I. FUNDING OPPORTUNITIES IN THE FIELDS OF HEMATOLOGY AND ONCOLOGY FROM THE NIH, VETERANS HEALTH ADMINISTRATION AND NON-FEDERAL SOURCES

Significant opportunities are currently available to support the fellowship training, career development, and targeted research projects of investigators in the fields of hematology and oncology. Tables 1 and 2 provide a brief description of the types of awards offered by the NIH and the Department of Veterans Affairs (VA). Tables 3, 4, and 5 outline research awards available to fellowship trainees (fellowship awards), and to young-to-mid level faculty (new investigator and career development awards) from non-federal sources. The latter have been extracted from “Hem/Onc Grants Newsletter” (http://www.dralanlevineassociates.com), a very useful monthly.

* Division of Hematology/Oncology, University of Michigan Medical School, 7216 Cancer Center, 1500 East Medical Center Drive, Ann Arbor, MI 48109-0948

Table 1. NIH award types.*

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RO1</td>
<td>Research Project Grant</td>
</tr>
<tr>
<td>RO3</td>
<td>Small Research Grant</td>
</tr>
<tr>
<td>R21</td>
<td>Exploratory/Developmental Grants</td>
</tr>
</tbody>
</table>

Table 2. Fellowship programs.

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F32</td>
<td>Predoctoral Individual National Research Service Award (NRSA)</td>
</tr>
<tr>
<td>F32</td>
<td>Postdoctoral Individual National Research Service Award (NRSA)</td>
</tr>
<tr>
<td>F33</td>
<td>National Research Service Award (NRSA) for Senior Fellows</td>
</tr>
</tbody>
</table>

Continued on following page
Table 1 (continued)

Research Career Programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KO1</td>
<td>Mentored Research Scientist Development Award. Career development in a new area of research. 3-5 yrs of support.</td>
</tr>
<tr>
<td>KO2</td>
<td>Independent Scientist Award. Develop the career of the funded scientist. 5 yrs of support; 75% effort.</td>
</tr>
<tr>
<td>KO5</td>
<td>Senior Scientist Award. For the outstanding scientist with a sustained level of high productivity. 5 yrs; 75% effort.</td>
</tr>
<tr>
<td>KO7</td>
<td>Academic Career Award. Developmental/Leadership in academic instruction, research, and administration. 2-5 yrs; 25-75% effort.</td>
</tr>
<tr>
<td>KO8</td>
<td>Mentored Clinical Scientist Development Award. Development of the independent clinical research scientist. 3-5 yrs of funding; 75% effort.</td>
</tr>
<tr>
<td>K12</td>
<td>Mentored Clinical Development Program Award. Support to an institution for the development of independent clinical scientists. 5 yrs of support; 75% effort.</td>
</tr>
<tr>
<td>K22</td>
<td>Career Transition Award. Support to an individual post-doctoral fellow in transition to a faculty position.</td>
</tr>
<tr>
<td>K23</td>
<td>Mentored Patient-Oriented Research Career Development Award. Development of the independent research scientist in the clinical arena. 3-5 yrs of funding; 75% commitment.</td>
</tr>
<tr>
<td>K24</td>
<td>Mid-Career Investigator Award in Patient-Oriented Research. Development of clinical mentors conducting funded research. 50% commitment with up to $62,500 in salary.</td>
</tr>
</tbody>
</table>

Program Projects and Centers

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>Program Projects. For the support of a broadly-based multidisciplinary, often long-term research program which has a specific major objective or a basic theme.</td>
</tr>
<tr>
<td>P30</td>
<td>Center Core Grants. To support shared resources and facilities for research by a number of investigators who focus on a common research problem.</td>
</tr>
<tr>
<td>P50</td>
<td>Specialized Center. To support any part of the full range of research development from very basic to clinical. Usually developed in response to an announcement of the programmatic needs of a particular NIH institute.</td>
</tr>
<tr>
<td>P60</td>
<td>Comprehensive Center. To support a multipurpose unit designed to bring together to a common focus divergent but related facilities within a given community.</td>
</tr>
</tbody>
</table>


Table 2. Veterans Health Administration funding opportunities.

MERIT Review

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MERIT Review Entry Program (MREP)</td>
<td>Funding to support a specific research project conducted by an entry level (beginning) investigator. 3 yrs of funding ($50,000/yr). Non-renewable.</td>
</tr>
<tr>
<td>Medical Research Type I</td>
<td>To support a specific research project. 1-5 yrs of support; up to $135,000 per year.</td>
</tr>
<tr>
<td>Health Services Research</td>
<td>To support a specific research project in the area of health services research. 1-5 yrs of support.</td>
</tr>
</tbody>
</table>

Career Development

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Career Development Award</td>
<td>To support a specific research project to be performed by a beginning clinical investigator with a VA-eligible clinician mentor. 3 yrs of support including investigator's salary plus $20,000/yr for research funding.</td>
</tr>
<tr>
<td>Advanced Research Career Development Award</td>
<td>To support a specific research project with the goal of extending the research training of a new clinician-investigator (with previous research training). VA-eligible clinician mentor required. 3 yrs of support including investigator's salary and up to $50,000/yr of research funds.</td>
</tr>
<tr>
<td>Career Development Enhancement Award</td>
<td>To support a specific research project to be performed by a clinician scientist who wishes to secure training time to enter a new area of research specialization. Applicant must be PI on an on-going VA peer-reviewed and funded research program. A sponsor is required. Award provides salary, including fringe benefits for up to six months.</td>
</tr>
</tbody>
</table>
Table 3. Fellowship awards.

American Association for Cancer Research: Research Fellowships (12/15); $30,000 X 1 YR; horst@aacr.org  
American Cancer Society: Postdoctoral Fellowships (3/1); $30,000 X 1-3 YRS; grants@cancer.org  
American Foundation for Urologic Disease: MD/PhD One Year Research Program (9/3); $25,000 X 1 YR; yara@afud.org  
American Foundation for Urologic Disease: PhD Postdoctoral Research Program (9/3); $23,000 X 2 YRS; yara@afud.org  
American Institute for Cancer Research: Postdoctoral Grants (12/18); $25,000 X 2 years; research@aicr.org  
American Philosophical Society: Clinical Investigator Fellowships (9/1); $50,000 X 2 YRS; ervach@amphil soc.org  
ASH: Fellows Scholar Award (9/1); $40,000 X 2 YRS; ASH@hematology.org  
Burroughs Wellcome Fund: Hitchings-Elion Fellowships (10/1); $332,500 over 5 YRS; www.bwfund.org  
Cancer Research Foundation of America: Fellowships (3/1); $30,000 X 2 YRS; sguiffre@crfa.org  
Cancer Research Institute: Fellowships in General Immunology and Cancer Immunology (4/1); $35,000-41,000 X 2 YRS; cancerres@aol.com  
Cooley's Anemia Foundation: Research Fellowship (3/5); $30,000 X 2 YRS; ncaf@aol.com  
Cure for Lymphoma Foundation: Fellowship Grants (10/2); $50,000 X 2 YRS; tmorris@cfl.org  
Damon Runyon-Walter Winchell Foundation: Post-doctoral Research Fellowship for Basic and Physician Scientists (8/15; 12/15; 3/15); $35,000-55,000 X 3 YRS; fellowship@cancerresearchfund.org  
Helen Hay Whitney Foundation: Fellowships (8/15); $33,000 X 3 YRS; 212-688-6794  
Hereditary Disease Foundation: John J. Wasmuth Postdoctoral Fellowships (2/15, 8/15, 10/15); $28,000-43,000 X 1-3 YRS; allantobin@hdfoundation.org  
Hereditary Disease Foundation: Milton Wexler Postdoctoral Fellowships (2/15, 8/15, 10/15); $57,000 X 3 YRS; allantobin@hdfoundation.org  
Immune Deficiency Foundation: Fellowships (5/31); $25,000 X 1 YR; 800-296-4433  
Irvington Institute for Immunological Research: Postdoctoral Fellowships in Immunology (7/1); $33,000 X 3 YRS; irving1@ix.netcom.com  
Jane Coffin Childs Memorial Fund: Postdoctoral Fellowships (2/1); $35,000 X 3 YRS; 203-785-4612  
Jose Carreras International Leukemia Foundation: Fellowships (11/2); $50,000 X 3 YRS; www.fcarreras.es/  
Ladies Auxiliary of the Veterans of Foreign Wars: Cancer Research Fellowships (3/1); $25,000 X 1 YR; 816-561-8655  
Leukemia and Lymphoma Society of America; Fellow/Special Fellow Award (10/1); $33,250-39,700 X 3 YRS; www.leukemia-lymphoma.org  
Leukemia Research Foundation: Physician Scientist Postdoctoral Fellowships (2/15); $45,000 X 2 YRS; hollis_lrf@ameritech.net  
Leukemia Research Foundation: Postdoctoral Fellowships (2/15); $25,000 X 2 YRS; hollis_lrf@ameritech.net  
Life Sciences Research Foundation: Postdoctoral fellowships (10/1); $40,000 X 3 YRS; sdirenzo@molbio.princeton.edu  
Lymphoma Research Foundation of America: Fellowship (12/15); $45,000 X 1 YR; lrfa@aol.com  
Multiple Myeloma Research Foundation: Fellow (8/31/2000); $40,000 X 1 YR; www.multiplemeloma.org/grant_applications.html  
National Hemophilia Foundation: Judith Graham Pool Postdoctoral Research Fellowships (12/1); $35,000 X 2 YRS; dkenny@hemophilia.org  
National Research Council: Postdoctoral Awards (1/15; 4/15; 8/15); $30,000-50,000 X 3 YRS; www.national-academies.org/rap  
National Stroke Association: Research Fellowships in Cerebrovascular Disease (12/1); $30,000 X 2 YRS; 303-754-0928  
NIGMS: Postdoctoral Fellowships in Clinical Pharmacology (F32); colea@nigms.nih.gov  
Pharmaceutical Research and Manufacturers of America Foundation: Fellowship for careers in clinical pharmacology (10/1); $24,000 X 2 YRS; foundation@phrma.org  
Susan G. Komen Breast Cancer Foundation: Postdoctoral Fellowships (3/15); $35,000 X 3 YRS; 888-300-5582  
U.S. Army: Clin Translational Res Fellowship (6/7); $48,000 X 3 YRS; cdmrp.pa@det.amedd.army.mil  
U.S. Army: Postdoctoral Traineeship Award (6/2); cdmrp.pa@det.amedd.army.mil  
U.S. Army: Prostate Cancer Research Program – Postdoctoral Training Awards (3); $98,000 over 2 YRS; cdmrp.pa@det.amedd.army.mil  
United Negro College Fund: Merck Science Initiative (1/31); $70,000 X 2 YRS; www.uncf.org

a Approximate submission due date  
b Approximate level of support  
c Contact address or phone number
Table 4. Awards for new investigators.

American Association for Cancer Research: Gertrude B. Elion Cancer Research Award (12/15); $30,000 X 1 YR; horst@aacr.org
American Cancer Society: Clinical Research Training Grants for Junior Faculty (3/1); $150,000 X 3 YRS; grants@cancer.org
American Cancer Society: International Fellowships for Beginning Investigators (10/1); $35,000 X 1 YR; grants@cancer.org
American Cancer Society: Research Projects Grants (4/1); $150,000 X 3 YRS; grants@cancer.org
American Federation for Aging Research: Paul Beeson Physician Faculty Scholars Program (11/15; $450,000 over 3 YRS; amfeda@whitaker.org
American Federation for Aging Research: Pfizer Research Grants in Cardiovascular Diseases in Aging (12/15); $50,000 X 2 YRS; amfeda@whitaker.org
American Health Assistance Foundation: National Heart Foundation Starter Grants (11/1); $250,000 X 2 YRS; www.ahaf.org/hrtsrck/research/heresrch.htm
American Heart Association: Scientist Development Grant (6/15; $100,000 X 4 YRS; nccrp@heart.org
American Society for Blood and Marrow Transplantation: New Investigator Award (11/30); $25,000 X 2 YRS; mail@asbmt.org
American Society of Clinical Oncology: Young Investigators Award (11/5); $35,000 X 1 YR; ulepic@asco.org
American Society of Hematology: Junior Faculty Scholar Award (9/1); $50,000 X 2 YRS; ash@hematology.org
Aplastic Anemia Foundation of America: New Researcher Award (11/30); $60,000 X 2 YRS; judyaamds@aol.com
Burrroughs Wellcome Fund: New Investigators Awards in Pharmacological or Toxicological Sciences (11/1); $210,000 over 3 YRS; vmcgovern@bwfund.org
Cancer Research Foundation of America: Research and Educational Grants (3/1); $35,000 X 2 YRS; squiffre@crfa.org
Cancer Research Institute: Investigator Award Program in General Immunology and Cancer Immunology (3/1); $50,000 X 4 YRS; cancerres@aol.com
Cancer Treatment Research Foundation: Clinical Investigator Award: $125,000 X 1 YR; 847-342-6484
CaP Cure: Young Investigator Award (6/1); $50,000 X 3 YRS; mbarreyro@capcure.org
Charles E. Culpeper Foundation: Biomedical Pilot Initiative; $25,000 X 1 YR; www.culpeper.org
Charles E. Culpeper Foundation: Scholarships in Medical Science (8/16); $100,000 over 3 YRS; www.culpeper.org
Cooley’s Anemia Foundation: Research Fellowship (3/5); $30,000 X 2 YRS; ncaf@aol.com
Cure for Lymphoma Foundation: Fellowship Grants (10/2); $50,000 X 2 YRS; fmorris@clf.org
Doris Duke Charitable Foundation: Clinical Scientist Award Program (12/15); $125,000 X 5 YRS; 212-974-7590
Elizabeth Glaser Pediatric AIDS Foundation: Scholar Awards (7/19); $30,000 X 3 YRS; research@pedaids.org
Epistemia Foundation of New York: Research Grant Program (4/3); $90,000 over 2 YRS; 212-882-5510
International Myeloma Foundation: Brian D. Novis Junior Investigator Research Grants (8/31); $40,000 X 1 YR; IMF@myeloma.org
Kidney Cancer Association: Eugene P. Schonfeld Young Researchers Award (4/1); $60,000 over 2 YRS; 847-332-1051
Laurie Ann Duker Cancer Research Foundation: Research Scholar Awards (5/7); $35,000 X 2 YRS; belfar@laurie.org
March of Dimes: Basil O-Connor Starter Scholar Research Award Program (2/15); $75,000 X 1 YR; mkatz@modimes.org
Melanoma Research Foundation: Research Grants for Young Investigators (7/1); $25,000 X 1 YR; research@melanoma.org
National Blood Foundation: Research Grant Program (12/4); $50,000 X 2 YRS; rbf@aabb.org
National Hemophilia Foundation: Career Development Grant (2/1); $70,000 X 3 YRS; dkenney@hemophilia.org
National Marrow Donor Program: Amy Strelizer Manasevit Scholars Program (1/15); $240,000 over 2 YRS; 612-362-3425
Office of Naval Research: Young Investigator Program (11/1); $100,000 X 3 YRS; 703-696-4111
Parke-Davis/Pfizer: ARA: A focus on the science (3/1); $50,000 x 2 YRS; ARAnts@mindspring.com
Pharmaceutical Research and Manufacturers of America Foundation: Research Starter Grants (9/1); $25,000 X 1 YR; foundation@phrma.org
Pharmaceutical Research and Manufacturers of America Foundation: Faculty Development Awards in Bioinformatics (9/1); $30,000 X 2 YRS; foundation@phrma.org
Rockefeller Brothers Fund: Charles E. Culpeper Scholarships in Medical Sciences (8/15); $100,000 X 3 YRS; rock@rbf.org
Searle Scholars Program: Scholar Grants (9/27); $60,000 X 3 YRS; ssp@jhu.edu
Sidney Kimmel Foundation for Cancer Research: Kimmel Scholar Award (12/8); $100,000 X 2 YRS; www.kimmel.org
U.S. Army: Ovarian Cancer New Investigator Awards (9/13); $100,000 X 3 YRS; cdmrp.pa@det.amedd.army.mil
U.S. Army: Preclinical Research Program – Minority Population Focus Collaborative Training Awards (5/7); $75,000 X 1 YR; cdmrp.pa@det.amedd.army.mil
U.S. Army: Prostate Cancer Research Program – New Investigator Awards (3/7); $225,000 over 3 YRS; cdmrp.pa@det.amedd.army.mil
U.S. Army: New Investigator Awards in Ovarian Cancer Research (10/20); $100,000 X 3 YRS; craig.tbeo@amedd.army.mil
Whitaker Foundation: Biomedical Engineering Research Grants (4/1); $240,000 over 3 YRS; wwm@whitaker.org

a Approximate submission due date
b Approximate level of support
c Contact address or phone number
Table 5. Career development awards.

AACR: Career Devel Award in Cancer Res (12/15); $50,000 X 2 YRS; horst@aacr.org
ACS: Clin Res Training Grants for Junior Fac (10/1); $150,000 X 3 YRS; grants@cancer.org
ACS: Professorship of Clinical Oncol (3/1); $40,000 X 5 YRS; grants@cancer.org
Agency for Health Care Policy and Research: Mentored and Clinical Scientist Development Award (KO8); $100,000 X 5 YRS; training@ahcpr.gov
American Foundation for Urologic Disease: MD Post-Resident Prog (9/1); $22,000 X 2 YRS; yara@afud.org
American Heart Association: Established Investigator Award (6/15); $75,000 X 4 YRS; ncpp@heart.org
American Heart Association: Scientist Development Grant (6/15); $65,000 X 4 YRS; ncpp@heart.org
American Society of Hematology: Junior Faculty Scholar Award; (9/1); $60,000 X 2 YRS; ash@hematology.org
ASCO: Clin Res Career Devel Award (11/3); $170,100 over 3 YRS; ulapiec1@asco.org
Burroughs Wellcome Fund: Career Awards in Biomedical Sciences (10/1); $445,000-574,000 over 4-6 years; http://www.bwfund.org
Damon Runyon-Walter Winchell Foundation: Scholar Awards; (7/1); $100,000 X 3 YRS; fellowship@cancerresearchfund.org
Doris Duke Charitable Foundation: Clin Scientist Award Program (1/15); $100,000 X 5 YRS; rjs6@columbia.edu
Leukemia and Lymphoma Society of America: Scholar Award/Scholar Award for Clin Res; (9/15); $70,000 X 5 YRS; www.leukemia-lymphoma.org
National Hemophilia Foundation: Career Development Award in Bleeding Disorders (2/1); $70,000 X 3 YRS; dkenny@hemophilia.org
NCI: Academic Career Award (KO7); beggl@mail.nih.gov
NCI: Cancer Prevention, Control, and Population Services Career Development Award (KO7); $105,000 X 3-5 YRS; lg2h@nih.gov
NCI: Clin Oncol Res Career Devel Prog (K12); (6/1); $105,000 X 5 YRS; lg2h@nih.gov
NCI: Established Investigator Award in Cancer Prevention, Control, Behavioral and Population Research (KO5); Salary + $25,000 X 5 YRS; beggl@mail.nih.gov
NCI: Mentored Patient-Oriented Research for Underrepresented Minorities (K23); $100,00 X 5 YRS; bailey@mail.nih.gov
NCI: Minorities in Clinical Oncology (KO8), $105,000 X 5 YRS; bailey@mail.nih.gov
NCI: Senior Scientist Award (KO5); lg2h@nih.gov
NCI: The Howard Temin Award (KO1); $105,000 X 5 YRS; AV8B@nih.gov
NCI: Transition Career Devel Award (K22) (10/1; 2/1); lg2h@nih.gov
NHLBI: Career Transition Award (K22); $125,000 X 3 YRS; curron@nih.gov
NHLBI: Mentored Minority Fac Devel Award (KO1) (7/21); $105,000 X 3-5 YRS; lorraine.silsbee@nih.gov
NIDDK: Mentored Research Scientist Development Award (KO1); $70,000 X 3 YRS; BishopT@extra.niddk.nih.gov
NIDDK: Small Grant Program for NIDDK KO8/K23 Recipients; $50,000 additional per year for the last 2 years of the award, BishopT@extra.niddk.nih.gov
NIDDK: Small Grants for Underrepresented Investigators, RO3 either $23,000 or $50,000 per year for up to 3 years; BishopT@extra.niddk.nih.gov
NIEHS: Transition to Independent Positions (K22); (6/8); $100,000 X 3 YRS; mm461n@nih.gov
NIH (NCI, NIAID, NHLBI, and NIDDK): Mid-career Investigator Award in Patient-Oriented Research (K24); mh35c@nih.gov, lg2h@nih.gov, BishopT@extra.niddk.nih.gov, houstonb@nih.gov
NIH (NIAID, NHLBI and NIDDK): Mentored Clinical Scientist Development Award (KO8); silsbeel@nih.gov; mh35c@nih.gov; lg2h@nih.gov; BishopT@extra.niddk.nih.gov
NIH (NIAID, NHLBI, NCI and NIDDK): Mentored Patient-Oriented Res Career Devel Award (K23); mh35c@nih.gov; lh2h@nih.gov; BishopT@extra.niddk.nih.gov; schuckeb@nih.gov
NIH: Independent Scientist Award (KO2); mh35c@nih.gov; creameri@nih.gov
NSF: Faculty Early Career Devel Program (7/25); $250,000 X 5 YRS; fstolni@nsf.gov
Pharmaceutical Research in Manufacturers of America Found: Faculty Devel Awards in Clin Pharmacol (10/1); $40,000 X 3 YRS; foundation@pharma.org
Pharmaceutical Research Manufacturers of America Foundation: Faculty Devel Awards in Bioinformatics/Basic Pharmacol and Toxicol (9/15); $30,000 X 2 YRS; foundation@pharma.org
U.S. Army: Career Development Award in Breast Cancer Res (6/7); $59,000 X 4 YRS; ocmdrp.pa@det.amedd.army.mil
U.S. Army: Clin Translational Res Career Devel Award in Breast Cancer Res (6/7); $59,000 X 4 YRS; ocmdrp.pa@det.amedd.army.mil

a Approximate submission due date
b Approximate level of support
c Contact address or phone number
II. ESSENTIAL PRINCIPLES OF SUCCESSFUL GRANT WRITING

Donald M. Miller, MD, PhD*

Success or failure as an academic scientist depends, ultimately, on the ability to obtain funding for your work. Thus, grant writing is an extremely important, but often unappreciated aspect of academic medicine. It is important to develop a personal strategy of grant writing that will optimize your chances of success.

Writing a grant can be regarded as a game of wits with the reviewers. If you (the principal investigator; PI) are to win, you must convince the reviewers that you 1) are a good scientist; 2) have a good hypothesis; and 3) will be able to do the work which you propose. The reviewers must be convinced that your application is in the top one-third of the applications that they are reviewing in order for it to have a chance for funding. It is important to understand the review process from the reviewers’ viewpoint in order to optimize your chances of success. It is also important to understand that not every application will be funded and that you will, as is the case with baseball players, be quite fortunate to bat .350. Thus you should be prepared to revise and resubmit. You should also develop a funding strategy that includes submissions of closely related grants to multiple sources of funding. It is a wonderful problem to be required to decide which of two similar applications to decline.

Who are the reviewers?

First of all, the reviewers are not the enemy. They are, quite likely, your friends. Almost certainly, they want you to be successful. They are scientists with the same day-to-day concerns as you. Although they have been successful at getting their grants funded, they have almost certainly had grants rejected, as well. Most study section members are “good citizens” who view the many hours that they spend reviewing grant applications as a payback for the service of others that has benefited their careers. The number of grants that they have to review may range from six to twelve at one session. They are looking for that one “outstanding grant” that they will be willing to fight for in the whole committee. You should try to convince them that your application is that one.

The individual reviewer is likely to be tired when reviewing your grants and may be not be in a particularly good mood. Therefore it is extremely important to make your grant as easy to read as possible. Irritants such as misspellings and syntax errors should be avoided at all costs. The organization of your application (with appropriate subheadings) and the correct font can make very important contributions to a sense of “competence.” It is also important to recognize the fact that, although the reviewers will read your application carefully, certain elements of the application will have greater importance in forming their opinions of your ideas. As in most human relationships, first impressions are very important. Thus, the Abstract and Specific Aims sections are generally important areas that each reviewer reads very carefully.

How to make grants “easy to read”

Unless you have thought through your proposed work in great detail, you will not be able to relate these ideas in a clear fashion to your reviewer. The hypothesis should be very clearly stated in the Abstract and the Specific Aims sections. The specific aims should follow very logically from the hypothesis and should address very specific and well-defined goals. They should be stated succinctly and clearly in a manner that gives a good idea of the work that is being proposed. They should be “aims” and not a description of the experiments that will be performed. The number of specific aims should be relatively small, from four to six, in order to avoid the appearance of diffuseness. Subdividing each specific aim into five or six sets of experiments is a reasonable approach, but should be done in the Methods Section, not in the Specific Aims section where it can significantly detract from the a succinct set of aims. Likewise, delineating the experimental methods in the Specific Aims section may be confusing and/or distracting.

The Background section should not attempt a comprehensive review of the entire area of research. Rather, you should use this section to demonstrate the importance of the work that you propose, to delineate and document the questions that you are addressing and to provide the reviewer with enough information to judge the relative importance of your work. It is important to use the background information to stress the importance of your proposed experiments as they relate to the rest of the field. While you should emphasize differences of your work with other labs in the field, this is not a place to be critical of other workers; the scientific world is a small one and one of these scientists may review your application.

The Preliminary Data section should be used to document your expertise in the area of the application, but also to provide evidence to the reviewer that you will be able to accomplish the specific aims. If work presented has been published or submitted, make that clear by providing references in bold or underlined fonts. Do not use this section to present data from every experiment that you have ever done but, rather, attempt to

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provide a concise and convincing description of your work. If you have important work (and important publications) that is peripherally related to the theme of the application, use them as well. Figures should not be “shrunk” to fit on the pages; it is far better to use a few clear charts and/or graphs than it is to use figures that can only be discerned with a magnifying glass. Do not be sloppy. The reviewer will likely judge the quality of your proposal, in part, by the quality of your preliminary data. Similarly, don’t over-interpret your data or draw conclusions that are not clearly justified. This will lead to distrust on the part of the reviewer and is likely to put him or her into a bad mood.

As with the other sections of the application, the Experimental Methods section of the application must be written very clearly. Each specific aim should be addressed with an individual set of experiments. It is critically important that the specific aims listed in the Abstract, Specific Aims section and the Experimental Methods section are exactly the same. If the specific aims are different in each place, the application is much more difficult to read and much less likely to be funded. Experiments should be outlined in considerable detail, but it is not necessary to provide every detail of every reagent. You will get brownie points for every mention of the word “control” and/or “potential problems.” Both of these should be clearly delineated with appropriate subheadings.

How to convince the reviewer that you are a good scientist
There are several ways in which the reviewer will judge your qualifications as a scientist. You should emphasize your training and experience. Particularly as a young scientist, you should describe the training that you have had and discuss its relevance to the current proposal. If your mentor is a leader in the field, mention this fact. If you have unique skills that make you especially qualified to do the work that you are proposing, emphasize that point. Discuss your productivity. Emphasize publications which are directly relevant to this proposal. Conversely, if there have been periods of low productivity, discuss them. Often there are very valid reasons (clinical training, illnesses, change of scientific direction, etc.) that may obviate reviewer concern about these issues.

How to convince the reviewer that you have a good hypothesis
It is extremely important to convince the reviewer that your application addresses an important hypothesis and that your proposed experiments will provide important new insights and will test the main hypothesis. Although the importance of your hypothesis will be clear to you, it may not be clear to the reviewer, who likely works in a related but distinct area. You should explain very clearly why this work is important and delineate the important questions of the area that will be answered by your experiments. Write down the underlying hypothesis of your application before you start writing, and then place it prominently in the abstract and specific aims sections.

It is important to assume that you know more about your area than the reviewer. Although the good reviewer is likely to be well read and familiar with your area, it is impossible for each reviewer to be intimately familiar with the literature of each area that he or she reviews. This means that you need to outline the basic tenets of your field in a way that emphasizes the importance of your project. Without being condescending, you should outline the basic data that support the importance of your application. It is extremely important to state clearly the unique features of your proposed project and the importance of the results. Do not overstate the importance of your work, but emphasize the contribution that you are making.

How to convince the reviewer that you will be able to do the work that you propose
This is particularly important for young investigators who do not have a long track record of success. Perhaps the most effective way to convince the reviewer that you will be successful is to write a cohesive, clear proposal. Think very carefully about the outline of your application. Make certain that the experiments that you are proposing directly address the specific aims. Make certain that your application does not appear to have been hurriedly written or sloppy. An application that has frequent misspellings or mistakes of organization is very unlikely to make a favorable impression. Likewise, an application that is presented in a very small font or in which the margins abut the edges of the pages, is difficult to read and unlikely to do well. Emphasize your experience in the field and document previous productivity in a way that will strongly suggest that you will be successful with this project, as well.

How to deal with rejection
Every scientist, no matter how good he or she is, has had grants that have not been funded. It is very disappointing, no matter how senior the investigator, to have this happen. As you plan your strategy, you are likely to feel that you have not been treated fairly and that the reviewers were either biased or did not understand the brilliance of your work. It is very important not to allow these feelings to make their way into the revised application. Rather, you should take the critiques as constructive criticism, whether or not you agree with them.

The letter describing your revisions is a critical part of a revised application and should acknowledge the
helpfulness of the reviewers’ comments, no matter how painful it is to do so. You should address each and every criticism of your application, no matter how small, trivial or insignificant. You should also point out that you have done so. If you disagree with specific comments in the critique, say so respectfully and acknowledge that the reviewer could possibly be correct as well. **Do not take an angry or defensive tone.** It is likely that at least one of the reviewers of the revised application will be one of the original reviewers and insulting his or her intelligence is certain to result in a second unfunded application. You should strongly emphasize the amount of work accomplished since the initial submission. If you have accomplished one of the specific aims or if you have done 25% of the work you proposed, say so. Emphasize these important facts by bold or italic fonts to recognize their importance.

This is a time of great optimism in American science. The tools to address important clinical problems are better than they have been in the past. More than any time in the history of biology and medicine, science is making major contributions to society. The key to participation in this incredible excitement is the ability to develop a funded research program. The development of a personal grant writing style and philosophy can significantly ease the tension associated with this part of academic medicine.

**III. WHAT HAPPENS AT STUDY SECTION AND WHAT TO DO IF YOUR GRANT IS NOT FUNDED**

*Roy L. Silverstein, MD*

One of the most disappointing events in the life of any scientist is receipt from the NIH of summary statements indicating that a grant application is not likely to be funded. It is worth remembering when this happens that most investigators, even well-established leaders in the scientific community, have gone through this humbling experience. It is important to keep in mind, however, that while on average only 20-25% of applications at any given cycle receive a fundable priority score, the ultimate likelihood of any proposal being funded is much higher, approaching 40%. In other words, the process of revising and resubmitting an application is worth the time and effort that it entails. This manuscript will review strategies for increasing the effectiveness of grant revision.

**The NIH Grant Review Process**

Before beginning, we need to understand who is it that is reviewing your grant, how your grant got into their hands, and how scientific priority and funding decisions are made at the NIH. About three quarters of the more than 45,000 Research Project Grants (RPGs) submitted annually to the NIH are unsolicited, investigator-initiated proposals. These include single project proposals, the most common being the RO1, as well as larger, multi-project proposals, such as the PO1 (program project). Career development awards and training grants, such as the “K” awards, may also be submitted unsolicited. The remainder of the RPGs submitted to the NIH are in response to specific requests and programs initiated by the Institutes and Centers (I/C) of the NIH, so called RFAs (Requests for Applications). On the three major yearly grant application receipt days thousands of packages are dropped at the doorstep of the NIH Center for Scientific Review (CSR), the division responsible for providing peer review for most proposals.

The first steps in the peer-review process are the simplest, but they have an important impact on the ultimate prospects of a proposal. After the applications are logged into a database, CSR Referral Officers review each application and decide which of the 20 Integrated Review Groups (IRG), formerly called Initial Review Groups, would be most appropriate for assessment of scientific merit and which of the 25 I/C would be most appropriate to provide funding. The IRGs are basically clusters of study sections organized thematically to review similar science. It is this step that therefore puts an application into the hands of a specific study section. **Table 6** lists the current IRGs.

Many, if not the majority, of grants from members of the American Society of Hematology (ASH) are assigned to the Cardiovascular Sciences IRG. Within Cardiovascular Science are eight chartered study sections, of which three have most relevance to ASH: Hematology-1 (HEM-1), Hematology-2 (HEM-2), and Pathology A (PTHA). The first two handle a broad array of hematology-related proposals, while the latter reviews, among others, grants involving endothelial and vascular biology. A significant number of applications, however, are assigned to other IRGs, including AIDS and Related Disorders, Immunologic Sciences, Genetic Sciences, and Oncologic Sciences, and thus can go to a wide variety of different study sections for peer review.

The CSR provides peer-review, assigns priority scores and calculates a percentile rank, but the ultimate funding decisions come from the individual Institutes and Centers of the NIH. These decisions are made three times each year, several weeks after all of the study sections complete their work. They usually follow the percentile rankings set by CSR, but the I/C are not compelled to do so and can make decisions moving applications up or down in priority based on their programmatic goals and needs, as defined by the I/C Director and Pro-

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* Weill Medical College of Cornell University, 1300 York Ave, Room C606, New York NY 10021-4805

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American Society of Hematology
gram Staff. Each I/C also has an Advisory Council, made up of senior scientists, leaders from patient advocacy groups, and other community leaders. This council helps in setting I/C priorities and policies and in making the ultimate funding decisions. Three NIH Institutes provide funding for most of the grants held by ASH members, the National Heart, Lung, and Blood Institute (NHLBI), the National Cancer Institute (NCI), and the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK).

The IRG system plays a crucial role in maintaining the integrity of the peer review process. Based on a sense within the NIH and the scientific community that the rapid advances in molecular biology, cell biology, and genetics had made the current thematic clusters obsolete and that the current IRG system may not be adequate for providing fair peer review to patient-oriented research and to the new technology-driven research, the CSR is undertaking an intense re-evaluation of the system. A panel of distinguished scientists (Panel on Scientific Boundaries), chaired by Bruce Alberts, President of the National Academy of Sciences, was appointed, and input was sought broadly from the various constituencies of the NIH. Phase I of their report was released in January 2000 (available on the CSR website, accessible from the NIH home page www.nih.gov; click on “Institutes and Centers”) and recommended significant changes in the culture and structure of the IRG system. They defined the main goal of the IRG system to be the provision of at least one appropriate venue for the review of all science relevant to health-related research and envisioned the IRGs as the functional unit of the review process, analogous to academic departments. Each IRG would have a leader (chair) and a “faculty” consisting of the Scientific Review Administrators (SRAs). Essential to the concept is that the research topics encompassed by each IRG would be sufficiently cohesive to allow an external advisory group of scientists for that IRG to judge the content of its entire portfolio and to provide periodic review of the IRG. The committee proposed 24 new IRGs (Table 6) designed to reflect the current state of biomedical research.

The new IRGs are structured so that biological questions under study will be reviewed with the perspective of human disease whenever possible. Phase 2 of the work of the Panel on Scientific Boundaries is to design the study sections for each of the 24 IRGs. The Panel stated that the study sections should be created so as to be neither too narrow or too broad and to have some overlap to allow flexibility in review. They should also be con-

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<tr>
<th>Current IRGs</th>
<th>Proposed IRGs</th>
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<tr>
<td>AIDS and Related Research (AARR)</td>
<td>Biological chemistry and macromolecular biophysics</td>
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<td>Behavioral and Biobehavioral Processes (BBBP)</td>
<td>Molecular approaches to gene function</td>
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<td>Biochemical Sciences (BCS)</td>
<td>Cell function and interactions</td>
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<tr>
<td>Biophysical and Chemical Sciences (BPC)</td>
<td>Fundamental genetics and population biology</td>
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<tr>
<td>Brain Disorders and Clinical Neuroscience (BDCN)</td>
<td>Biology of development and aging</td>
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<tr>
<td>Cardiovascular Sciences (CVS)</td>
<td>Fundamental bioengineering and technology development</td>
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<tr>
<td>Cell Development and Function (CDF)</td>
<td>Risk, prevention, and health behavior</td>
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<td>Endocrinology and Reproductive Sciences (ENR)</td>
<td>Health of the population</td>
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<tr>
<td>Genetic Sciences (GNS)</td>
<td>Infectious diseases and microbiology</td>
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<tr>
<td>Immunological Sciences (IMM)</td>
<td>AIDS and AIDS-related research</td>
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<td>Infectious Diseases and Microbiology (IDM)</td>
<td>Oncological sciences</td>
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<tr>
<td>Integrative, Functional, and Cognitive Neuroscience (IFCN)</td>
<td>Immunology</td>
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<tr>
<td>Molecular, Cellular, and Developmental Neuroscience (MDCN)</td>
<td>Hematology</td>
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<tr>
<td>Musculoskeletal and Dental Sciences (MSD)</td>
<td>Cardiovascular sciences</td>
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<tr>
<td>Nutritional and Metabolic Sciences (NMS)</td>
<td>Endocrinology, metabolism, and reproductive sciences</td>
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<tr>
<td>Oncological Sciences (ONC)</td>
<td>Bone, muscle, connective tissue, and skin</td>
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<td>Pathophysiological Sciences (PPS)</td>
<td>Digestive sciences</td>
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<tr>
<td>Risk, Prevention and Health Behavior IRG (RPHB)</td>
<td>Pulmonary sciences</td>
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<tr>
<td>Social Sciences, Nursing, Epidemiology and Methods (SNEM)</td>
<td>Renal and urological sciences</td>
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<tr>
<td>Surgery, Radiology and Bioengineering (SRB)</td>
<td>Surgery, applied imaging, and applied bioengineering</td>
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<td></td>
<td>Molecular, cellular, and developmental neuroscience</td>
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<td>Brain disorders and clinical neuroscience</td>
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ngested to both basic science and to specific diseases or organs and should serve multiple Institutes within the NIH. The first project undertaken in Phase 2 was Hematology. This new IRG will be of major interest to ASH members and will consider applications ranging from basic research to clinical studies on hematopoiesis, stem cell transplant and gene therapy, transfusion medicine, blood cells and their diseases, normal and pathological hemostasis and thrombosis, iron metabolism, hemoglobin structure, regulation, and disorders, fibrinolysis, and vascular biology. Large scale population studies and clinical trials would not be included. A subcommittee led by ASH member Mohandas Narla met in early 2001 and has proposed three new Study Sections for this IRG: Hematology A, B and C. In broad terms, HEM-A would review red cells, iron, and hemoglobin; HEM-B would review stem cells, transplantation, graft-versus-host disease, transfusion medicine, and leukemia and leukemogenesis; HEM-C would review hemostasis, thrombosis, platelets, and vascular biology, including angiogenesis, endothelial cell biology and matrix interactions. By design, there would be some overlap of these Study Sections with those in other IRGs, such as Cardiovascular Sciences, Oncological Sciences, and Immunology. The report of the subcommittee is available on the CSR website, and as of the time this manuscript was submitted, was still open for discussion. It has not yet been determined when these new study sections will convene, nor can it be predicted what impact they will have on proposals initiated by ASH members.

The assignment of a grant to both study section and I/C is an interactive process involving CSR Referral Officers, study section SRAs, and I/C program representatives. This decision is based mainly on the title of the proposal and the abstract, but the Referral Office also seriously considers written requests from applicants for both study section and Institute assignments; all you have to do as an applicant is include a cover letter with the application indicating your preferences. If you have no preferences your cover letter should include a list of the specific scientific areas that are critical to understanding your application. The CSR website maintains a list of all study sections, their rosters and the dates of their meetings. It is definitely worth reviewing this site to get a feel for the constituency of the study sections and which ones might be most hospitable to your proposal. Careful attention to the title and abstract can also help steer a grant to a desired study section and I/C. For example, if you are studying the structure-function relationships of a particular transcription factor, putting the words “hematopoiesis” or “blood cell development” in the title will most likely direct the grant to one of the HEM study sections and to NHLBI or NIDDK, rather than a gene regulation study section and to the Institute of General Medical Sciences.

A typical chartered CSR study section is composed of 18-20 individuals nominated by the SRA. The SRA recruits members with the goal of providing fair and expert peer review for all applications. Appropriate peer reviewers are usually active and experienced investigators, diverse in seniority, outlook, geographical location, gender, and ethnicity, who have achieved recognition for their own research accomplishments. Members are almost always independent, NIH-funded researchers, although industry scientists are also eligible. Study sections meet three times each year, reviewing as many as 80 applications each time, and members serve for multi-year terms. Service on a study section is thus a major commitment, and in my experience, members take their commitment very seriously. Ideally the combined knowledge of the group spans the diversity of subject matter assigned to that study section, but of course this is not always possible and the study section’s membership is supplemented by temporary “ad hoc” members and written outside opinions. It is the hope of the CSR that the new IRG system, when implemented, will improve the “fit” of member expertise with the study section application portfolio. In some instances, Special Emphasis Panels (SEPs) are formed by CSR on an ad hoc basis to review applications requiring special expertise or due to special circumstances (such as when a conflict of interest occurs). SEPs are also formed by the individual I/Cs to review program project grants and I/C-initiated applications submitted in response to specific requests for applications (RFAs). Last year 27% of NIH proposals (1727 applications) were reviewed by the individual I/Cs. Since the NCI and NHLBI handle the largest number of these applications, it is important for all investigators, especially early career investigators, to keep track of RFAs and Program Announcements regularly posted by the NIH. Most medical center research offices keep track of these and they can also be found on the NIH website.

After applications are assigned to a study section, the SRA reads them, checks for completion, and assigns them to study section members best suited to review that specific application. At least two, but usually three members are assigned each grant for written review (one primary and one or two secondary) and one or more additional members assigned as discussants. Discussants can prepare a brief written review, but it is not required. All members of the study section receive all applications (with the exception of those for which that member is in conflict) approximately six weeks before the meeting, but in my experience, most members read only their assigned grants and just skim the remainder, looking at the titles, abstracts and specific aims pages.

The CSR has set explicit criteria for optimal peer
review. Most importantly, the role of the peer reviewer is only to judge the research proposal, not to provide advocacy or gate-keeping for a field, discipline, or style of research. The review process, according to CSR, should meet the following criteria:

1. Set a high standard for scientific excellence, facilitating the selection of the best scientists and ideas on any given topic for NIH support.
2. Optimize the benefits that can be gained from the progress of science and its contributions to health.
3. Encourage innovation and risk taking.
4. Exercise fairness.
5. Be monitored continuously.
6. Be clearly explained to both scientists and the general public.

To effect these goals reviewers are instructed to consider and comment specifically on the following issues and to use these criteria to generate a priority score:

1. The overall significance of the research proposal; i.e. if the project succeeds what impact will it have on human disease and on our understanding of basic life processes; will important new technologies emerge.
2. Innovation in aims and approach.
3. The experimental approach. Basically, are the studies described in the application feasible and will the proposed experiments successfully address the aims.
4. Qualifications of the principal investigator (PI). For new investigators the previous training environment is considered. For all investigators, productivity as assessed by peer reviewed publications is considered. A small number of high impact, high quality publications is more important than a larger number of publications in lower impact journals.
5. The richness of the research environment. Among the issues that the reviewers address is the specific experience of the PI with the proposed experiments, whether there are preliminary data to support each of the aims, and will the proposed experiments, if successful, allow definitive conclusions. Here, issues of study design, controls, pitfalls, interpretation of results and alternative strategies are addressed. In summary, the proposal should be important, feasible and novel.

Study section meetings all follow the same general format. They usually last two days and take place in a hotel near the NIH. Members sit around a large conference table with the chairperson and the SRA, who jointly conduct the meeting, sitting together at the head of the table. Representatives from the various relevant I/C are usually present as observers and sit behind the conference table. A week or so before the meeting the SRA asks study section members for a list of R01 applications believed not to rank in the top half of scientific merit. At the beginning of the meeting a collated list is reviewed and a final list of “streamlined” applications established. These are not scored or discussed at the meeting, but reviewers’ written critiques are provided to the applicant. In general, any one member of the study section can vote to remove an application from the “streamlined” list. The advantage of this system is that it allows more time at the meeting for discussion of applications judged to have scientific merit more likely to be funded and, since summary statements are not prepared, the applicant receives the critiques faster and has more time to prepare a revised application. It is important to remember that “streamlining” is not equivalent to disapproval; many streamlined applications achieve a fundable priority with careful revision.

The bulk of the time at the study section meeting is spent discussing the individual applications. Members come to the meetings with their written reviews. The chair usually asks each reviewer to indicate his or her enthusiasm for the proposal and then asks the primary reviewer to provide a brief summary of the proposal and a more detailed summary of his or her review, concentrating on the strengths and weaknesses. If all reviewers are in agreement in their initial assessment of enthusiasm, the chair will then ask the secondary reviewer and discussants to make additional brief points. If there is some disagreement, they will be asked to provide more detailed comments justifying their differences of opinion. After these comments have been made the chair will open discussion to the entire study section. A serious attempt is made to raise all appropriate issues and arrive at a consensus priority score. After a period of discussion, ranging from 10-30 minutes, the budget is discussed and human and animal rights issues raised. The reviewers are then asked to consider the overall priority independently of budget; however, in practice, extremes of budget at the high and low ends can influence the enthusiasm for the project. Finally the chair re-polls the reviewers to determine if the discussion has changed their initial level of enthusiasm. Following this a secret written vote is taken.

The scale of scores is based on criteria defined by CSR (Table 3), and the study section members are strongly encouraged to “spread” their scores over the entire range. For RO1 applications, with streamlining of the bottom half, the scores should be spread from 1 to 3. In practice each study section develops its own “culture” of scoring, so that when the scores are averaged after the meeting, the percentile rank is calculated based on the entire pool of grants reviewed by that committee over the last few cycles. This means that similar priority
experience in the application. Reviewers are asked at
encourages new investigators to describe their level of
considered independent research grants. Also the NIH
grant support. Prior "K" awards and "T" awards are not
in the NIH commitment to supporting new investigators,
Medical Sciences. This decision did not reflect a decrease
tors of the CSR and the National Institute of General
working group of senior scientists chaired by the Direc-
"new" investigators based on the recommendations of a
Special Consideration for New Investigators
In 1998 the NIH discontinued the R29 FIRST (First In-
dependent Research Transition) Award program for
“new” investigators based on the recommendations of a
working group of senior scientists chaired by the Direc-
tors of the CSR and the National Institute of General
Medical Sciences. This decision did not reflect a decrease
in the NIH commitment to supporting new investigators,
but rather recognition of serious flaws in the structure
of the program. Now the face page of all applications
contains a check box to identify new investigators, de-
 fined as those without prior independent NIH research
grant support. Prior “K” awards and “T” awards are not
considered independent research grants. Also the NIH
encourages new investigators to describe their level of
experience in the application. Reviewers are asked at

scores from different study sections can result in sur-
prisingly different percentile ranks. After the SRA and
staff complete the summary statements for all of the ap-
lications (usually about 6 weeks), they are sent to the
applicants and to the appropriate I/C for funding con-
sideration. At this point the I/C program officials be-
come the applicant’s link to the NIH with regard to dis-
position of the application.

In my own experience on four different chartered
CSR study sections and numerous Special Emphasis
Panels, the review process is extremely fair with careful
attention paid to every proposal. Although the time spent
on each application at the actual meeting is relatively
brief, in the weeks before the meeting most reviewers
spend at least 6-8 hours carefully considering each of
the applications assigned to them as primary or second-
ary reviewer. The general tone of most study sections is
positive; that is, the focus is on identifying the strengths
of each application. With applications that will probably
fall outside the payline the reviewers generally make a
serious effort to identify the most important and correct-
able weaknesses. The members of the study section are
usually strong advocates for research in their fields and
would like to see as many grants funded as possible.

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<tr>
<th>Descriptor</th>
<th>Score</th>
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<tr>
<td>Outstanding</td>
<td>1.0 - 1.5</td>
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<tr>
<td>Excellent</td>
<td>1.5 - 2.0</td>
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<tr>
<td>Very Good</td>
<td>2.0 - 2.5</td>
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<td>Good</td>
<td>2.5 - 3.0</td>
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<tr>
<td>Average</td>
<td>3.0 - 3.5</td>
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<tr>
<td>Below Average</td>
<td>3.5 - 4.0</td>
</tr>
<tr>
<td>Fair</td>
<td>4.0 - 4.5</td>
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<tr>
<td>Poor</td>
<td>4.5 - 5.0</td>
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Re-Submission of Applications
As mentioned previously, despite the hard work of ev-
ery grant writer and the best intentions of every study
section, most applications will not receive a fundable
priority score. As a result, virtually all successful inves-
tigators must become adept at the process of revising
and resubmitting applications. At most study section
meetings, as many as a quarter to a third of applications
are re-submissions. As of October 1996 the NIH allows
only two attempts at revision (A1 and A2) and only two
years beyond the date of receipt of the initial unamended
application. This decision was not meant to be punitive,
but intended to recognize the historical reality that ap-
lications beyond A2 were rarely successful and, even
when successful, were almost never followed by suc-
cessful renewal. After three unsuccessful attempts, the
NIH feels that the investigator would be best served by
taking a fresh start at his or her research plan.

General Rules of Grant Writing
When preparing a re-submission there are several rules
of thumb to follow. As with all applications, it is ex-
tremely important to pay attention to the basic rules of
grantsmanship described by Dr. Miller in the previous
chapter. Remember that most members of study section
are busy senior scientists. While they are very willing to
invest several hours on your application, if your grant is
difficult to read your chances are diminished. Therefore
it is very important to make your application easy to read
and free of typographical errors. Use a readable font of
reasonable size for a tired, middle-aged reviewer. A pro-
portionally spaced, 12-point type, such as Times New
Roman or Arial, is easiest on the eye. Be generous in your spacing; skip lines between paragraphs and don’t crowd figures into the text. With a 25 page, single spaced application the extra information “squeezed” in by crowding margins and paragraphs and using a small typeface is counterproductive. Figures must be high quality; take advantage of modern computer word processing and printing technologies and use color if appropriate – everyone else does! Place the figures into the body of the proposal, adjacent to the text that refers to the figure if at all possible. Most busy reviewers do not want to search through appendices or through pages of text to find a figure. Provide high quality originals for all of the submitted copies of your application so that all of the reviewers have the highest quality figures. Make figure legends as brief as possible. Provide a brief title for the figure that contains the conclusion drawn from the figure, make sure the graphs and images are well labeled, and describe them carefully in the text. Remember not to use small typeface in the figures, as they will not photocopy well.

Pay attention to your prose! Be clear and concise; avoid jargon and long lists of abbreviations. Try to make your application “flow” in a logical manner. It is best to make your specific aims section brief. There should be a clear statement that outlines the broad goals of the proposal and the hypotheses that drive it, followed by a list of specific aims that is not simply a list of the planned experiments but rather outlines the conceptual framework that organizes the proposal. While it is safe to assume that the reviewers will be sophisticated and knowledgeable scientists, it is a mistake to believe that they will be absolute experts in your own specific field. Therefore the goals for the introduction and background sections are similar to those of a good, brief (non-comprehensive) scientific review article; you want to excite the reader about your area of science and educate him or her as to the key open questions in the field. A model strategically placed early in the proposal helps the reviewer see the “big picture” and places your work in the context of the field. In addition, you also want to convince the reviewers that your hypotheses are sound and that they are well justified by your own published work, that of others in your field, and your unpublished preliminary data. Since assessment of “significance” is a key component of the review process, be explicit in your text as to what makes your proposal significant.

The goals of the preliminary data section are twofold. First, high quality preliminary data convince the reviewers that the proposal is feasible and that the PI has the experience necessary to perform key experiments. Thus it is important to include preliminary data that support the use of the key technologies in the experimental plan. Most reviewers expect to see preliminary data to support the feasibility of each of the specific aims. Second, the preliminary data should support the hypotheses that drive the proposal. Even if the proposed studies are elegant, feasible, and likely to succeed in your laboratory, the reviewers need to be convinced that the hypotheses are sound and significant. The NIH, at the discretion of the study section SRA, allows applicants to submit supplementary preliminary data after the initial submission date. If you chose to do this, you should contact the SRA first to determine the proper procedure for that study section. You should submit new data as early as possible, preferably before the applications are mailed to the reviewers (usually 6 weeks before the meeting). No reviewer is happy to receive new information after he or she has already spent 6-8 hours reviewing an application and writing the critique. Supplementary data should be brief, important, and critical to the application; most successful applications are not made so by the addition of new, last minute data.

The experimental design section of the grant is perhaps the most common place where the inexperienced grant writer stumbles. This should not be a “cookbook” type list of experimental procedures. The best way to show that an experimental technique is feasible is to provide convincing preliminary data, not a detailed description of the methodology. Reviewers are looking for an outline of a rational experimental approach with attention to controls, interpretation of expected results, frank discussions of pitfalls and limitations, and consideration of alternative approaches. Since assessment of innovation is a critical component of the review process, it is useful to explicitly state in your proposal where your approach is particularly novel.

The scientific community is a small one; there are few secrets. If your career status has changed since the initial submission or if the status of key collaborators has changed, it is wise to inform the study section of this (through the SRA). For example, if you accepted a position at a new institution, you should inform the committee of what this means in terms of your laboratory facilities, time to commit to the project, etc.

**Specific Suggestions for Amending an Application**

It is very important to take the criticisms and suggestions of the study section seriously and not to get hung up on concerns that you have “enemies” or competitors on the committee, or that your application went to the “wrong” study section, or that the reviewers made mistakes. Remember that the priority score reflects the consensus of at least three senior scientists who carefully read and reviewed your application and, for non-streamlined applications, additional input from an experienced group of grant reviewers at the meeting. If the critiques really do reflect mistakes in interpretation and under-
standing of your application, then the most reasonable conclusion is that your proposal was difficult to read and not easy to understand.

When the study section reviews an amended application the reviewers pay close attention to how you have responded to the previous critiques. They will not have your previous application(s), but they will have copies of the summary statements and critiques. A successful re-submission always includes gracious and specific responses to the written critiques. Defiant re-submissions with only cosmetic changes and superficial attention to the critiques almost never succeed, no matter how eloquent the rebuttal. A thoughtful response that includes new data and that makes additions and deletions to the experimental approach section as suggested by the study section impresses the reviewers and is more likely to result in improvement in priority score. The introduction to the amended application should be detailed and should make clear to the reviewers what was deleted, what is new, and how the proposal has been otherwise modified. Some applicants use highlighters or margin symbols to flag important changes.

The first step in planning a re-submission is to read the reviews very carefully. I recommend making a list of all the specific criticisms, both positive and negative. In the introduction to the revised application it is always good to summarize the positive comments and thank the reviewers for them. Since there is always turnover of personnel on the study section, this serves to inform any new reviewers of the good feelings of the last set of reviewers. It is also wise to thank the reviewers for their help in identifying the weaknesses of your proposal. Once you have generated a list of the specific issues raised by the study section, it is useful to separate the minor technical issues from the rest. Even though a large part of the critique may be made up of these minor points, they are really not as important as the “big picture” issues. They should all be carefully addressed, but attention to these should not be the major focus of the re-submission.

The remaining criticisms should be ranked in order of importance, remembering that the key elements of the review process that determine priority score are “Significance,” “Innovation,” and “Approach.” It can be very helpful to ask one or more colleagues with recent study section experience to review your critiques. As mentioned before, nearly all scientists have been through this, so do not be embarrassed by the implicit “rejection” of the critiques. The language of the critiques tends to be understated and to use terminology that has more meaning to the peers on the study section than to the applicant. An experienced colleague or mentor can help sort out these subtle meanings and identify the critical changes and the new data required to push the application into the fundable range. Another good source of information is the SRA. If the grant was not streamlined, the SRA can often provide a general sense of how the application was received by the committee, what issues generated the most discussion, and how enthusiastic the committee would be towards a re-submission. Institute program officers, if present at the study section, can also provide similar insights.

Among the more common criticisms that appear in summary statements are that the proposal is “too ambitious” or that it is “overly descriptive.” The first is especially relevant to younger investigators. It is easy to see how this happens; a scientist just getting started is excited about his or her work, anxious to do as much as possible, and perhaps a little fearful that reviewers will find the application weak if all possible studies aren’t considered. The reviewers, on the other hand, see the proposal as diffuse and perhaps reflective of an inability of the investigator to make critical decisions and to set priorities. If this criticism is raised it is essential to take it seriously, cutting where suggested by the reviewers and focusing on the most significant and most feasible aspects of the proposal. The flip side of this coin is represented by proposals that are judged to be overly narrow in scope. Here the reviewers are concerned that the focus is too narrow and that the studies will not contribute enough significant new knowledge to the field. This is a more difficult problem to address and often requires substantial new approaches on the part of the applicant, i.e. new aims and new preliminary data. Advice from senior colleagues can be very useful in this regard.

The criticism of a proposal as “overly descriptive” reflects the desire of the NIH to support research that reveals the fundamental mechanisms of human disease and/or basic life processes. This type of insight rarely comes from descriptive studies, no matter how well performed. If this criticism appears in the summary statements the reviewers will expect to see significant re-working of the amended application with the addition of new aims that are more mechanistic in nature and new preliminary data to support those aims. As with grants considered too narrow in focus, grants judged as overly descriptive may reflect hesitancy on the part of the investigator to ask the big and important questions. Finding a new collaborator to help in the design and execution of critical mechanistic studies is one strategy to address this criticism.

Another common criticism is that the approach of the proposal is a “fishing” expedition and not hypothesis-driven. This comes up in particular with proposals involving gene expression arrays, proteomic screens, and yeast 2 hybrid screens. These are perfectly acceptable methods; it is just very important to try to frame the studies in the context of a hypothesis and, more importantly,
to outline a clear and detailed experimental approach designed to interpret any information obtained from these screens. The study section will want to know how you will verify true positives, prioritize findings if there are multiple positives, and convert these discoveries to mechanistic insights.

Perhaps the most important advice for any applicant is to finish the proposal early and send it to an experienced colleague for rigorous criticism. After living with a grant for days and weeks, it is easy to lose perspective and see clarity where others may see obfuscation. As chief of a large academic division, I am happy to pay a small honorarium to outside consultants to obtain a formal pre-review in the NIH style of any application from our faculty; I am sure that most Department Chairs and Division Chiefs feel likewise.

There are many complaints about the NIH peer review system. This is not surprising given that the majority of proposals reviewed at any given study section are judged to have priority too low for funding. On the other hand a much larger number are ultimately funded and a large number of investigators are continuously funded through most of their careers. Persistence, flexibility, thick skin, and willingness to pay attention to friendly and well-meant criticism will go a long way towards success.