

# Writing Competitive Research Grant Proposals

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B.S. in Ed. Chemistry/Biology, MS Chemistry Education

University of Nebraska Lincoln

Ph.D. Chemistry

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Secondary School Teacher (1971-1982)

Science 7-12, Chemistry

Academic Research (1982-1987)

- Mass Spectrometry, surface science
   Research Scientist, Fortune 50 Company (1987-1999)
- Established Tandem Mass Spectrometry Facility
   Patent Attorney (1999-2012)
- Patent Attorney (1999-2012)
- large firm, in-house, contract

**American Chemical Society** 

Program Manager, ACS Petroleum Research Fund (2012-present)





## Overview

- General approach to writing grant proposals
- ACS Petroleum Research Fund
  - Introduction and History
  - ACS PRF Research Grant Types
  - Proposal Formatting, Submission, and Processing
- Question/Answer Session





## Know the agency's mission.

- Every funding agency has ideas about what it wants to fund.
- An agency usually does not fund re-written proposals previously sent to other agencies, because the overall goals are different.
- Don't attempt to contort the agency's mission to fit your research project.





Read all instructions carefully.

Follow the instructions!!!

A common reviewer's guide:

If the PI can't follow instructions for the proposal, then the PI probably can't follow instructions and perform laboratory research.





Write with confidence, but not with disregard for other ideas.

Your writing should convey the attitude that:

- You have identified an important problem.
- You are the right person to do the work.
- You will get the job done and find some answers to the problem discussed.





Have a great scientific idea that can be investigated thoroughly within the context of the institutional resources available to the Principal Investigator.

 Proposing to do stable-isotopic research at a small liberal arts college without its own mass spectrometer: is this competitive, or fundable?





If in doubt, contact the Program Officer.

• Preferably, **before** you spend the time writing an uncompetitive or non-compliant proposal.





## Logical Sequence for Proposal Development

Now that you have an idea, how do you go about writing the proposal?





## **Proposal Preparation**

#### **Heilmeier's Catechism**

- How is it done today, and what are the limits of current practice?
- What's new in your approach and why do you think it will be successful?
- Who cares?
- If you're successful, what difference will it make?
- What are the risks and the payoffs?
- How much will it cost?
- How long will it take?
- What are the midterm and final "exams" to check for success?





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## General Outline for Research Grant Proposals

- Abstract often written in slightly more general terms, readable by non-experts.
- Background and Significance demonstrate that you know the field thoroughly.
- Specific Aims 1-2 sentences on each point that you intend to investigate.
- Experimental Plan.
- Resources available, and resources required to complete your research.





## Proposal Preparation: Start to End

- Start with Specific Aims.
- Keep these in mind when writing Background and Significance of the research; show the logical relationship between Background and Specific Aims.
- Discuss previous relevant work and the need for the proposed study.
- Experimental Plan again follows from the Specific Aims; show how to achieve each objective.
- Reiterate the Specific Aims in the Abstract (usually in paragraph form, not bullets).





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## Proposal Preparation: Start to End

- Carefully read and follow all instructions provided by the funding agency:
  - Formatting
  - Length of proposal
  - Budget limits
  - Submission procedures
- Don't run the risk of having your science "downgraded" by reviewers and/or program managers, because you didn't follow instructions!





## Writing the Proposal

- 1. Create a topical outline.
- 2. Develop subtopics and expand the outline.
- 3. Draft main graphics.
- 4. Develop the first draft of the text.
- 5. Review, revise, and complete the draft.
- 6. Submit a copy to administrators for approval.
- 7. Critical review of graphics and text.
- 8. Finalize text and graphics.
- 9. Submit to agency as soon as proposal is ready **don't** "wait until the deadline" to submit.





# Components of a Competitive Proposal

- Clear presentation.
  - State what the problem or hypothesis is.
  - State why the issue is significant.
  - State what you are going to do.
  - Explain how you are going to carry out the work.
  - Recognize and address potential problems
- Keep narrative focused on the project.
- Use tables, charts, and figures effectively.
- Mention the role that students will play in the research.
- Present preliminary results if you have them.





## Review Criteria for Research Proposals

#### (1) Significance:

- Does this study address an important question/problem?
- If the aims of the application are achieved, how will scientific knowledge be advanced?
- What will be the effect of these studies on the concepts or methods that drive this field?

#### (2) Approach:

- Are the conceptual framework, design, methods, and analyses adequately developed, well-integrated, and appropriate to the aims of the project?
- Does the applicant acknowledge potential problem areas and consider alternative tactics?





## Review Criteria for Research Proposals

#### (3) Innovation:

- Does the project employ novel concepts, approaches or methods?
- Are the aims original and innovative?
- Does the project challenge existing paradigms or develop new methodologies or technologies?
- Sometimes a proposal that is not particularly innovative can succeed due to other strong factors





## Review Criteria for Research Proposals

#### (4) Investigator:

- Is the investigator appropriately trained and well suited to carry out this work?
- Is the work proposed appropriate to the experience level of the principal investigator and other researchers (if any)?

#### (5) Environment:

- Does the scientific environment in which the work will be done contribute to the probability of success?
- Do the proposed experiments take advantage of unique features of the scientific environment or employ useful collaborative arrangements?
- Is there evidence of institutional support?





# Common Errors in Proposals

- Project does not fit agency's mission.
- Proposal violates one or more agency guidelines.
- Project is beyond capabilities of investigator, students, or institution (don't propose too much).
- Lack of proofing: grammar, spelling, formula, numbering, math errors.
- Administrative errors: Missing pages, figures, tables, or signatures on title and budget pages.





## Common Errors in Proposals

- Proposal is unfocused, poorly organized.
- Low personnel budget Not enough people to do all the proposed work.
- Low impact No publishable results even if funding is obtained.





## One Way to Learn About Grant Proposals:

#### Volunteer to be a reviewer

- Contact a Program Manager in your field.
- Program Managers have to send out several hundred review requests each year; Most will be glad to have more committed reviewers.
- One review is not a major time commitment.

#### For ACS PRF:

 Reviewers are asked for only one review per proposal cycle, **not** multiple requests from different Program Managers in the same cycle.





### Information on Federal Grants

Federal funding sources, and application procedures at "grants.gov":

http://www.grants.gov/index.jsp

NSF, NOAA, NASA, NIH, DOE, EPA, FDA, DOD





# An Introduction to the ACS Petroleum Research Fund









## History of the PRF Trust

- Founded 1944 by seven oil companies in order to avoid anti-Trust action by U.S. government
  - Fund was recipient of income from patents of Universal Oil Products Co.
  - PRF was managed by Guaranty Trust Company (later Morgan Guaranty Trust Company of New York)
- No grants until 1954. PRF Trust diversified in 1960, when UOP sold, generating \$72.5 Million in assets
- PRF Trust Transferred to ACS in 2000; <u>assets are stocks and</u> <u>investments</u> generating income to ACS PRF for research grants
- No restrictions on non-US institutions in the Trust document, but ACS PRF will not fund institutions in countries where receipt of funds by the Principal Investigator cannot be assured





### Value of the ACS PRF Investments

- Market value of the PRF Endowment was \$600 million on 12/31/2007
- Market value was under \$400 million in early 2009 but has since recovered to \$450+ million
- \$400 million is considered to be the 'historical value' of the Fund; if the endowment decreases below this value, only interest and dividends from the Fund are available (*i.e.*, the ACS PRF grant budget is cut in half)





# Agreement of Transfer of Trust

"The recipient shall use all funds ... exclusively for advanced scientific education and fundamental research in the 'petroleum field,' which may include any field of pure science which in the judgment of [ACS] may afford a basis for subsequent research directly connected with the petroleum field."





## Definition of the 'Petroleum Field'

The term 'petroleum field' as used herein embraces (1) exploration for, and the production, transportation and refining of, petroleum, petroleum products and natural gas, and (2) the production and refining of substitutes for petroleum products from natural gas, coal, shale, tar sands and like materials.





ACS PRF Advisory Board Committees and Research Areas	
1	Synthetic Organic Chemistry
2	Geochemistry
3	Inorganic Chemistry
4	Physical Organic Chemistry
5	Surface Science
6	Chemical Physics
7	Polymer Science
8	Geology and Geophysics
9	Chemical and Petroleum Engineering
10	Materials Science





# ACS PRF Research Areas (I)

#### 1. Synthetic Organic Chemistry

Organic synthesis, including organic and organometallic reagents and catalysts, and asymmetric synthesis.

#### 2. Geochemistry

Isotope, organic, and sedimentary geochemistry, marine geochemistry, and diagenesis.

#### 3. Inorganic Chemistry

Coordination and organometallic chemistry, homogeneous catalysis, small soluble clusters, new ligands, main group, transition metal, and lanthanide and actinide metal chemistry.

#### 4. Physical Organic Chemistry

Reaction mechanisms, kinetics, photochemistry, organic radical chemistry, reactive organic species, enzymes in non-aqueous media working on petroleum substrates.

#### 5. Surface Science

Surface phenomena and reactions, heterogeneous catalysis, and characterization of surfaces directly relevant to petroleum and petroleum products.





## ACS PRF Research Areas (II)

#### 6. Chemical Physics/Physical Chemistry

Theoretical chemistry, quantum/statistical mechanics, and molecular dynamics; optical, laser, ultrafast, and mass spectroscopies, and gas phase reactions.

#### 7. Polymer Science

Synthesis, characterization, and properties of polymers and dendrimers; organized media; and liquid crystals.

#### 8. Geology and Geophysics

Stratigraphy, sedimentology, paleontology, geomorphology, structural geology, flow through porous media, and geophysics.

#### 9. Chemical and Petroleum Engineering

Engineering studies including process and operations control and design; fluid flow and multiplase flow dynamics; and related computations.

#### 10. Materials Science

Synthesis, characterization, bulk properties, and solid-state chemistry of materials directly relevant to petroleum, or to conversion of petroleum and petroleum products.

Inclusion into one of these categories does <u>not</u> necessarily make the research petroleum-related.





## Research Must be Petroleum-Relevant

- PI must submit a 100-word description of how the proposal is "<u>fundamental research</u> in the petroleum field"
- This is not the same as the abstract.
- The relationship to the "petroleum field" should be obvious, not a stretch of one's reasoning.
- This statement is entered in a text box in the online submission process.
- Proposals with inadequate statements will be declined without scientific review.





# Does ACS PRF Support Green Chemistry Research?

 ACS PRF does not have a specific category for "Green Chemistry" research, but high quality fundamental research in the petroleum field, which may have a "green" focus (e.g., research on increasing process efficiency, more effective and less costly catalysts,) may be considered.





### **Research Areas Excluded From PRF Support:**

Patentable or directly commercializable research

Applied research, such as development of new
experimental or theoretical methods or development
of devices

Biomedical, pharmaceutical or drug-delivery studies including synthesis of compounds for biological evaluation

Whole-cell, organelle, tissue, organ, or whole organism studies; synthesis of compounds for biological evaluation

Biofuels, biomass, and biosensors

Biopolymers, including blends and block





## **Research Areas Excluded From PRF Support:**

Environmental remediation studies; Anthropogenic effects of petroleum; Groundwater pollution and hydrology

Carbon dioxide capture and sequestration

Micro- and nanofluidics

Nanoscience not directly related to petroleum-derived materials

Quantum dots, semiconductors, or superconductors Low-temperature phenomena and subatomic physics





## **Research Areas Excluded From PRF Support:**

All forms of solar energy, including photovoltaics and solar cells

Batteries for renewable energy

Hydrogen fuel cells, hydrogen storage, and hydrogen generation from non-petroleum sources

Wind farms

Social, economics, or history research





# ACS PRF Research Grant Types







## ACS PRF Research Grant Types

#### Doctoral-degree departments:

- Doctoral New Investigator (DNI) "Starter Grants"
- New Directions (ND) Research Grants

#### Non-doctoral departments:

- Undergraduate New Investigator (UNI) "Starter Grants"
- Undergraduate Research (UR) Grants





#### Grants to Doctoral Departments

#### New Directions (ND) Research Grants

- Faculty in Ph.D.-granting departments
- To enable PI to initiate a "new research direction" not previously published or funded
- Two-year grants, \$110,000 total

#### Doctoral New Investigator (DNI) Grants

- New faculty within first three years of appointment, who meet
   ACS PRF eligibility criteria
- To enable PI to establish independent research different from Ph.D. or postdoctoral research topic
- Two-year grants, \$110,000 total





#### Grants to Non-doctoral Departments

#### Undergraduate Research (UR) Grants

- Faculty in non-Ph.D.-granting departments
- Major objective to support undergraduate research, but M.S. stipends may also be requested
- Three-year grants, \$70,000 total

#### Undergraduate New Investigator (UNI) Grants

- New faculty within first three years of appointment, who meet ACS PRF eligibility criteria
- To enable PI to establish independent research involving undergraduates, which differs from previous Ph.D. or postdoctoral research
- Two-year grants, \$55,000 total





## ACS PRF Eligibility Criteria

- Proposer must be eligible to seek external funding as a Principal Investigator (PI)
- Proposer must be eligible to serve as the formal director of student research at the appropriate level (*e.g.*, Must be "major professor" of M.S. or B.S. theses, or Ph.D. dissertations)
- Proposer must have reasonable expectation of continued employment for the duration of the proposed research





#### Impact of ACS PRF Grants

- ACS PRF grants are known for launching careers. DNI/UNI "starter grants" have given many assistant professors their first peerreviewed funding.
- "Seed money" grants emphasize novel research directions, and allow development of worthwhile but risky ideas (proof-of-concept data).
- To date, 26 Nobel laureates have received ACS PRF funding for their research projects.





# Proposal Format, Submission, and Processing







## Format of ACS PRF Proposals

- Text is limited to 4000 words, excluding 250word abstract, references, figures, and tables
- Research should be a single project, with limited scope, not a number of ideas
- About half the text should be background and justification, and half on project plan
- PI must submit the names of at least six peer experts capable of reviewing the proposed research





## ACS PRF Proposal Cycles

- ACS PRF Advisory Board meets May and October to consider proposals.
- Proposal review requires at least five months before the Advisory Board meeting.
- Two "submission windows," October-November (May meeting) and February-March (October meeting).
- Deadline listed on ACS PRF Website is the <u>last day</u> for proposals to be <u>received</u>. No exceptions will be made.





## Submission of Proposals

- All proposals are submitted as PDF files, through ACS PRF Web portal
- Proposals must be *received* by 5PM (Eastern) on submission deadline.
- No exceptions or late submissions will be accepted





## Peer Reviews of Proposal

- Program Manager selects 6-7 external reviewers; some will be suggested by PI, others will be identified by Program Manager.
  - At least 2 or 3 completed reviews are considered necessary before evaluation by PRF Advisory Board.
- Within 4-6 weeks after review request is sent, external peer reviews received by Program Manager.





# Proposal Evaluation by Advisory Board

- Copies of proposals and external peer reviews are sent to ACS PRF Advisory Board committee members.
- Advisory Board members study proposals and reviews, and make their own evaluations.
- Advisory Board meets in May and October, to discuss proposals and recommend grants.
- Advisory Board committees place variable weight on external reviews; a thorough review is given more weight than the overall grade assigned by external reviewer.





#### ACS PRF Criteria for Judging Proposals

- (a) The overall quality, significance, and scientific merit of the proposed research, including the extent to which it will increase basic knowledge and/or stimulate additional research.
- (b) The extent to which advanced scientific education will be enhanced through the involvement of students in the research.
  - Especially considered for UR and UNI proposals
- (c) The qualifications or potential of the principal investigator(s) and adequacy of the facilities to conduct the research.





#### ACS PRF Criteria for Judging Proposals

- (d) The extent to which the proposed research represents a new or independent area of investigation for the principal investigator(s).
  - Most significant for ND proposals
- (e) The impact of ACS PRF funding the research, including the effect on the principal investigator's overall research program and financial needs. For example, a PI is not encouraged to submit a proposal to ACS PRF for research that has current funding.





## Post-Advisory Board Processing

- Applicants of reviewed proposals are notified by email about one week after Advisory Board meeting, with funding recommendation.
- Notification letters to applicants of recommended proposals emailed after the PRFAB recommendations are approved by the ACS Board Committee on Grants and Awards, usually in the month after the PRFAB meeting.
- Edited reviewer comments for the proposals are sent to all applicants, usually within a month of the PRFAB meeting.





## Limitations on Proposals to ACS PRF

- Applicants may submit only one ND or UR proposal per calendar year.
- Denied DNI/UNI applicants may revise and resubmit as soon as they receive review excerpts.
- HOWEVER, applicants may submit only three "starter grant" proposals in a career; or have one DNI or UNI proposal funded.





# ACS PRF Program Managers

- Dean Dunn: d\_dunn@acs.org
  - Geochemistry, Geology, and Geophysics; Assistant Director
- Thomas C. Clancy: <u>t\_clancy@acs.org</u>
  - Polymer Science and Chemical and Petroleum Engineering
- Nancy J. Jensen: <a href="mailto:n\_jensen@acs.org">n\_jensen@acs.org</a>
  - Synthetic Organic Chemistry and Inorganic Chemistry
- Askar Fahr: <u>a\_fahr@acs.org</u>
  - Physical Organic Chemistry and Physical Chemistry/Chemical Physics
- Burt Lee: <u>b\_lee@acs.org</u>
  - Surface and Materials Science





#### How to Contact ACS PRF

#### Internet:

http://www.acsprf.org

#### **Program Managers:**

Email: prfinfo@acs.org

Phone: 202-872-4481











