Grantsmanship:
Grant Writing Basics

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Idea ⟶ Proposal ⟶ Funded Project
or "How do I get there from here?"

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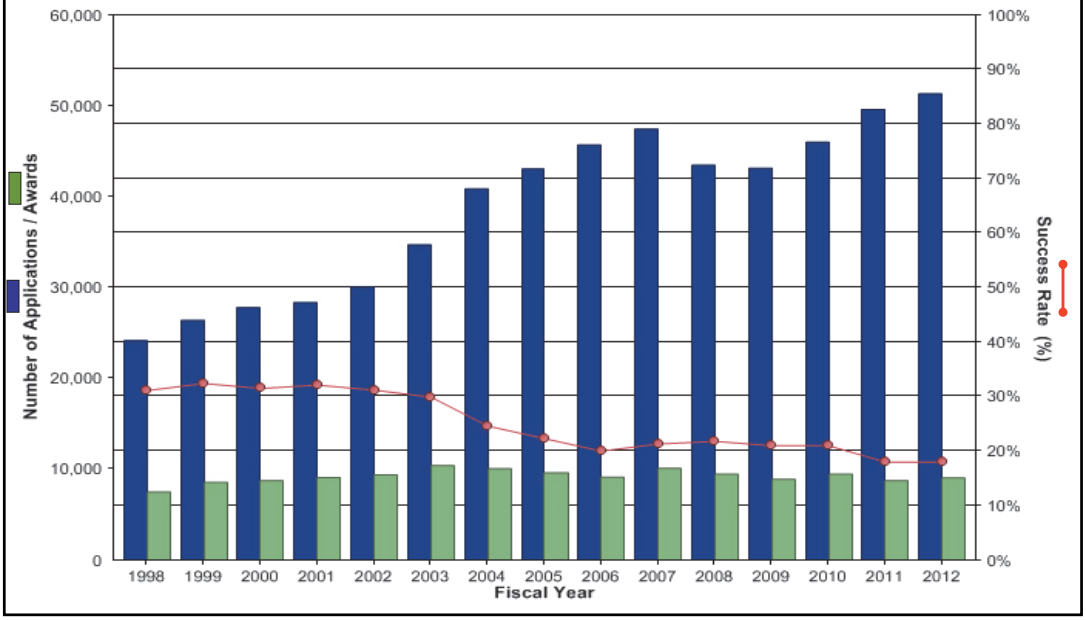
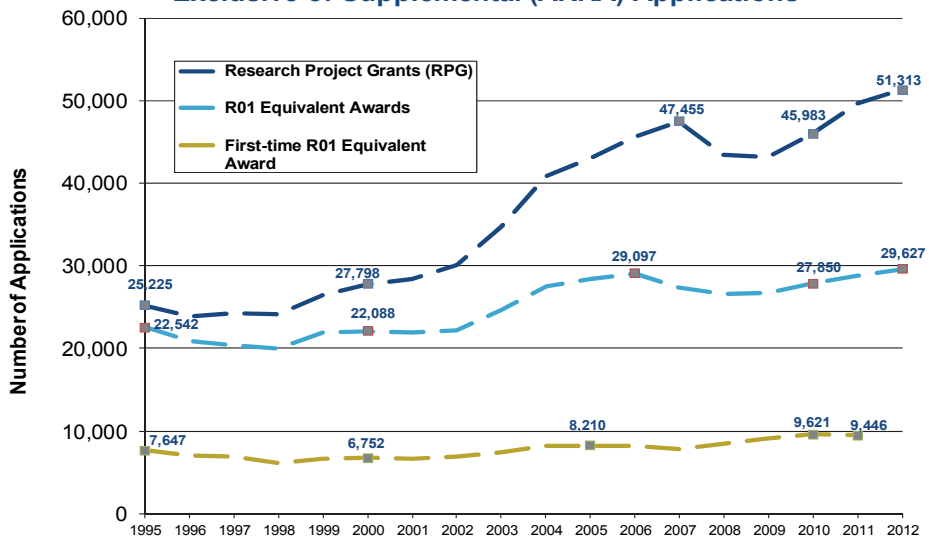
"Ever been to a research grant review before?"

NIH Funding Rates



Number of Applications (With Breakout of First-time R01)
Exclusive of Supplemental (ARRA) Applications



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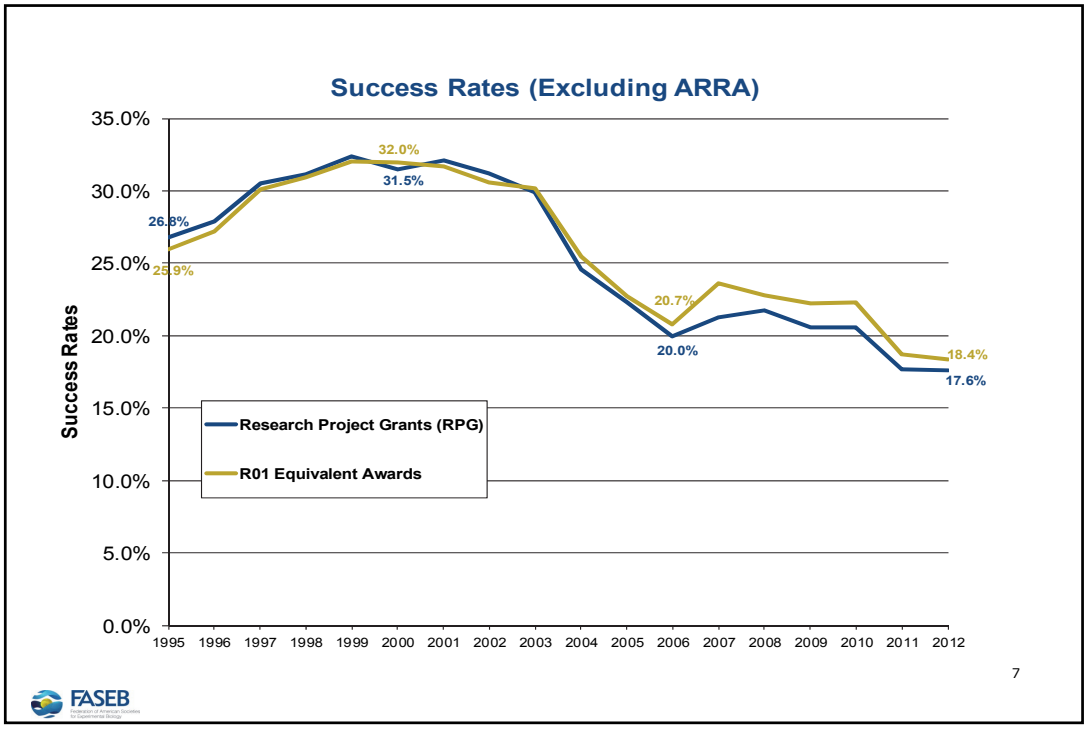
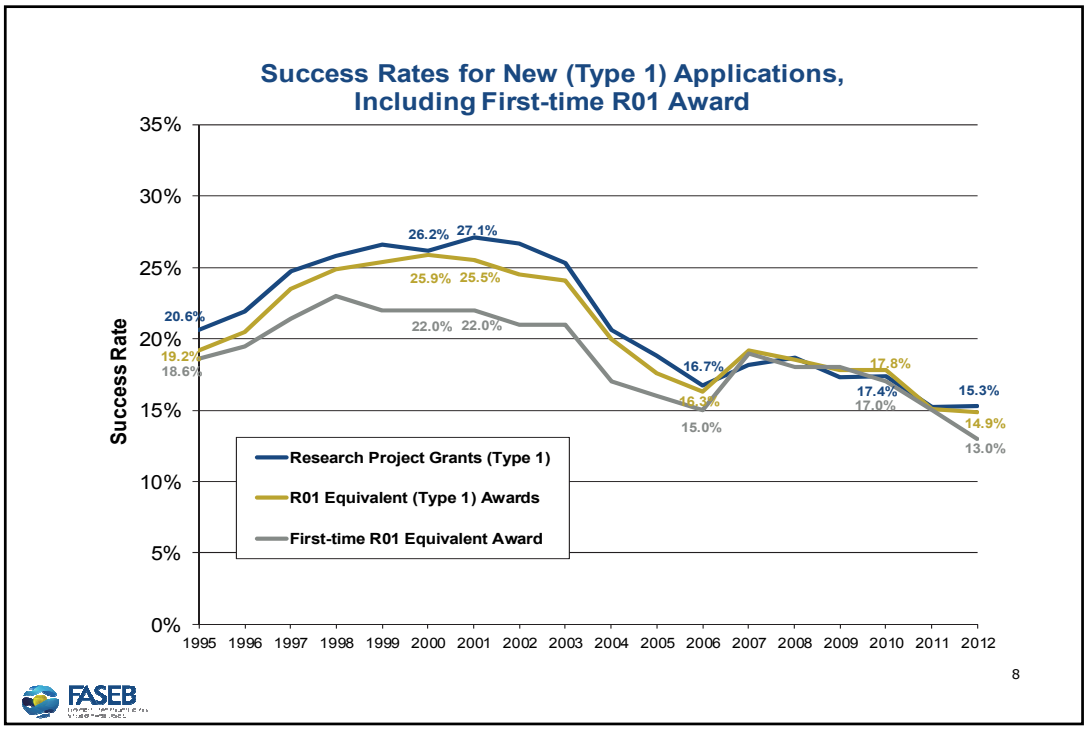
FASEB


Success Rates (Excluding ARRA)
Success Rates
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
26.8%
32.0%
31.5%
25.9%
20.7%
20.0%
18.4%
17.6%
Research Project Grants (RPG)
R01 Equivalent Awards
7
FASEB

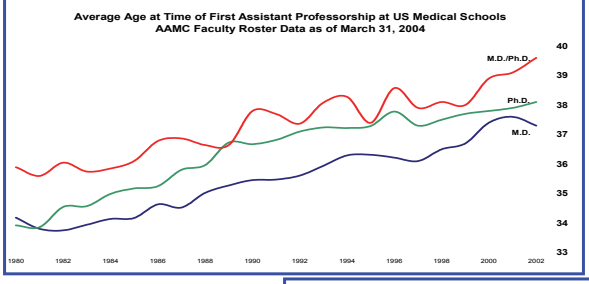

Success Rates for New (Type 1) Applications,
Including First-time R01 Award
Success Rate
35%
30%
25%
20%
15%
10%
5%
0%
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
20.6%
26.2%
27.1%
19.2%
25.9%
25.5%
18.6%
22.0%
22.0%
16.7%
16.3%
15.0%
17.8%
17.4%
17.0%
15.3%
14.9%
13.0%
Research Project Grants (Type 1)
R01 Equivalent (Type 1) Awards
First-time R01 Equivalent Award
8
FASEB

Summary of Trends in NIH Funding FY1995-FY2011

	FY1995	FY2012	% Change
NIH Budget (in millions)	$11,300	$30,702	171.7%
R01 Equivalent Funding ($ millions)	$4,718	$11,022	133.6%
Total # R01 Equivalent Grants	21,680	26,285	21.2%
R01 Equivalent Applications	22,542	29,627	31.4%
Ave. $ per R01 Equivalent (in thousands)	$217.6	$419.3	92.7%
# of R01 Equivalent Awards	5,849	5,437	-7.0%
R01 Equivalent Success Rates	25.9%	18.4%	-29.0%

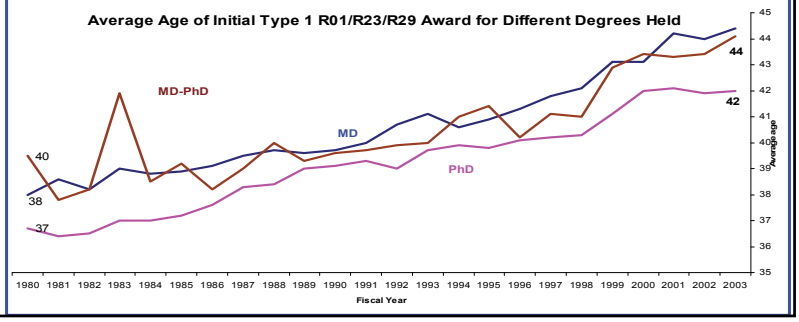
FASEB

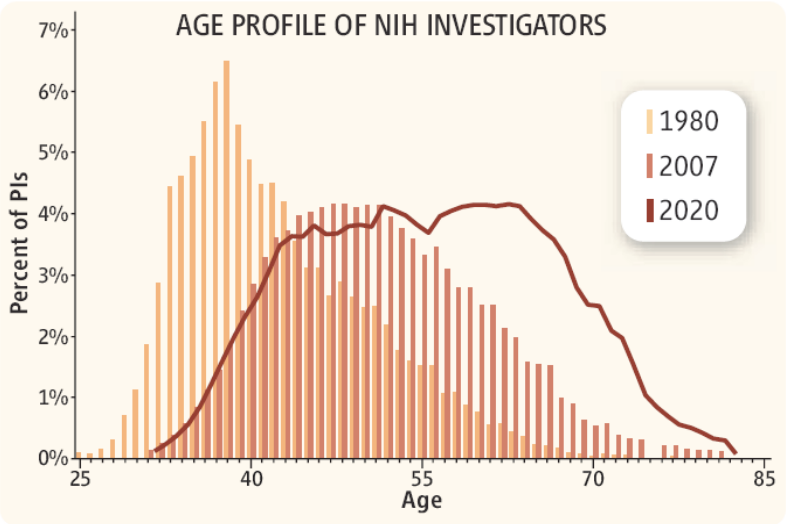
First Tenured-Faculty Appointment Occurs at an Ever-Later Age



The Challenges

First Major Independent Research Support Occurs at an Ever-Later Age





Graying work force. NIH investigators are aging, and those over 68 could outnumber those under 38 by 2020.

SCIENCE VOL 322 7 NOVEMBER 2008

Required Reading

http://www.hhmi.org/grants/office/graduate/labmanagement.html

There is no substitute for "Excellent Science":

- The best writing in the world cannot make a poor idea fundable:

HOWEVER

- The best science in the world can easily be destroyed by poor writing and is not fundable if not clearly communicated to the reviewers.

> *There is no grantsmanship that will turn a bad idea into a good one, but there are many ways to disguise a good one.*
>
> William Raub, a former deputy director of NIH

THE ‘ *F* ’ WORD

- What are the major factors that determine whether a grant will be scored highly & FUNDED?

  The SCIENCE & HOW WELL IT IS COMMUNICATED

- i.e., The ‘*review process*’ REALLY DOES work: (on AVERAGE)
  - (in general, good science is funded, poor science is not. However when funding is extremely tight, the curve is very steep and small, almost arbitrary differences in scoring can easily push a good application out of the funding range.
- Learn the RULES and play by them
- FOLLOW the INSTRUCTIONS

A proposal is an argument

- It is a work of persuasion and not a collection of disparate facts.
- It is not merely a description of the work you want to do; you are making an argument that it needs to be done and that you are the right person to do it.
- Make a tight, focused, compelling argument.

Reviewers Focus on the Four Cs

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

Content. Organize your ideas around associated aims linked to your central hypothesis. (The mission statement of each I/C sets forth its areas of emphasis.)

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

Cutting edge. Be ready to take legitimate risks, preferably based on preliminary data, to move the science forward. NIH rates grant applications on innovation (see "Criteria for Rating of NIH Grant Applications" on this page).

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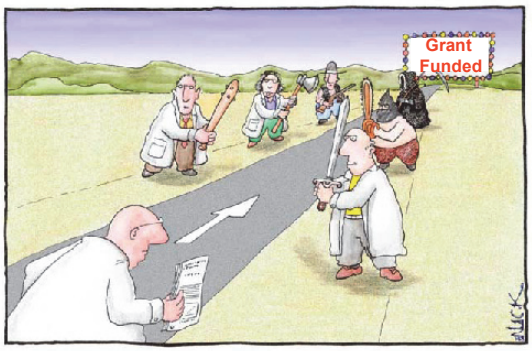
Electronic Grants Submission and new Formats and Review Criteria



Most scientists regarded the new streamlined peer-review process as 'quite an improvement.'

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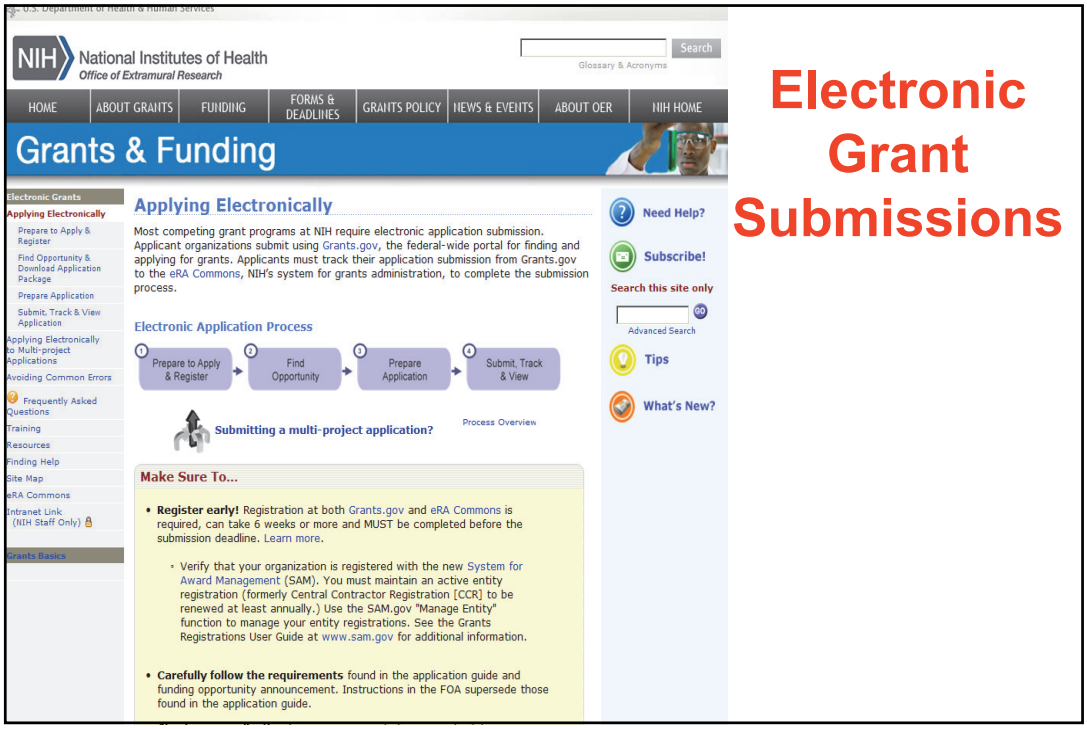

Electronic Grant Submissions

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NIH Grants Receiving Office (Prior to eGrants)

New NIH Electronic Submission Format

SECTION OF APPLICATION Also refer to the relevant section of the application instructions and the FOA.	PAGE LIMITS *
Introduction to Revision or Resubmission Applications	1 page
Introduction to Revision or Resubmission Applications For each project and core of multi-component applications	1 page
Specific Aims	1 page
Research Strategy (Item 5.5.3 of Research Plan) For Activity Codes R03, R13/U13, R21, R36, R41, R43, Fellowships (F), SC2, SC3	6 pages
Research Strategy (Item 5.5.3 of Research Plan) For Activity Codes R01, single project U01, R10, R15, R18, U18, R21/R33, R24, R33, R34, U34, R42, R44, DP3, G08, G11, UH2, UH3, SC1, X01	12 pages
Research Strategy (Item 5.5.3 of Research Plan) For all other Activity Codes, including Cs, Ps, Ss, Ts, Us, etc.	follow FOA instructions *
Biosketch (per person) For all Activity Codes except DP1 and DP2	4 pages
Biosketch (per person) For DP1 and DP2	2 pages
Appendix **	No page limits, but content limitations. See relevant section of instructions and FOA

Research Review Criteria at a Glance
(for Parent Announcements)

	Research and Research Center (R, DP, RC, P, etc)	SBIR/STTR (R41, R42, R43, R44)	Academic Research Enhancement Award (AREA) (R15)
Overall Impact	**Overall Impact** • Significance • Investigators) • Innovation • Approach • Environment	*Overall Impact*	*Overall Impact*
Scored Review Criteria (Scored individually and considered in overall impact score) PAR & RFA: May add questions to each scored criterion or additional criteria		✓ *Significance* ✓ *Investigator(s)* ✓ *Innovation* ✓ *Approach* ✓ *Environment*	✓ *Significance* ✓ *Investigator(s)* ✓ *Innovation* ✓ *Approach* ✓ *Environment*
Additional Review Criteria (Not scored individually, but considered in overall impact score) PAR & RFA: May add new criteria or questions to each additional criterion	R01-BRP only: • Partnership and Leadership All: ✓ *Protections for Human Subjects* ✓ *Inclusion of Women, Minorities, & Children* ✓ *Vertebrate Animals* ✓ *Biohazards* • Resubmission • Renewal • Revision	• Phase II • Fast Track ✓ *Protections for Human Subjects* ✓ *Inclusion of Women, Minorities, & Children* ✓ *Vertebrate Animals* ✓ *Biohazards* • Resubmission • Renewal • Revision	✓ *Protections for Human Subjects* ✓ *Inclusion of Women, Minorities, & Children* ✓ *Vertebrate Animals* ✓ *Biohazards* • Resubmission • Renewal • Revision
Additional Review Considerations (Not scored individually and not considered in overall score)	R01-BRP only: ✓ *Technology Transfer* All: • Applications from Foreign Organizations • Select Agents • Resource Sharing Plans ✓ *Budget & Period of Support*	• Select Agents • Resource Sharing Plans ✓ *Budget & Period of Support*	• Select Agents • Resource Sharing Plans ✓ *Budget & Period of Support*
Additional Comments to Applicant	Additional Comments to Applicant	Additional Comments to Applicant	Additional Comments to Applicant

Responses for items with emphasis (✓*italics*) are required. Last Reviewed on August 27, 2012 Page 1 of 1

Fundamental Criteria Evaluated by Reviewers (for essentially all funding agencies)

1. Scientific and intellectual quality, and merit
2. Potential impact on field
3. Innovation: Is application novel, or does it have potential impact due to other merits.
4. Is there a clearly stated and valid hypothesis that can be rigorously tested by logical specific aims?

Fundamental Criteria Evaluated by Reviewers

5. Is there preliminary data to support the hypothesis?
6. Are the methods and procedures appropriate, adequate and feasible as proposed? Are the investigators qualified and/or experienced?
7. Are the facilities and environment adequate and appropriate?

Developing a Research Plan

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1. Application MUST be based upon a strong hypothesis !!!!!!!!!!!!!!!!!!
2. Application must be highly focused; and specific aims clearly related to and capable of testing the central hypothesis.
3. Almost all applications should address a *MECHANISM*. "MECHANISTIC", not 'descriptive' , science always ranks best.
4. Application must reasonable and feasible. 'Overly ambitious' proposals fare poorly. Retain focus!
5. Specific Aims must be related and MUST rigorously test central hypothesis. Retain focus!

Suggestions for good scientific writing

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- Employ short, simple sentences and paragraphs. Goal is communication, not Nobel Prize in literature.
- Employ active rather than passive voice ("We will develop a cell line….", not "a cell line will be developed…"
- Keep related concepts together, and place clauses and phrases as close as feasible to the words modified.

Suggestions for good scientific writing

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- Edit mercilessly, especially for redundancy.
- Proof read extensively and repeatedly – including figure legends, tables and graphs. Look carefully for typographical and grammatical mistakes, omitted information, and errors in figures and tables. Eliminate any discrepancies!
- Neatness counts!!! Sloppy work always is reviewed poorly as it reflects unfavorably upon the investigators organization and competence.

Grantsmanship Essentials

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- Excellent Science
- READ and Follow Directions (agency specific)
- Be Succinct
- Have others read (and re-read) your proposals
- Don't rush
- Make it easy for the reviewer
- Make it easy for the reviewer
- *Make it easy for the reviewer*

Make it easy for the reviewer

29

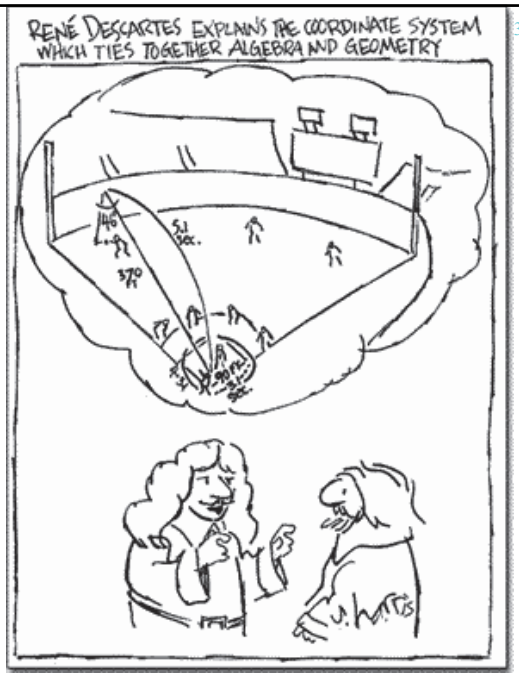
- DO NOT ANTAGONIZE THE REVIEWER
- THE REVIEWER SHOULD BE YOUR FRIEND
- YOUR REVIEWER MUST BE YOUR ADVOCATE
- HELP THE REVIEWER WHENEVER POSSIBLE
- IF YOU GET A POOR SCORE:
  - The reviewers were not idiots (probably):
    - The science was bad
    - You wrote a poor grant
    - BOTH

Make it easy for the reviewer

30

- Reviewers are usually NOT experts in the precise topic of the proposal.
- The proposal MUST be written so a person who is NOT an expert can understand it.
- Avoid jargon, define abbreviations.
- Provide adequate background information.

Important to communicate clearly – all reviewers unlikely to be an expert in the field.



Make it easy for the reviewer

- Reviewers have limited time – BE CONCISE.
  (page limits are ***LIMITS***, not suggested guidelines if the author is so inclined….)

- **'It is incumbent upon the APPLICANT to tell a coherent story to the Reviewer, NOT for the REVIEWER to ferret out what the applicant intends to do". ("anonymous SRA, 1996")**

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Make it easy for the reviewer

- Grants are often reviewed late at night, on airplanes, in hotel rooms, etc.
- The Applicant needs to invest the time to make the science readable and understandable.
- Reviewers work as a service to the community, not for ego, money or prestige.

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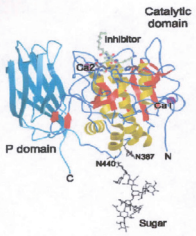
Make it easy for the reviewer

- Reviewers are generally more senior scientists (i.e. older) and do not have 20/20 eyesight.
- Make the grant easy to read: Reviewing is tiring.
- FONTS – size and typeface (*don't* cheat).
- LINE SPACING (don't cheat).
- Provide WHITE SPACE.
- Utilize PARAGRAPHS.
- FIGURES and *LEGENDS – suitable sizes.*
- *Mark REVISIONS appropriately.*

Principal Investigator: [redacted]

Figure 2. Crystal structure of mouse furin (from Henrich et al, 2003)



The furin crystal structure **(Figure 2)** reveals many interesting aspects, not the least of which is an extremely acidic substrate-binding groove. This extended region of negative charge is sufficient to explain the highly inhibitory properties of polyarginines previously discovered in our combinatorial peptide library screening efforts. Another interesting finding was the novel structure of the P domain, a beta barrel which abuts the catalytic domain and affects catalytic parameters, and was found to be formed by a jellyroll-type beta barrel (shown in blue in Figure 2 above). The furin structure was published this year in Nature Structural Biology (Henrich et al 2003, #7).

2. CRES collaboration (with G. Cornwall). The protein CRES is a testes-specific cystatin-related protein which is however inactive against cysteine proteinases due to its lack of certain critical residues (Cornwall et al 2002, #6). We have collaborated with Dr. Gail Cornwall of Texas Tech to examine the inhibition of this protein against PC2; Dr. Cornwall initially contacted us because PC2 is colocalized with CRES in testicular tissue. Our experiments surprisingly showed that CRES represents a potent inhibitor of PC2, with inhibitory activity in the nanomolar range. Other serine proteases and other proprotein convertases were not affected. We are continuing to collaborate with Dr. Cornwall on structure-function analysis of CRES inhibition (Cornwall et al, 2000; #6).

3. Development of the mini-RIA. In order to facilitate radioimmunoassay of a large number of fractions derived from size fractionation of precursor cleavage products, we developed a "mini-RIA" procedure in which tubes are handled in 96 well racks during the majority of the RIA. This technique, which saves considerable operator time, has now been published in Analytical Biochemistry (Laurent and Lindberg, 2002; #5). This technique will be useful in analyzing the effect of mutations on specificity in Aim 1.

4. Overexpression of CPE, PAM and POMC. We have recently initiated the overexpression of rat CPE (vector obtained from Dr. Lloyd Fricker of AECOM) using the CHO cell system, and have received PAM-3-overexpressing CHO cells from Dr. Betty Eipper of the University of Connecticut, which we are in the process of amplifying further. Expression has been confirmed using enzyme activity assay as well as Western blotting. The current estimated expression levels of CPE and PAM-3 are about 0.1 mg/liter (based on the known specific activity of purified recombinant CPE and PAM-3 previously obtained from the Fricker and Eipper laboratories; we have also obtained recombinant PAM-3 from Unigene); however, we have only begun methotrexate amplification, and expect to ultimately achieve 10-20 times these levels. These studies support our ability to perform the experiments described in Specific Aim 4.

PROJECT GENERATED RESOURCES: During the course of this work we have generated milligram quantities of convertases (mouse PC1, mouse PC2, and human and mouse furins) and developed inhibitors useful both *in vivo* and *in vitro*. We make limited quantities of both purified proteins and peptides (where financially feasible) available to the scientific community. In addition, we have generated recombinant prodynorphin, proenkephalin, proenkephalin antisera, and proenkephalin

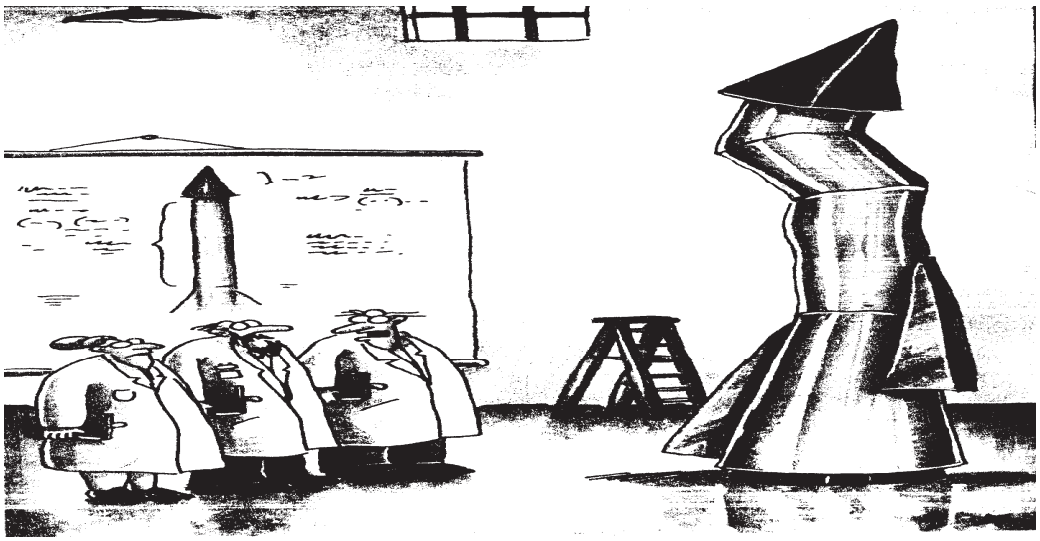
Include ample white space between small paragraphs with simple figures and diagrams.

A Real Study Section = REAL PEOPLE

APPLICATION PLANNING Guidelines

- Critically evaluate the field and its literature.
- Critically evaluate YOUR familiarity and experience with the field and its literature.
- Are the key research questions in the field well defined and is there consensus?
- Is it a 'mature' field of study or is it over studied?
- Is the work proposed novel or simply modest extensions of previous work?
- Is the work controversial?
- Discuss proposed scope of work with appropriate agency program staff –they are supposed to help you.

Evaluation of Research Plan



"It's time we face reality, my friends...We're not exactly rocket scientists."

RESEARCH PLAN Guidelines

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- Make certain you have CURRENT application materials, instructions and deadlines!
- Make certain all aspects of experimental design are hypothesis driven. Limit descriptive studies to those essential to support mechanistic studies, and provide rationale and justification for ALL experiments.
- Ensure all specific aims are related and focused toward central hypothesis.
- Critically evaluate and then provide support for feasibility of specific aims.
- Justify scope of application.

RESEARCH PLAN Guidelines

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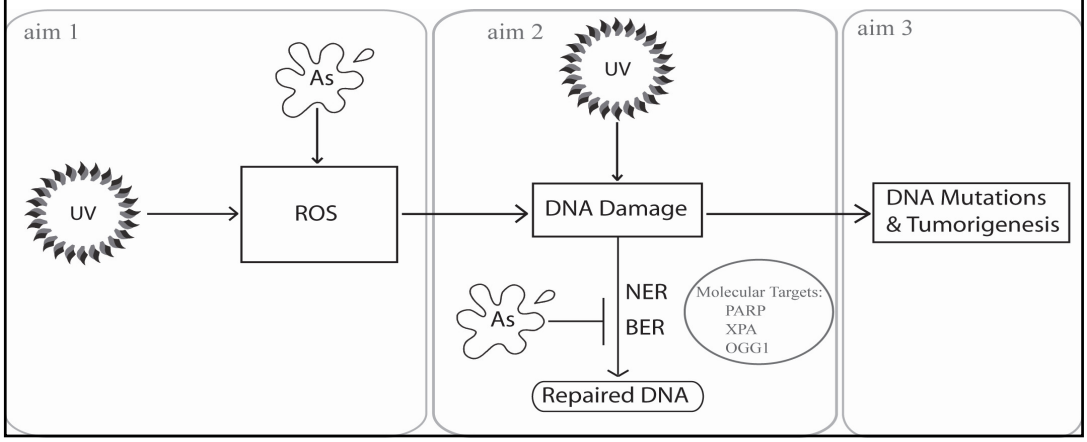
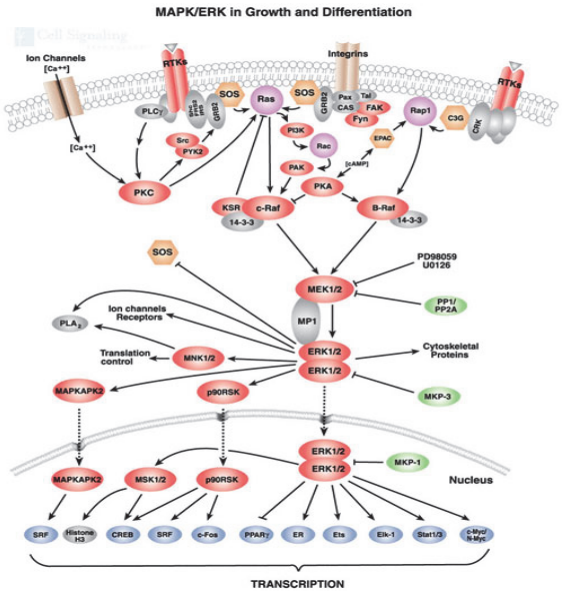
- Present information, clearly, logically and straightforward as possible.
- Reinforce innovative aspects of project.
- Clearly describe what new information will be forthcoming and what gaps in a field will be addressed.
- Cite literature appropriately (qualitatively and quantitatively – but don't write a review).
- Reiterate the central hypothesis and its rationale.

It can be extremely helpful to include diagrams, flow charts or cartoons to help Illustrate key concepts in your proposal.

But Don't over do it. SIMPLICITY and CLARITY are the goal. It does no good to further confuse the reviewer.

*The central hypothesis for the current proposal is that arsenic acts as co-carcinogen for UVR-induced skin tumorigenesis through a dual mechanism involving elevated oxidative stress and inhibition of DNA repair that results in increased DNA damage and tumor formation. (**Fig 1**).*





This is too complex!

Streamline your diagrams to highlight the essential points.

Include a caption or legend that describes all acronyms and abbreviations.

Make sure the figure and labels are legible.

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ORGANIZING THE GRANT

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- ABSTRACT
- SPECIFIC AIMS

HYPOTHESIS

- Background and Significance
- Preliminary Results
- Experimental Approach
- Materials and Methods
- Human Subjects
- Vertebrate Animals
- Literature Cited

Short – but often requires the most time and effort

HYPOTHESIS Guidelines

- Ensure that the application contains a clearly stated and testable hypothesis and one that is relevant to the mission goals of the funding agency.
- Ensure that testing the central hypothesis will provide important new information and advance the field.
- Ensure that the hypothesis is directly testable by the proposed methodology and specific aims.
- Make certain the central hypothesis is clearly stated in both the Abstract and Specific Aims.

ABSTRACT Guidelines

- Strictly adhere to word limitations or space limitations (do not circumvent with small fonts.)
- Clearly state the central hypothesis.
- Clearly state and very briefly describe objectives (often done by stating specific aims).
- Clearly delineate the significance of the proposed research.
- Clearly indicate how and why the proposed work is innovative.
- Briefly outline the experimental approach.

Developing Specific Aims

1. Specific Aims are EXTREMELY important. Present initial and lasting impression of the application. **(like a first date - usually generates an 'initial score' for the reviewer that is difficult to overcome with the remainder of the application!)**
2. Aims should clearly state objectives and goals which are highly focused and rigorously test the hypothesis.
3. If you have more than one hypothesis (not recommended) formulate and state aims for each.
4. Ensure that methods and approach relate directly to hypothesis and aims.
5. Present alternative hypotheses and justify selection of the one you propose to test.
6. DO NOT confuse Aims with "'Long-term Goals".

"My project is simply this. I want to find out once and for all whether there's any truth in the belief that money can't buy happiness."

BACKGROUND & SIGNIFICANCE Guidelines (Changed for new NIH format)

- Keep the statement of significance brief AND succinct, BUT clearly state it for the reviewers.
- Clearly state and demonstrate how your research is innovative, or develops or improves technology.
- Delineate how the hypothesis and research will increase current state of knowledge in field.

Significance of Proposed Work

BACKGROUND & SIGNIFICANCE Guidelines (Changed for new NIH format)

- Relate goals of application to the longer-term, big picture scientific objectives and to the betterment of public health.
- Justify your proposal with background information about the research field and demonstrate to reviewers that you understand the field and have a balanced and adequate knowledge of it.
- Use this section to discuss gaps or discrepancies in the field and identify the next logical stage of research beyond your current application.

Preliminary Data

PRELIMINARY DATA Guidelines

(Changed for new NIH format)

- Providing preliminary data is extremely important and should convince reviewers that you are qualified in the technologies and methods proposed and can critically interpret results from such studies (publications).
- Preliminary data must support the hypothesis to be tested and demonstrate feasibility of the project.
- Preliminary data may consist of your own publications, publications of others, manuscripts submitted for publication from your laboratory, unpublished data from your own laboratory or from others, or some combination of these.
- Make sure it's clear which data are yours and which were reported by others.

Experimental Design and Methods Guidelines

- Describe the experimental design and procedures in detail and give a rationale for their use.
- Organize this section so each experiment or set of experiments corresponds to one of your specific aims and is titled and numbered in the same order.
- Experiments MUST follow a logical sequence.

Experimental Design and Methods Guidelines

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- ***Convince*** reviewers that the methods you chose are appropriate and that, unless innovative, they are well established.
- If your methods are innovative, show how you have changed existing, proven methods while avoiding technical problems.
- Define why the new methods are advantageous to the research you propose to do.

Experimental Design and Methods Guidelines

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- Define why the new methods are advantageous to the research you propose to do.
- Most applications now permit colored charts, graphs, and photographs in their applications.
- Describe any hazardous procedures, situations, or materials and appropriate precautions.
- Include supporting publications from your lab as appendix.

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Experimental Design and Methods Guidelines

- Ensure that selected methods are appropriate to achieve the stated specific aims.
- Justify each experiment proposed and provide rational for its relevance to the central hypothesis.
- Present rationale and justification for appropriateness of methodology for each experiment, especially if it is novel.

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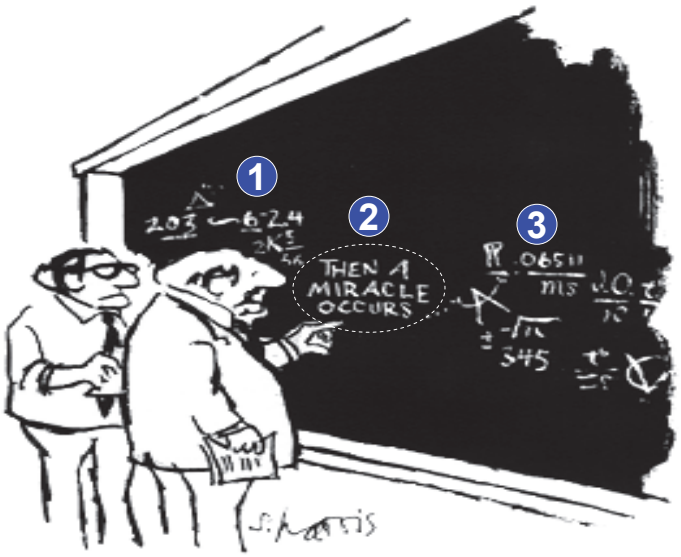
Experimental Design Guidelines

- While you may assume reviewers are experts in the field and familiar with current methodology, NOT ALL WILL BE, and they will not make the same assumption about you. It is not sufficient to state, "We will grow a variety of viruses in cells using standard in vitro tissue culture techniques." Reviewers want to know which viruses, which cells, and specific techniques; and most of all: *the rationale for using the particular system*.
- ***HOWEVER, do not provide excessive experimental detail at the expense of EXPERIMENTAL DESIGN.*** *(Don't confuse the two!!!)*

Experimental Design



"I think you should be more explicit here in step two."

Experimental Design and Methods Guidelines

- Call attention to potential difficulties you may encounter with each approach. Reviewers will be aware of possible problems; propose alternatives and convince them you can handle such circumstances.
- Discuss how any experimental limitations will affect results and interpretation of data.
- Include discussion of appropriate CONTROLS (*can't have too many*), expected results and how data will be interpreted (not just analyzed, or statistics).

Data Analysis and interpretation

This section must not be superficial!

"It's black, and it looks like a hole. I'd say it's a black hole."

Experimental Design and Data Analysis

- Demonstrate awareness of the limits of the results you can expect. State the conditions under which the data would support or contradict the hypothesis and the limits you will observe in interpreting the results.
- Convince reviewers you will be able to interpret your results by revealing your understanding of the complexities of the subject.
- Many applications benefit from statistical analysis. The early involvement of a statistician to determine the amount of data to collect and the methods for analyses is often essential. Must have a Power analysis to validate sample size.
- Describe your proposed statistical methods for analyzing the data you plan to collect.
- Define the criteria for evaluating the success or failure of each Specific Aim.

Experimental Design and Methods Guidelines

- Discuss anticipated data, their significance and the limits of the anticipated data.
- Discuss how the data will be interpreted (not just analyzed)
- Recruit statisticians as consultants if appropriate
- Clearly define criteria for evaluating the success or failure of each specific aim, as well as the central hypothesis.

Data Analysis

Guidelines for LITERATURE CITED

- Refer to the literature thoroughly and thoughtfully but not to excess. The publications you cite need not be exhaustive but should include those most relevant to your proposed research.
- Do not omit or overlook or omit references to relevant published research indicating that the proposed approach has already been attempted or the methods proposed may be inappropriate for answering the questions posed.
- Follow required format!!! Varies, but each citation usually requires the names of all authors (not et al.), name of the book or journal, volume number, page numbers (not first page only), and year of publication.

Format Guidelines:

READ and Follow the Directions!!

Do not cheat or fudge.

Format Guidelines

- Type setting (font size and spacing) requirements are stated and must be adhered too – (may be fixed for some online applications).
- Most formats require minimum of 11 point font, minimum of 15 cpi and minimum 6 lines per inch.
- Best to use larger fonts to improve readability
- Include sufficient white space and figures.
- Font in figures and tables may often be somewhat smaller, but ensure it is easily legible.
- Do not twiddle with fonts to circumvent page limitations!

Budget

The budget is important for two reasons:

1) It must provide sufficient resources to do the work proposed. It is counterproductive to underbudget a grant, you are setting yourself up for failure to achieve the stated aims.
2) The budget must be realistic and correspond to the scope of the work proposed. If you over or under budget, a reviewer will infer you are inexperienced and incapable of conducting the work successfully.

Budget & Justification

Generally need to provide at least a brief 'Justification' for each major budget category, even for modular grants.

Be REALISTIC in your requests!
Do your homework on costs!

Often, NO SPECIFIC FORMAT, BUT ADDRESS and clearly justify EACH MAJOR BUDGET CATEGORY – ESPECIALLY PERSONNEL, TRAVEL, EQUIPMENT AND SUPPLIES. Very helpful to link budget items, including personnel to each specific aim that they are essential for.

You will be living with the budget for the duration of the grant, so try to develop a good 'relationship' with it at the beginning.

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"The Grant": Key Aspects of the Research Plan

1) What do you intend TO DO?
2) Why is the work important?
3) What has already been done?
4) How are you going to do the work?

THE REVIEW CRITERIA: Generally similar criteria for all applications (NIH 'gold standard'). Write application targeted to address review criteria – may vary between funding agencies.

- ✱ OVERALL IMPACT
  - ☐ SIGNIFICANCE
  - ☐ APPROACH
  - ☐ INNOVATION
  - ☐ INVESTIGATOR
  - ☐ ENVIRONMENT

Additional Information:

- **Timeline (detailed): will vastly strengthen an application and is often omitted.**
- Compliance:
  - (Bio)hazards
  - Vertebrate Animals
  - Human Subjects (women, children, minorities)
  - Recombinant DNA
  - Blood born Pathogens

Use of Animals, Humans and hazardous materials in Research must be addressed

"The beauty of math, of course, is that we don't even need an ethicist."

RESEARCH PLAN Guidelines

- Make certain the proposed budget is appropriate for the proposed studies and consistent with agency guidelines.
- Include ALL required information for human subjects, vertebrate animals and biohazards.
- Include detailed timetable for proposed studies and ensure it is consistent with experimental design.

WRITING THE GRANT

- ABSTRACT
- SPECIFIC AIMS

HYPOTHESIS

- Background and Significance
- Preliminary Results
- Experimental Approach
- Materials and Methods
- Human Subjects
- Vertebrate Animals
- Literature Cited

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Grantsmanship Essential:

FOCUS

Identify & Maintain a Research Interest

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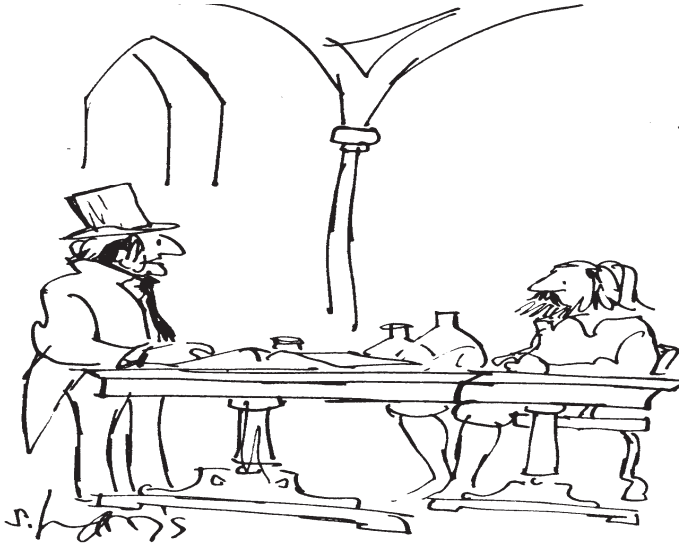

"Bunsen, I must tell you how excellent your study of chemical spectroscopy is, as is your pioneer work in photochemistry - but what really impresses me is that cute little burner you've designed"

COMMON "FATAL FLAWS" OF (NEW) INVESTIGATORS:

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- OVERLY AMBITIOUS.
- POORLY FOCUSED.
- LACK OF: EXPERIMENTAL *DESIGN* and *RATIONALE* (*NOT* LACK OF 'METHODS').
- LACK OF: ALTERNATIVE APPROACHES.
- LACK OF: ANTICIPATED DIFFICULTIES.
- LACK OF: APPROPRIATE CONTROLS (POSITIVE ***AND*** NEGATIVE).
- LACK OF: ANTICIPATED RESULTS, DATA INTERPRETATION AND DATA ANALYSIS, STATISTICS.

NEW INVESTIGATORS

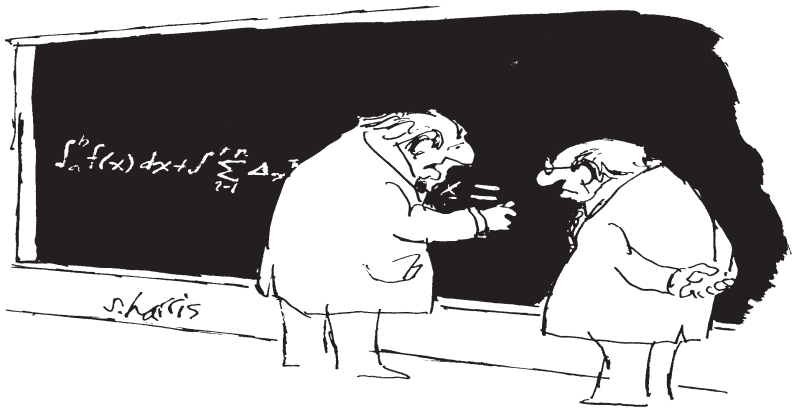
80

- ***ALWAYS*** have others read your proposal.
- Have MANY others read your proposal.
- LISTEN to their criticisms – don't be defensive.
- Get assistance – have a MENTOR and Get HELP. Read *Examples* of Successful Applications.
- DON'T put all your eggs in one basket – be flexible, maintain breadth but *not at the expense of focus*.
- PRACTICE – write multiple grants to multiple agencies.
- DO YOUR HOMEWORK – target your proposal.

Target the proposal to appropriate agency and in the case of NIH, the appropriate Institute and specific IRB.

TALK to the Program Managers!

Why Collaborative Research is Important – Get Help!



"This is the part I always hate!"

Prevent these major reasons for causing poor review scores:

- *Lack of original ideas*
- *Lack of acceptable scientific rationale*
- *Lack of knowledge of relevant published work*
- *Lack of experience in essential methodology*

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COMMON FATAL ERRORS:

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- DON'T 'CUT and PASTE'
- Nearly impossible to catch all inconsistencies, and can often lead to comment: *"This proposal leaves the impression that it has not been carefully planned and prepared".*
- Have OTHERS PROOF READ your application!
- DON'T rush or wait till deadline – leave time for *reflection, internal review, and revision*.
- PROOF READ! PROOF READ! PROOF READ!

COMMON FATAL ERRORS:

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- Lack of significance of the hypothesis or the problem being studied.
- Scientific validity questionable or invalid.
- Equivocal hypothesis and/or preliminary data
- Lack of originality or lack of innovation.
- Experimental design is superficial or unfocused.
- Overly ambitious experimental plan – scope of work unfocused or unrealistic for budget or timeline proposed.

COMMON FATAL ERRORS:

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- Lack of testable hypothesis, descriptive vs. mechanistic experimental design. ("Fishing expedition, snipe hunt or molecular groping, methodology in search of a question").
- Proposed experiments lack appropriate or sufficient controls (need BOTH positive and negative controls).
- Innovative proposal but lacking sufficient preliminary data to support proposed work (i.e 'risky').
- Preliminary data presented do not in fact support the hypothesis to be tested, or fully demonstrate the feasibility of the proposed work ("data of convenience").

COMMON FATAL ERRORS:

- Rationale not provided for experiments, methods, model systems, relevance to hypothesis.
- Lack of alternative approaches and techniques if primary approach fails.
- Insufficient methodological detail to convince reviewers the investigator is competent.
- Lack of discussion of potential problems, difficulties and limitations of methods.
- Selection of inappropriate model systems (i.e studying the expression of a pulmonary protein using a liver cell line, simply because that line is available).

COMMON FATAL ERRORS:

- Investigator lacks demonstrable experience (publications, preliminary data) in proposed techniques or has not recruited a member of research team or collaborator who does.
- Application lacks critical and appropriate literature citations leaving impression applicant is unfamiliar with field or neglecting key or contradictory data.
- Application is unclear as to which data discussed was obtained by applicant or has been reported by others.

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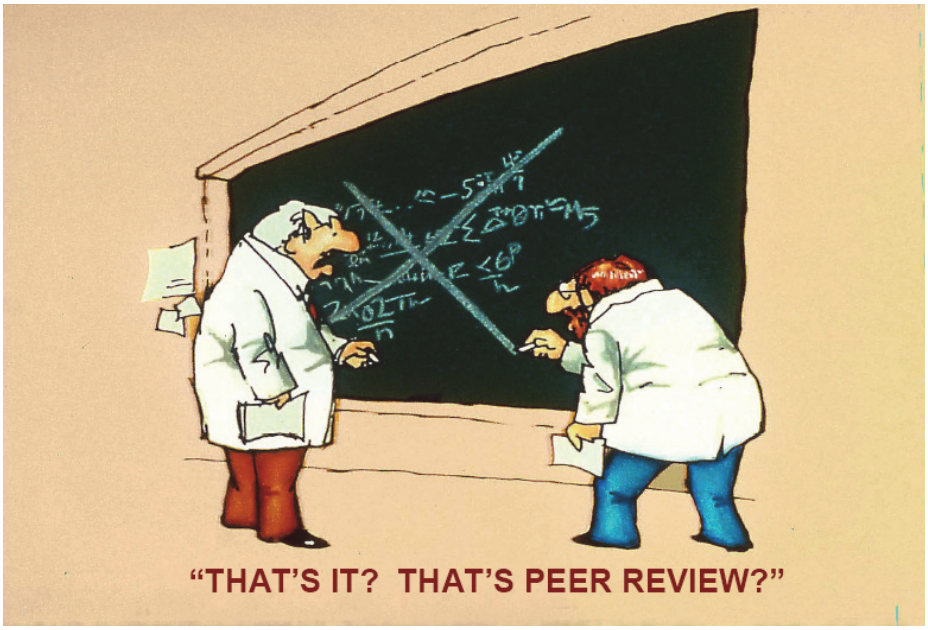
Final Hints:

- If at first you don't succeed, try, try again.
- Get Assistance!
- Constantly re-evaluate your proposal.
- Know when to cut your losses.
- Accept the challenge and commitment to research as required in today's VERY highly competitive funding environment.
- STAY FOCUSED !!!!!

90



Guidelines for Revising Applications

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- READ the summary statement and identify the problems.
- Address reviewers' comments point by point and identifying changes clearly.
- Provide a summary of substantial additions, deletions and changes (usually 1-3 page "Introduction").
- Clearly delineate sections that are the same in the previous application and those that are different, showing precisely where changes were made and new information added.
- If you disagreed with the reviewers, explain WHY indicated where new information was added (font, marginal notations – follow directions!).

RESPONDING TO THE REVIEW

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- DON'T get angry
- READ the review and THINK about it.
- Have OTHERS read the review – new investigators may need an 'interpretation'.
- RESPOND to the criticisms
- Re-evaluate the ENTIRE proposal
- CLEARLY delineate the CHANGES in the revision (MIEFTR).

THE REVIEW

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"I don't mind if the applicant tells me I am wrong or disagrees with me……..,

but I don't like to be ignored"

(*anonymous reviewer, 1998*)

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Interpreting THE REVIEW:
Learning the Lingo

"This applicant lacks any discernable aptitude for the biological sciences……..."

(***anonymous reviewer, 1998***)

Persistence is KEY – Grants are rarely funded during first submission.

REVISE WISELY!

SUCCESS RATES FOR AMENDED NIH GRANT APPLICATIONS

Application type	Amendment	Sub. or resub.	Fund.	SR(%)
New R01	Unamended	8620	1730	**20.1**
	First	3461	1163	**33.6**
	Second	917	406	**44.3**
New PA	Unamended	1658	348	21.0
	First	508	197	38.8
	Second	130	56	43.1
Renewal R01	Unamended	3068	1546	50.4
	First	1272	603	47.7
	Second	441	219	49.7