built.

At the National Science Foundation, policy is set by the National Science Board (NSB), a panel of up to 25 members appointed by the President of the United States and confirmed by the Senate. NSB is apolitical, with members coming from universities and industry across the spectrum of scientific fields served by the agency. BWF is governed by a 12 member board comprised predominantly of highly accomplished basic and clinical scientists. Non-scientist members of the board are often drawn from science-related industry. Voluntary public health agencies' directions are often set by boards that include scientists, lay people, those affected by the diseases that are the agency's focus, and more.

Which grant when? There are many opportunities available to write grants, so it is tempting to chase grants that are especially large, or prestigious, or that have a deadline convenient to your workflow. But writing the wrong proposal for a given grant opportunity is a serious mistake. A proposal that over-reaches—for example, one that contains far too many aims for the grant's time frame, or that promises more work than can possibly be done with the funds available—may strike one reviewer as naïve, another as foolish and a third as dishonest. None of these impressions is helpful.

Each year there are dozens of competitive grant programs aimed at new investigators, some requests for proposals that

aim at researchers in your field. At the same time, there are multiple federal deadlines for investigator initiated proposals each year. You cannot write a proposal for every solicitation that fits you, and if you try you will not have enough time to achieve everything else you need to get done in your early faculty career. You will be more successful if you write proposals only when you have a good chance of getting them funded. Not every funding opportunity that is relevant to your field will fit you or fit your work. Some will be clearly aimed at another career stage. Others may be meant to support projects larger or smaller than the one that you have in mind. Some will have deadlines too soon for you to meet or too far away to be useful. Most substantial funders have program officers, staff scientists who administer the agency's grant portfolios. Getting to know the program officers at the organizations that are most likely to fund your work is an excellent use of your time because they can give you valuable insight into whether what you hope to submit will be competitive for the grants programs that they manage.

Most new investigators need to spend the first years of their faculty appointment demonstrating independence from those who trained them, by developing and publishing work that is clearly separated from what they accomplished at the end of their postdoctoral training. Startup funds support this early work, as do many of the New Investigator grants from private funders.

Postdoc-to-faculty bridging awards, which bridge the gap between postdoctoral training and independence, have become more common but are still rare. Today the most prominent bridging grant is NIH's Pathway to Independence Award, the K99/R00. NIH's "K" series grant mechanisms are career development awards,³⁸ and "R" series mechanisms are research project grants³⁹ that support independent investigators. The K99/R00 supports mentored postdoctoral training. Once hired into a tenure track faculty job or its equivalent, the award recipient's work is reviewed and if it is judged adequate, the awards can continue with the faculty level R00 segment of the award. Funding of the second step is not

guaranteed—it is possible to lose the award after the postdoctoral stage is reviewed.

NIAID does not fund many K99/R00 awards, preferring to support a different mechanism, the Research Scholar Development Award (K22). The K22 provides early career researchers two years of support to help them as they make the transition from mentored trainee to independence. Open to US citizens, non-citizen US nationals (people born in American Samoa, Swains Island, or the US Minor Outlying Islands) and US permanent residents, the program targets postdoctoral fellows who are about to go on the job market. Applications undergo a two part review. The first part, submitted as a postdoc, is reviewed for merit. Those who receive a fundable score may then submit the second part after they have gained an independent tenure track faculty position or its equivalent. The award provides up to \$150,000 in its first year and up to \$100,000 in its second.

Two other NIH mechanisms can be useful in building preliminary data that can grow to support an R01. Designed as pilot funding for new or risky projects, R21 and R03 grants support small-scale research projects, exploratory and developmental research.⁴⁰ R03s, or small research grants, provide up to \$50,000 per year for up to two years of work on pilot projects, small self-contained projects, and new techniques or technologies. R21s, or exploratory/developmental grants, provide up to \$175,000 for one year or up to \$275,000 total for two years for work on new ideas, as well as for tool and technology development work that may lead to a leap forward for the field in which the work is done. Both of these awards may be a good fit for new assistant professors, but both have innovation elements that are important to gaining support. Consulting with a program officer will help you decide if one of these mechanisms will really fit the proposal you are considering submitting.

A number of private grants are available for early stage new investigators, as well. The Infectious Disease Society of America (IDSA) has two young investigators programs, one of them focused on vaccines. Both are aimed at faculty who do not yet

have R01s. The Searle Scholars program supports only researchers who are close to the date of their faculty appointment. The American Heart Association's National Scientist Development Grant program, which supports work broadly related to cardiovascular disease and stroke, fits some researchers working in infectious diseases and supports researchers who are in the first four years of their faculty appointments. A Young Investigator program from the Arnold and Mabel Beckman Foundation aims to support invention of tools, methods, and materials that will open up new areas of research. Your institution will provide you with access to grant databases and often with lists of opportunities aimed at your career stage or broad area of interest. Because so many private funders offer early faculty grants meant to stimulate work on the funders' specific interests, it is a good idea to read announcements very closely to see if a broadly named grant is, in fact, narrower in interests than it appears. Likewise, it is worth browsing solicitations that do not seem to fit you to see if they have unexpected breadth. Many private funders post lists of those who have gotten their awards, as well as of members of their peer review committees. These, too, provide valuable clues about whether a proposal on your work would have a good chance of being funded by a particular organization.

Looking for solicitations that specifically fit your work rather than your career stage is effective as well. NIH Requests for Applications (RFAs) and Program Announcements (PAs) advertise funding opportunities that can be quite specific. They can reflect priorities of NIH as a whole or priorities of an Institute. These sometimes come with their set aside funding, rather than competing with proposals addressing other topics, but they are not easier grants to get. When applying for these opportunities, you are usually competing with the best and most well established people in your field. If you are not ready to successfully compete for an RFA or PA, writing investigator initiated proposals that address these priorities is a good strategy for getting funded.

Talking with the program officer listed in the request or announcement under Scientific/Research Contact(s) will help

you gauge your chances of putting in an application that will compete well for funding. Helping you understand whether your planned proposal fits into their program and recommending other programs where your work might fit is a core element of a program officer's job. At NIH, within the National Institute of Allergy and Infectious Diseases in mid-2011 there were about 200 program officers. Researchers in your field will be able to advise you on who among the agency's program officers are managing programs covering the kind of work that you would like to get funded.

NSF uses Program Descriptions, Program Announcements, and Program Solicitations to communicate opportunities to investigators. While program descriptions and program announcements are made to highlight programs that use the generic NSF grant format, which is published in their Grant Proposal Guide,¹⁹ program solicitations announce opportunities that are more focused and usually last for a limited time. These programs may have different submission and review processes than most NSF programs and may limit the number of proposals a researcher or an institution may submit. NSF programs sometimes incorporate letters of intent or preliminary proposals, which allow researchers and the agency to invest less time in unfunded proposals when a program's funding rate is expected to be especially low.

What Does It Take to Get a Grant?

What do you want to accomplish in science? What are the BIG questions that will drive you for the next 30 years, and how does that then define what you must accomplish in the next three years? What are the key hypotheses you must test now, and are you proposing the right set of experiments to get there? Can you really accomplish what you say you can?

The proposals you write throughout your career will have different scopes, but they should never be trivial or grandiose. Knowing what is practical and possible is critical to demonstrating true independence. When you are in training, you begin to understand what can be accomplished in the scales of weeks, months and years.

Many leave their training understanding the costs of their own experiments, but the costs of running the whole lab are usually not well understood by students and postdocs. If you are not yet confident with your ability to plan budgets, you should draw on the expertise of colleagues and your department's grant administrator to help you set reasonable budgets. In FY2009, the median single year direct cost of an R01 was \$250,000 and the mean was \$258,000.⁴¹

NIH uses five core review criteria: significance, approach, innovation, investigator, and environment.⁴² A number of other factors, including protections for human subjects; inclusion of minorities, both genders, and children in clinical research; involvement of vertebrate animals; provisions for dealing with biohazards; and whether the proposal is a resubmission, renewal, or revision, were made additional review criteria in fiscal year 2010. They are not scored separately but are considered in a proposal's scoring. Plans for sharing new resources developed during a project, safety and monitoring plans for work involving select agents, and the appropriateness of a proposal's budget and period of support, are also considered during NIH review.

The significance score reflects whether the problem the proposed work will address is important, how knowledge or practice will advance if the aims are achieved, and its potential impact on the field. The approach score rates the reasonableness and workability of the proposed project, and whether the work will be a fitting approach to achieving the proposal's specific aims, and whether the proposal shows the investigator understands potential problems that may arise and knows how to move forward if the initial plan is not fruitful. Scores for innovation consider whether the proposed work is original, exploring an innovative hypothesis or taking on an existing barrier in a new way. The investigator rating indicates whether the principal investigator is well trained, productive, suited to doing the work, is able to get things done, and has included appropriate collaborators needed for the proposed project to succeed. The environment score marks whether the work will be done in a scientific setting

that is conducive to success, with the appropriate pieces—for example, clinical access and a subject population needed for doing the work—available. A sixth score, the overall impact score, is not a sum of the other five. The overall impact score asks reviewers to indicate the likelihood that, as a whole, the proposed work will have a sustained, important influence on its field. The overall impact score reflects whether all of the parts of a proposal come together as a whole in a way that matters and will get the job done.

NSF review focuses on only two criteria, but many of the same factors that NIH review focuses on are contained within them. The first criterion, intellectual merit, comprises factors including how well qualified the proposed work is; whether the work is important for advancing knowledge and understanding in the field in which it is rooted and across different scientific fields; creativity, originality or potential to be transformative; conception and organization of the proposed work; and sharing of resources created by it. The second criterion, broader impacts, includes the proposed activity's potential for advancing knowledge while also promoting teaching, training and learning; broadening participation by under-represented groups; enhancing the infrastructure for research and education; potential for being disseminated broadly; and benefit to society.¹⁹

Private funders score on similar criteria. At the Burroughs Wellcome Fund, the Pathogenesis of Infectious Disease program is aimed at early but independent assistant professors. Review of applications has both scientific and career development elements. Selection is based on factors that include the applicant's qualifications, demonstrated independence, and potential to conduct innovative research; the quality and originality of the proposed work; its potential to advance the science in its field; and whether the proposal brings new experimental approaches to under-studied questions. Institutional environment is important for career development, so BWF is clear on its requirements for this review criterion. The environment includes what the work needs to succeed, and there should be evidence that the institution has taken, or

is prepared to take, exceptional steps toward fostering the candidate's career development.

Serving as a reviewer can rapidly help you improve your understanding of what comprises a fundable grant and of how scientific review works. CSR offers an Early Career Reviewer (ECR) program that allows independent but not yet funded investigators to participate in study section up to twice.⁴³ Having your proposals reviewed by colleagues and reviewing their proposals in turn is an invaluable exercise that can give you more experience to improve your grant writing. As you read and critique others' proposals you will get a better sense of how language and structural factors make a persuasive argument or leave the reviewer doubting that the proposed work is up to par. Colleagues' critiques will highlight the same problems, inconsistencies and unclarity that will give reviewers pause. Ideally, by the time it is submitted, your proposal will anticipate and respond to the concerns that will arise as a reviewer reads and follows your logic.

Submitting a proposal takes longer than you might think. If you are about to write your first few proposals as an independent investigator, when you have found an opportunity that seems right for you, talk with local mentors, your chair, and other investigators in your department to make sure you understand your own institution's requirements and timelines. Each institution has its own procedures around proposal submissions, and the time required and bureaucracy level at your faculty institution may be different from those at the institutions at which you trained. You may find that though you could prepare your narrative proposal before the funder's deadline, there will not be enough time for the whole application packet to be completed. If your work will involve vertebrate animals or human subjects; select agents—biological agents and toxins that have the potential to pose a severe threat to public, animal or plant health, or to animal or plant products; stem cells; or recombinant DNA, additional time may be needed for moving the proposal through the appropriate committees and preparing adequate documentation to include in your application.

Your institution will also usually have a system, with its own deadlines, for deciding who will be nominated for limited solicitations, funding opportunities that allow the institution to submit only one or a few applications. Internal competition for these nominations may be held considerably in advance of the grant application's deadline. At some institutions, there is one annual deadline that covers all limited solicitations, so local decisions about who can apply can be made nearly a year ahead of the application deadline. If you miss your institution's deadline, you will not be nominated and cannot submit a proposal, no matter how well the solicitation fits you.

Proposals also may require letters from outside supporters and from collaborators, which must be submitted by their authors before the proposal deadline. You should ask for letters well ahead of time and be ready to follow up in the weeks and days before the deadline. If the letters are required elements of the proposal and their writers miss the deadline, your whole proposal will usually be removed from consideration.

Once a proposal is submitted, review time can be quite long, and there can also be a long period between when you know your proposal will be funded and when the grant begins to be paid. Understand the grant maker's timeline—at NIAID, funding a proposal can take 5 to 17 months,¹² though AIDS grants, which are submitted later in the agency's grant cycle, sometimes take less time. At NSF, funding takes more than 6 months.¹⁹ At BWF, 9 months is a good estimate for the time from submission deadline until checks go out to those who have been funded.

Electronic submission of grant proposals has become fairly universal across funders. For federal grants, you will need to register at grants.gov, the cross-agency grant information and proposal submission site. NIH applications also involve the agency's own grant administration resource, eRA Commons, which also requires registration. Applications to NSF require pre-registration at NSF's administration and submission site, FastLane. Private funders' application information will direct you to their electronic submission sites, which also will require you to

register. At this writing, 40 private funders use a common submission site, proposal Central, and require pre-registration there. Other private funders use their own in house electronic submissions site or other commercial sites.

There are many good resources available on how to write grants (see refs. 4–11), and to the best of this author's knowledge, there are no secrets to be revealed. It is important that the grants you submit be well thought out and well written. NIAID makes available⁴⁴ several (currently four) annotated examples of well-prepared R01 applications, as well as the summary statements consolidating comments from members of the study sections that reviewed the proposals.

In conceiving, developing, writing and submitting requests for funding, there are clear mistakes that cripple proposals and make them poor candidates for support. With the exception of profound intellectual errors, most flaws in grants can be fixed, and what is learned in fixing them can make one a stronger applicant.⁴⁵ Even if a proposal's central flaw is in its fundamental ideas, it can be learned from, thought through anew and potentially turned in a new direction. Researchers who do not have difficulties with the mechanics of writing should send their first good draft to mentors and colleagues for review.

If you are a clear thinker but are aware that your writing skills are not good, hiring an editor to work with you on your grants may be helpful. Friends and colleagues are often glad to help you with your writing, but jumbled thoughts and tortured grammar take much effort to decipher and your early drafts may provide them with far more work than they had intended to take on. A number of editorial services are listed at the end of this journal's Guidelines for Authors. Whether on campus or at a distance, working with an editor who specializes in the health sciences and is familiar with your field can provide value beyond a grammar and usage check. A scientifically skilled editor can help you improve your choice of words and the structure of your arguments. Working with this kind of editor will take some of your time, as the editor will have to be sure that he or she is

revising the grant in ways that still capture your intentions. The process can add days or weeks to the time it takes to prepare your proposal, but will teach you things that will help you improve your writing. As soon as the proposal is a good reflection of your intentions, send the draft to colleagues and mentors for a scientific critique.

NIH's proposals are now much shorter than they once were, and private funders' proposals and those of NSF are also often relatively short. Though a proposal's parts unfold in a particular order—title, abstract or summary, specific aims, background/significance, methods, etc., the quality of the hypothesis and the appropriateness of the specific aims are the most important aspects of a proposal. Because proposals are relatively short, there is little room for extra information. Every element of the grant should reinforce the strength of the hypothesis and your ability to carry out your aims. You have to communicate that you are interested in a high-impact problem, that your hypothesis is a critical one for addressing the problem, that your specific aims are smart and achievable, and that you, yourself, are the right person to get the job done. If the proposal format devotes space to methods, you have room to communicate that you know the right way to approach the problem and that you have alternative approaches should your primary approaches fail. Even proposal elements that seem routine, descriptions of the facilities available to you, for example, should be written in a way that underscores that your setting will help ensure that you accomplish your aims.

Many agencies make public information about who may be reviewing your proposal. When you submit an investigator initiated proposal to NIH, the Center for Scientific Review (CSR), which manages most scientific review within the agency, will assign it to the Institute that seems to fit it best, and then to a review panel within that institute. At NSF and at many private funders, program officers determine which reviewers will be assigned to a proposal. You can include with your proposal a cover letter describing where (for NIH) your submission should be reviewed and the background or interests of appropriate reviewers. Some researchers

also use cover letters to ask that particular reviewers not be assigned to the proposal, usually citing conflicts of interest.

Reviewers approach proposals in different ways. Where some might read your specific aims first, others might first page through your curriculum vitae or your budget. Every section should serve you well as a potential "front door." Wherever they begin their review, most reviewers quickly decide whether your proposal is not competitive, highly competitive, or somewhere in the middle. Even something as short as the proposal's title, which becomes a public record if your grant is funded by a federal agency, matters. At NIH, the title provides information that helps the CSR decide which Institute and review panel should review your grant. A reviewer encountering a title that doesn't fit the proposed work may spend his or her first few reading minutes trying to fit what is written in the proposal to the ideas that were implied by the title.

Following instructions counts when you submit proposals. Using the wrong font or font size, exceeding page limits, using narrower than permitted margins and other tricks to get more words on a page can get your grant rejected without review. Even with the correct type and margins, the readability of a proposal can be an issue. Reading text without white space is difficult and tiring. Breaking extremely long paragraphs into smaller ones each focused on one idea and incorporating relevant figures makes the proposal more readable. When the proposal is complete and has been given a final edit for typographical and grammatical errors, convert it to a pdf format and then make sure that it opens properly with the most current version of Adobe Acrobat.

Plan to submit the finished proposal a few days before the deadline, and follow up with others, including your institution's department of sponsored research and anyone who is to submit a letter in support of your application, a few days early as well. If your proposal has errors that cause it to be rejected by the grant agency's submission system, having left time to address any problems will let you make a successful submission. At some funding organizations, including NIH,

proposals must successfully pass through more than one electronic gateway before they are officially received. If a proposal does not get through the whole process by the stated deadline, it is late and generally not accepted.

If something outside your control happens that will keep you from submitting on time, contact the program officer. Natural disasters, major unexpected life blows and other rare events sometimes merit short extensions that will keep a researcher from having to wait until the next deadline date to submit an application that was nearly complete at the time of the delay.

After a funder receives your proposal, it will be sent out for review, generally by two or more active scientists and then considered in the context of other proposals submitted at the same time. Low application success rates are common at this time. At BWF in all competitive programs, fewer than 10% of applicants are being funded, and in the Pathogenesis of Infectious Disease Awards, the funding rate is around 8.5%. At NIAID, the payroll has been at 10% across research project grants and has been set at 14% for new investigators. The low rate of funding is not a matter of policy. It reflects the tremendous pressure of researchers pursuing a relatively small number of dollars.

Many proposals will be triaged and will not go forward to full review. Given the very low funding level, triage does not necessarily mean that the rejected proposal was scientifically flawed or poorly written, though some triaged grants are. Triage can happen to relatively good grants when the number of applications is high relative to the number of grants

that will be made. At NIH, the lower half of the applicant pool after initial scores are in are “streamlined” (triaged) and not discussed at study section. NSF does not triage proposals.

At NIH and NSF, reviewers’ comments and scores are communicated to the applicant to help the applicant decide whether to resubmit. Feedback from private funders varies and is sometimes not available. If a funding agency gives you feedback, whether in the form of reviewer comments or as a summary, read it, put it away, and then read it again in a few days when you will likely be less disappointed, angry, upset or frustrated. Reviews with substantial comments are most useful. Reviews that nitpick about unimportant issues can be confusing. Such comments are often the equivalent of a polite, embarrassed cough indicating that the proposal has problems too big to be succinctly stated. If you get this kind of comments, you should share them with your advisors and ask again for a very frank critique of your proposal.

Whether or not feedback is given, talking with the program officer about what went on when your proposal was discussed (if it was discussed) and why your application was not funded is a good idea. At many organizations, the program officer runs the peer review meeting and will have good knowledge of the discussion around your proposal. At NIH, a Scientific Review Administrator from CSR runs the review meeting, but program officers are usually present, or send a delegate to listen for them, when proposals submitted to their programs are reviewed. Program officers might not give you an answer to the

question “Should I resubmit this proposal,” but the things they tell you about your proposal’s review will give you good insight into the answer.

If your proposal was reviewed and scored well but not well enough to get the grant, you should be very encouraged. In this circumstance it is almost always appropriate to revise your proposal, paying very close attention to reviewer comments and program officer advice, and then resubmit it as soon as you can. If you have been given written reviews, each reviewer comment should be explicitly expressed in the revision and highlighted (for example, by underlining or using bold type). At many agencies, the same reviewers will see your proposal the second time through and they will be looking for your proposal to have been improved per their comments.

If, and when, your proposal earns a fundable score and then is funded, the best thing to do is celebrate. The grant getting process is hard, and even well-funded researchers only rarely get to enjoy this particular moment of success. In the days after you have been notified that your grant is in line for funding, you will learn how to formalize the necessary assurances for human subjects, animal use, and more. Then you will learn how to manage the flow of dollars from your new grant; and how you and your institution will interact to report on your spending and scientific progress. But these are subjects for another review.

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References

1. Wadman M. Closing arguments. *Nature* 2009; 457: 650-5; PMID:19194426; <http://dx.doi.org/10.1038/457650a>
2. Joiner KA, Hiterman S, Wormsley S, St. Germain P. Timing of revenue streams from newly recruited faculty: implications for faculty retention. *Acad Med* 2007; 82:1228-38; PMID:18046134; <http://dx.doi.org/10.1097/ACM.0b013e318159cfa4>
3. Dorsey ER, van Wuyckhuysse BC, Beck CA, Passalacqua WP, Guzik DS. Economics of new faculty hires in basic science. *Acad Med* 2009; 84:26-31; PMID:19116473; <http://dx.doi.org/10.1097/ACM.0b013e3181904633>
4. Getting Funded. Making the right moves- a practical guide to scientific management for postdocs and new faculty. Chevy Chase, Maryland: The Howard Hughes Medical Institute and Burroughs Wellcome Fund, 2006:153-74.
5. Sumandea CA, Balke CW. Funding opportunities for investigators in the early stages of career development. *Circulation* 2009; 119:1320-7; PMID:19273733; <http://dx.doi.org/10.1161/CIRCULATIONAHA.107.752691>
6. Mollidrem JJ. Preparing basic and translational grant proposals: Thoughts from the trenches. *Hematology Am Soc Hematol Educ Program* 2010; 2010: 181-4; PMID:21239790; <http://dx.doi.org/10.1182/asheducation-2010.1.181>
7. Berg KM, Gill TM, Brown AF, Zerzan J, Elmore JG, Wilson IB. Demystifying the NIH grant application process. *J Gen Intern Med* 2007; 22:1587-95; PMID:17687616; <http://dx.doi.org/10.1007/s11606-007-0301-6>
8. Platanias LC, Eklund EA. Hematology grants workshop. *Am Soc Hematol Educ Program* 2004:473-80.
9. Agarwal R, Chertow GM, Mehta RL. Strategies for successful patient oriented research: why did I (not) get funded? *Clin J Am Soc Nephrol* 2006; 1:340-3; PMID:17699226; <http://dx.doi.org/10.2215/CJN.00130605>
10. Berger DH. An introduction to obtaining extramural funding. *J Surg Res* 2005; 128:226-31; PMID:16098537; <http://dx.doi.org/10.1016/j.jss.2005.06.004>

11. Lee SJ. Tips for writing successful patient-oriented research career development awards. *Am Soc Hematol Educ Program* 2010;185-8.
12. Strategy for NIH Funding. National Institute for Allergy and Infectious Diseases. <http://www.niaid.nih.gov/researchfunding/grant/strategy/pages/default.aspx>. Accessed November 11, 2011.
13. Brock MV, Bouvet M. Writing a successful NIH Mentored Career Development Grant (K Award). *Ann Surg* 2010; 251:1013-7; PMID:20485135; <http://dx.doi.org/10.1097/SLA.0b013e3181deb4ef>
14. Chang S, Hughes DC, Chamberlain RM. Works-In-Progress: guiding junior scientists through career development applications. *J Cancer Educ* 2008; 23: 142-8; PMID:18709584; <http://dx.doi.org/10.1080/08858190802188727>
15. Davidson NO. Grant writing and academic survival: what the fellow needs to know. *Gastrointest Endosc* 2005; 61:726-7; PMID:15855979; [http://dx.doi.org/10.1016/S0016-5107\(05\)00377-9](http://dx.doi.org/10.1016/S0016-5107(05)00377-9)
16. About EPSCoR, National Science Foundation. <http://www.nsf.gov/od/oa/programs/epsco/about.jsp>. Accessed November 11, 2011.
17. NIAID Research Funding–Budget and Funding–Archive of Final NIAID Paylines by Fiscal Year. <http://www.niaid.nih.gov/researchfunding/paybud/pages/paylinesfinal.aspx>. Accessed November 11, 2011.
18. Faculty Early Career Development Program–US National Science Foundation. http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503214. Accessed November 11, 2011.
19. The National Science Foundation Proposal and Award Policies and Procedures Guide. http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/nsf11_1.pdf. Accessed November 11, 2011.
20. Research America. 2010 US Investment in Health Research. 2011.
21. Biological Systems Science Division (BSSD), US Department of Energy. <http://science.energy.gov/ber/research/bssd/>. Department of Energy, Accessed November 11, 2011.
22. Strengthening the presence of SCIDAC in the academic community, SCIDAC–scientific discovery through advanced computing, Department of Energy. <http://www.scidac.gov/institutes.html>. Accessed November 11, 2011.
23. Off-Site Research, VHA Handbook, Department of Veterans Affairs. http://www.va.gov/vhapublications/ViewPublication.aspx?pub_ID=1486. 120016 Accessed November 11, 2011.
24. The Presidential Early Career Award for Scientists and Engineers (PECASE) Program, US Department of Health and Human Services. <http://grants.nih.gov/grants/policy/pecase.htm>. Accessed November 11, 2011.
25. Farrand L. The National Association for the Study and Prevention of Tuberculosis. *J Am Public Health Assoc* 1911; 1:334-7; PMID:19599607
26. Bynum JH. Program of the National Foundation for Infantile Paralysis. *J Natl Med Assoc* 1945; 37:129-31; PMID:20893296
27. Rosenfield A. Confronting a health care crisis. *AIDS Patient Care STDS* 2006; 20:463-6; PMID:16839242; <http://dx.doi.org/10.1089/apc.2006.20.463>
28. Shepard WP. The American Heart Association as a national voluntary public health agency. *Circulation* 1950; 2:736-41; PMID:14783826
29. Kress B. Flight Attendant Medical Research Institute (FAMRI). *Tob Control* 2004; 13:i67-9; PMID:14985620
30. Jagpal N, Craig J. Learning from Madoff: lessons for foundation boards. Washington D.C.: National Committee for Responsive Philanthropy, 2009.
31. Bloom S. A catalyst of the bioengineering field plans its farewell. *J Clin Invest* 2005; 115:1966; PMID:16075034; <http://dx.doi.org/10.1172/JCI26115>
32. Committee for the Evaluation of the Lucille P. Markey Charitable Trust Programs in Biomedical Sciences BoHEaW, National Research Council. Funding biomedical research programs: contributions of the Markey Trust. 2006.
33. Young Faculty Award DARPA. [http://www.darpa.mil/Our_Work/DSO/Focus_Areas/Young_Faculty_Award_\(YFA\).aspx](http://www.darpa.mil/Our_Work/DSO/Focus_Areas/Young_Faculty_Award_(YFA).aspx). Accessed November 11, 2011.
34. The NIH. Almanac. <http://www.nih.gov/about/almanac/>. Accessed November 11, 2011.
35. Congress s. Public Law 81-507, The National Science Foundation Act. 1950.
36. NSF strategic plan 2011-2016, National Science Foundation. http://www.nsf.gov/news/strategicplan/nsfstrategicplan_2011_2016.pdf. 2011.
37. Mandel R. A Half Century of Peer Review, 1946-1996. Bethesda, MD: Division of Research Grants, National Institutes of Health, 1996.
38. Information about NIH Career Development Awards–K Kiosk, Office of Extramural Research, National Institutes of Health. <http://grants.nih.gov/training/careerdevelopmentawards.htm>. Accessed November 11, 2011.
39. Funding and Guideline Information on Selected Grant Mechanisms and Programs–Types of Grant Programs, Office of Extramural Research, NIH. http://grants.nih.gov/grants/funding/funding_program.htm#RSeries. Accessed November 11, 2011.
40. NIAID Research Funding–Small and Exploratory/Developmental Research Grants SOP, National Institute of Allergy and Infectious Diseases, NIH. <http://www.niaid.nih.gov/researchfunding/sop/pages/smallgrants.aspx>. November 11, 2011.
41. NIAID Research Funding–New Investigator Guide to NIH Funding, National Institute for Allergy and Infectious Diseases, NIH. <http://www.niaid.nih.gov/researchfunding/grant/pages/newpiguide.aspx>. Accessed November 11, 2011.
42. Enhancing Peer Review. The NIH Announces Enhanced Review Criteria for Evaluation of Research Applications Received for Potential FY2010 Funding. <http://grants.nih.gov/grants/guide/notice-files/NOT-OD-09-025.html>. Accessed November 11, 2011.
43. Early Career Reviewer Program.
44. Sample R01 Applications and Summary Statements, National Institute of Allergy and Infectious Diseases. <http://www.niaid.nih.gov/researchfunding/grant/pages/appsamples.aspx>. Accessed November 11, 2011.
45. Allen EM. Why are research grant applications disapproved? *Science* 1960; 132:1532-4; PMID:13682512; <http://dx.doi.org/10.1126/science.132.3439.1532>