Writing Successful Technical Proposals
Understanding the Process

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Celia Elliott is recognized, internationally, for her teaching of scientific writing:
http://physics.illinois.edu/people/Celia/

Laura has taught with her in two courses she has developed over the past 13 years:
"Introduction to Physics Research" and *"Senior Thesis"*
This lecture is primarily what she has developed and written: **THANK YOU CELIA!**

Okay, so what <u>is</u> a "proposal"?
(Hint: it is not a scientific article!)

   A written description of scientific work

   That has not yet been done

   To be carried out by <u>specific</u> people

   Over a <u>specific</u> time period

   For a <u>specific</u> amount of money

   Employing <u>specific</u> methods and facilities
      that will, if successful,

✓✓*Create new knowledge, solve an important*
   societal problem, train the next generation,
   or promote economic growth through
   new technology and applications

First steps: Find out who has the _MONEY_ and _WHAT THEY ARE INTERESTED IN_ (market research)

For the US

     National Science Foundation (NSF)

     National Institutes of Health (NIH)

     US Department of Energy (DoD)

     Defense Advanced Research Projects Agency (DARPA)

     Intelligence Advanced Research Projects Agency (I-ARPA)

     Air Force Office of Scientific Research (AFOSR)

     Office of Naval Research (ONR)

     Army Research Laboratory (ARL)

     National Association for Space Administration (NASA)

Some of these agencies have funds for international research grants (check their websites often). If they do, they often require a US collaboration => _NETWORK_!!!

3

Finding funding for where you are

- **Check the WEB**: For example, for Indonesia: *http://asiapacific.anu.edu.au/blogs/indonesiaproject/2013/05/06/research-grants-20132014-call-for-proposals/*

- *Talk to people at your home (or nearby) institution.*
  - *There are people there who know AND who will help you.*
  - *Find out who they are and get to know them*
  - *Go to them often to get advice*

- *Ask colleagues for copies of their successful proposals and STUDY them – they make GREAT TEMPLATES!*

The proposal process begins when the funding agency identifies a goal

1. **Identifies a need within its mission**
2. **Allocates finite resources to meet its goal**
3. **Assigns responsibility for the program to a specific person, the "program officer"**
4. **Creates and issues a "request for proposals" (RFP)—a document that describes the program, resources, and rules for submitting a proposal**

To be successful, you must know and consider all four things when preparing your proposal

Use the RFP for "market" research

SYNOPSIS: The Electronics, Photonics, and Magnetic Devices (**EPMD**) program seeks to improve the fundamental understanding of devices and components based on the principles of micro- and nanoelectronics, photonics, magnetics... The program enables discovery and innovation advancing the frontiers of nanoelectronics, spin electronics, molecular and organic electronics, bioelectronics... EPMD supports related topics in quantum engineering and novel electromagnetic materials-based high frequency device solutions, radio frequency (RF) integrated circuits, and reconfigurable antennas... The program supports cooperative efforts with the semiconductor industry... EPMD additionally emphasizes emerging areas of diagnostic, wearable and implantable devices...with nanoscale precision through new approaches to extreme ultraviolet metrology.

http://www.nsf.gov

To *structure your proposal* and *make your pitch*

SYNOPSIS: The Electronics, Photonics, and Magnetic Devices (**EPMD**) program **seeks to improve the fundamental understanding of devices and components** based on the principles of micro- and nanoelectronics, photonics, magnetics... The program enables discovery and innovation **advancing the frontiers of nanoelectronics**, spin electronics, molecular and organic electronics, bioelectronics... EPMD supports related topics in quantum engineering and novel electromagnetic materials-based high frequency device solutions, radio frequency (RF) integrated circuits, and **reconfigurable antennas**... The program supports cooperative efforts with the semiconductor industry... EPMD additionally **emphasizes emerging areas of diagnostic, wearable and implantable devices**...with nanoscale precision through new approaches to **extreme ultraviolet metrology**.

http://www.nsf.gov

The first cut for submitted proposals is an administrative check

Clerical review comes first
- ☑ **Is the proposal complete?**
- ☑ **Was it submitted by the deadline?**
- ☑ **Does it conform to the RFP's preparation instructions?**

Then the program officer (usually a generalist) looks at the science "from 35k" (an overview)
- ☑ **Does the project fall within the program guidelines?**
- ☑ **Will it contribute to the agency's mission?**
- ☑ **Is it scientifically sound?**

Next, the proposal is peer reviewed

Reviewers are given specific criteria on which to base their recommendations

- ☑ **Overall scientific and technical merit**

- ☑ **Feasibility**

- ☑ **Potential contributions of the project to the funder's specific mission**

- ☑ **Proposer's unique capabilities, experience, facilities, techniques**

- ☑ **Qualifications, capabilities, and experience of key personnel**

- ☑ **Realism of the project costs**

Recognize reviewer realities

They're experts, they're busy, and they have a lot of other things competing for their attention

They read proposals under less-than-ideal conditions

They'll print out your proposal with the beautiful color figures on their cheap B&W printer to read on the plane

They are *looking* for mistakes, omissions, objections

They're probably reading several proposals on the same topic—how will yours compare?

Important checkpoints in the proposal process are

- ☑ **Submission—complete and on time**
- ☑ **Administrative check for conformance with preparation instructions**
- ☑ **Program officer review**
- ☑ **Peer review**
- ☑ **Rank ordering of reviewed proposals**
- ☑ **Selection of proposals for funding**

Most proposals include standard parts

A "cover page"

Project summary

Project description

References cited in the technical narrative

Biographies of key personnel

Itemized budgets and a budget narrative

Other support of the project personnel

Facilities, equipment, other resources

Every element is important; the ones you don't care about are often the tie-breakers

Before you pick up a pencil, answer four strategic questions...

What is the goal of this project?
What hypothesis are you going to test?
What question(s) are you trying to answer?

Why is it important?
What important questions will it answer, how will it stimulate future progress in the field, what problem will it solve, what useful applications will it enable?

What resources are needed?
How much is it going to cost? in time as well as in funds?

How does this project further the objectives of the **funder**?
How will your successful project advance their goals ?

In answering these four questions…

➢ Use a journalistic writing style: who, what, when, why, how.

➢ Write down the answers to these four questions. Think about them—write and *re*write, and *rewrite*… your answers until you have four clear, direct, and persuasive sentences.

➢ Put them in your project summary.

This exercise will help you to focus your thinking and write a tighter proposal.

Notes on proposals parts…

Cover page

Project summary

Project description

References cited in the technical narrative

Biographies or CV's of key personnel

Itemized budgets and a budget narrative

Other support of the project personnel

Facilities, equipment, other resources

The *COVER PAGE* is the first "hook" to the reviewer

Most of it is incredibly boring, so make your

TITLE COUNTS

-- *descriptive, concise, and memorable!*

The *PROJECT SUMMARY* is the first thing that most reviewers read

Write it for a generalist

Remember those four sentences you wrote?
THIS IS WHERE THEY GO

- Write the project summary *last*, so it reflects the *entire project*
- The project summary may be posted publicly
- Some agencies have very specific rules—obey!

This section is SO IMPORTANT, so let's expand…

First, let's define our terms…

- A <u>project summary</u> is a stand-alone document in a formal multi-part proposal that explains the goals, methods, and expected outcomes of the project

Different agencies call this document different names (abstract, executive summary)

It's always much shorter than the technical description (1 page or less)

The project summary does for the full proposal what a picture postcard does for a famous painting

Anton S. Barkhatkov (1917-2001). Near the lake. 1977

Project Summary

Project Description

Even though it usually comes first in the proposal document, don't write the project summary until last

- The project summary must present the entire scope of the project, which may have (probably has) evolved as you were writing
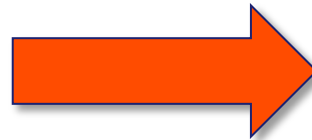
Map the summary to your technical project description

- Present the same concepts
- In the same order
- Using the same terminology

So that reviewers remember them

Same concepts, same words, same order

Give the reviewer a guide of what's to come

Celia's Foolproof Project Summary Recipe

Ingredients:

What <u>problem</u> will you study and why is it important?

What <u>methods</u> will you use and why did you choose them?

What <u>results</u> do you expect and how will you analyze them?

How will funding your project <u>benefit</u> the agency?

Assemble ingredients in this order. Don't add ingredients or omit any. <u>Measure carefully</u>.

Taste frequently and adjust seasonings.

Allow to rest before serving.

The project summary must "stand alone"

No figures

No tables

No references

Project Summary

No complex equations

No unfamiliar acronyms

Don't write a partial project summary

big miss
steak

- Don't just cut-and-paste the first few paragraphs of the research plan and call it the summary—bad idea!

It *must* describe the *entire* project—hypotheses, goals, objectives, methods, data analysis, significance, and benefits to the agency*

Omissions and ambiguities in the summary raise immediate questions in reviewers' minds about the whole project

* NOTE: Different agencies have different requirements, e.g., NSF requires "intellectual merit" and "broader impacts."

Don't assume everybody reading your project summary will be an expert in your narrow field: some *will,* but some *won't,* and they may all have equal votes

big miss steak

- Advice from NIH:
  "This section should be informative to <u>other</u> persons working in the <u>same or related fields</u> and <u>insofar as possible understandable</u> to a scientifically or technically literate reader."

Greene's rule: Ask a colleague from a somewhat different field to read. I'm in superconductivity and I ask my polymer friends!

Get rid of irrelevancies and eliminate introductory fluff*

- Project summaries are always constrained by word or page limits

- Don't waste precious space on any idea that is not directly relevant to your project, no matter how "interesting" it might be

Delete, rephrase, clarify, quantify

*In fact, eliminate *all* fluff; reviewers appreciate conciseness

http://online.physics.uiuc.edu/courses/phys496/Spring12/Lectures/Fluff.pdf

If your project is funded, the project summary may be made public

big miss
steak

- Do not include any confidential or proprietary information

- Don't put anything in the project summary that you wouldn't want to see on the agency's website

- The summary should make you look good to prospective collaborators, other scientists, and other funders

To recap…

big miss steak

- Follow the rules—witlessly
- Map your summary to your technical narrative
- Follow the four-ingredient recipe
- Aim for the 3 C's: *clear, concise, compelling*
- Write for a generalist—emphasize *meaning*
- Leave out proprietary information
- Plan for time to revise and polish

On to the Project Description, CVs, Facilities…

The *PROJECT DESCRIPTION* describes the science

Provide all the parts you'd include in a scientific paper (and some you wouldn't):

Introduction

Review of the literature

Proposed research

Expected results

Broader impacts

Results of prior support

Exercise: Is It Plagiarism?
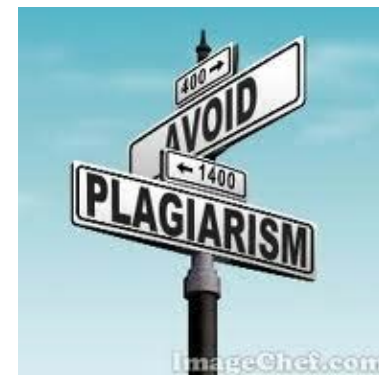
Professor Henshun is writing a proposal for a research grant, and the deadline for the proposal submission is two days from now. To complete the background section in the PROJECT DESCRIPTION Prof. Henshun copies a few isolated sentences of a journal paper written by another author, Dr. Safana. The copied sentences consist of brief, factual, one-sentence summaries of earlier articles closely related to the proposal, descriptions of basic concepts from textbooks, and definitions of standard mathematical notations. None of these ideas is due to the other author. Henshun adds a one-sentence summary of the journal paper by Safana, and cites it.

Exercise: Is It Plagiarism?

Does the copying of a few isolated sentences in this case constitute plagiarism?

By citing the journal paper, has Henshun given proper credit to the other author?

Hint: Put yourself in the place of Dr. Safana and you are the Reviewer. How do you feel?
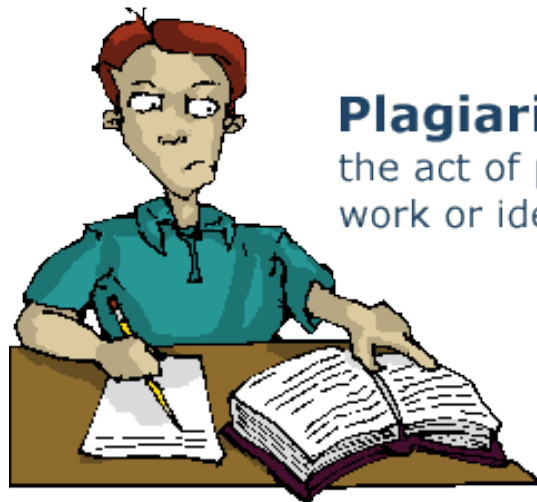
Plagiarism:
the act of presenting another's work or ideas as your own.

Exercise: Is It Plagiarism?

From the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine:

- "..because trust in science depends so heavily on the assumption that the origin and content of scientific ideas will be treated with respect, plagiarism is taken very seriously in science, even though it does not introduce spurious results into research records in the same way that fabrication and falsification do. But someone who plagiarizes may insist it was a mistake, either in note taking or in writing, and that there was no intent to deceive. Similarly, someone accused of falsification may contend that errors resulted from honest mistakes or negligence.

- "Within the scientific community, the effects of misconduct—in terms of lost time, damaged reputations, and feelings of personal betrayal—can be devastating. Individuals, institutions, and even entire research fields can suffer grievous setbacks from instances of fabrication, falsification, and plagiarism. Acts of misconduct also can draw the attention of the media, policymakers, and the general public, with negative consequences for all of science and, ultimately, for the public at large."

For an excellent discussion of plagiarism, see
http://www.plagiarism.org/plag_article_plagiarism_faq.html.

CV's of KEY PERSONNEL who will work on the project are required

Do not include any information that is not specifically requested

Select publications and activities that are most closely related to the proposed project

Conform to all page limits and formatting requirements

Don't pad your personnel list
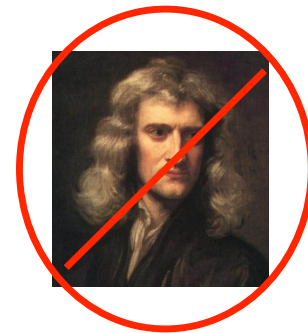
The *FACILITIES SECTION* should highlight your (unique) capabilities

Emphasize special facilities and equipment

Highlight your successes in prior work

Show leveraging of existing infrastructure
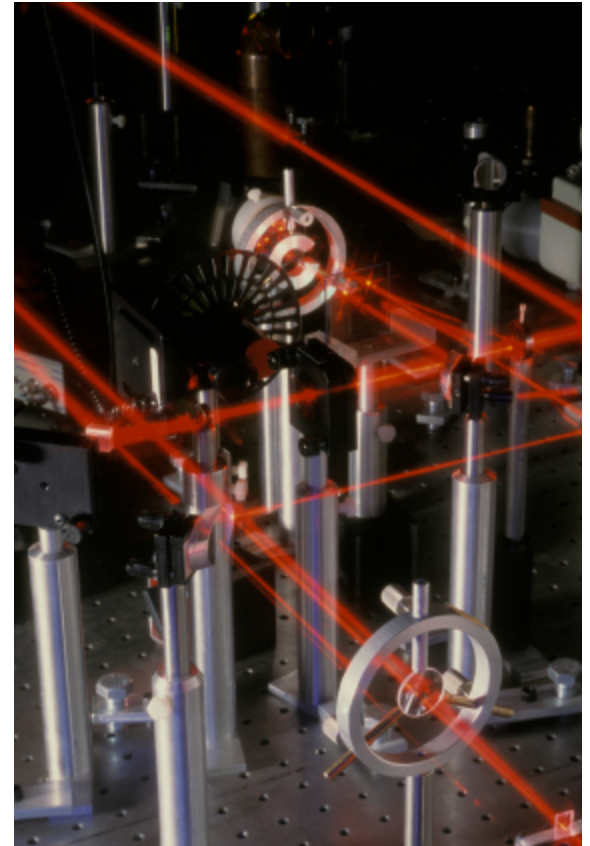
Most proposals do not fail because of bad science—but because of

- ✓ **Failure to follow directions**
- ✓ **Poor logical organization**
- ✓ **Lack of detail**
- ✓ **Failure to consider the funder's objectives**
- ✓ **Failure to anticipate reviewers' objections**

If your proposal fails (and some will)…

Ask for copies of the reviewers' comments; consider them carefully and objectively; determine what can be improved

Find out what kinds of projects *were* funded

Talk to the program officer about resubmitting

Investigate other funding agencies

Rewrite it and submit it again, or—

Recognize that there is no "market" for the project, at least for now, with that agency, and move on

Don't give up!

Proposal Process Summary

Do your market research

Ask early and ask often

Enlist people to help you

Pay attention to your title and your project summary—they're really, really important

Emphasize what the "buyer" gets

Have pity on your reviewers;
make their job as easy as possible

You may not win the first time—keep trying!

Now let's go on to how to get started and tips from the trenches...

Getting Started, including Celia's "Tips from the Trenches"

- Celia M. Elliott and Laura Greene
- Department of Physics
University of Illinois at Urbana-Champaign
- *cmelliot@illinois.edu lhgreene@illinois.edu*

Use the Elliott equation* to estimate the time it will take to prepare your proposal:

- $$t = 3H + \varepsilon \ , \qquad [1]$$

where *t* is the time it <u>actually</u> takes to prepare, check, and submit a proposal, and *H* is the number of hours you think any idiot ought to be able to do it in.

*based on >19 years of solid empirical data

Start with the RFP (request for proposal) and make an outline and individualized checklist

CHECK LIST

1. fonts, margins ✓
2. page limits ✓
3. req sections ✓
4. certifications ✓
5. budget info ✓
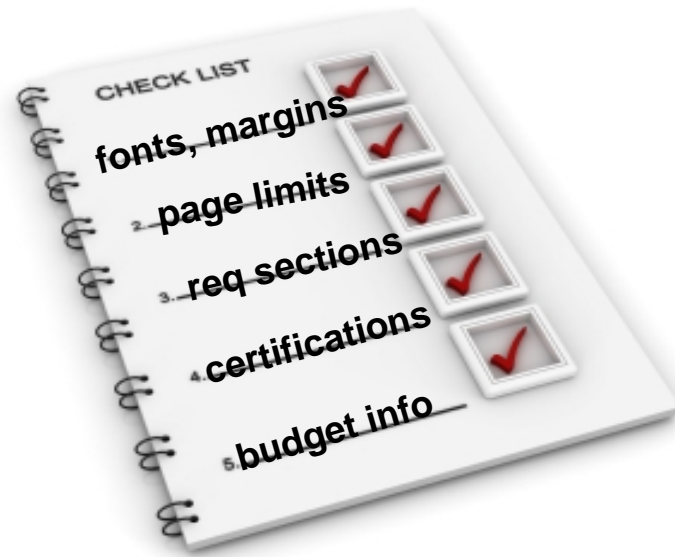
Program announcements supersede standard policies, and agencies are getting stricter

Organize your project narrative to follow the RFP

Use the same words

Print out the RFP, read carefully and

HIGHLIGHT ALL THE POINTS THAT MIGHT BE RELEVENT!

WRITE every one of those points in a check list (next page)

Do this several times so you know you have all the important points on a list, and keep that list for checking off tasks.

Print out this check list and use it!

Proposal Checklist

PI: _____ Co-PIs? _____

Agency: _____ RFP No. _____

URL: _____

Deadline: _____ How submitted? _____

Program Officer (Name & Contact): _____

Must includes/deviations from standard instructions:

_____
_____
_____
_____
_____
_____

Review criteria:

_____
_____
_____
_____
_____
_____

Project narrative outline:

Buzz words:

Notes:

Include some extra sections (think "prospectus")

Qualifications of key personnel

Project timeline and milestones

Specific deliverables

Contributions to research infrastructure and human resources

Plan B: How will you complete the research if you are NOT funded, or funded at a lower level than you requested?

Plans for sustainability (think "business plan")

Summary section

Show how your project will contribute to the funder's mission

- **Make it clear that funding your proposal will advance the objectives of the agency**

- **Every RFP contains an "objectives" section—quote their words back to them**

- **Answer the question "Why should a policy maker care?"***

  ***using absolutely no jargon**

Position your important points strategically

- **…and make it easy for a busy reviewer to pick them out of the surrounding text**

Never stop selling

- **Make every section of the proposal *work* for you**

- **Don't make the reviewer hunt for reasons to say "yes"**

Don't propose too much

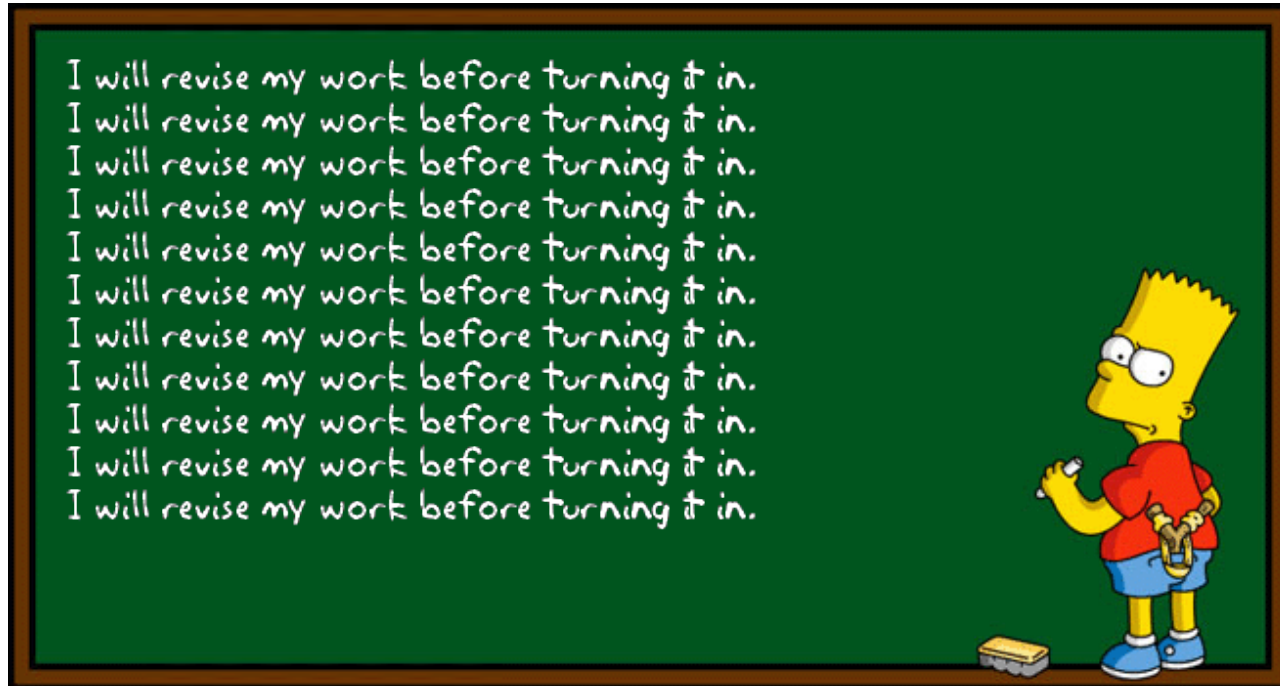## Narrow and deep usually trumps broad and shallow

Provide "quotable" points for your reviewers

Make it easy for them to write a positive, compelling review

Reiterate your key "selling" points in a summary section at the end of the technical narrative—end with a bang, not a whimper

Allow time to revise

Use your revisions to clarify, simplify, and persuade
Have a colleague read your draft
and give you suggestions
Run your spell-checker
after every revision

Check a hard copy printed from the portal's server

Section D. References Cited

1. Yildiz, A., J.N. Forkey, S.A. McKinney, T. Ha, Y.E. Goldman, and P.R. Selvin, *Myosin V walks hand-over-hand: single fluorophore imaging with 1.5-nm localization.* Science, 2003. **300**(5628): p. 2061-5.
2. Yildiz, A., M. Tomish... Science, 2004. **303**:
3. Kural, C., H. Kim, S. ... *move a peroxisome* ... **308**(5727): p. 1469
4. Kural, C., A.S. Serpi... *Tracking melanoso*... Proc Natl Acad Sci U
5. Rohde, C.B., F. Zeng, ... *for on-chip high-th*... *resolution.* Proc Nat
6. Hulme, S.E., S.S. S... *microfabricated arr*... 2007. **7**(11): p. 151
7. Kural, C., M.L. Nonet... 2009. **48**(22): p. 46...

Section D. References Cited

1N YildizLANLJNNForkeyLSNANMcKinneyLTNHaLYNENGoldmanLand PNRNSelvinLMyosin V walks hand-over-hand: single fluorophore imaging with 1.5-nm localization. ScienceLRPPSN300HUVR8IZ pNRPV1NUN
RN YildizL ANL MNTomishigeL RNValeL DNL and PNSelvinL RNL Kinesin Walks Hand-Over-Hand. ScienceLRPPTN303ZpNVWWVVVN
SN KuralLCNLHNKimLSNSyedLGNGoshimaLVNNGelfandLand PNRNSelvinLKinesin and dynein move a peroxisome in vivo: a tug-of-war or coordinated movement? ScienceL RPPUN308HUVRWZ pN 1TVYMVRN
TN KuralLCNLANSNSerpinskayaLYNHNChouLRNDNGoldmanLVNNGelfandLand PNRNSelvinLTracking melanosomes inside a cell to study molecular motors and their interaction. Proc Natl Acad Sci U S ALRPPWN104H SIZpNUSVVSVRN
UN RohdeLCNBNLFNZengLRNGonzalezNRubioLMNAngelLand MNFNYanikLMicrofluidic system for on-chip high-throughput whole-animal sorting and screening at subcellular resolution. Proc Natl Acad Sci U S ALRPPWN104HUIZpNI S8Y1NUN
VN HulmeLSNENLSNNSNShevkoplyasLJNAApfeldLWNFontanaLand GNMNWhitesidesLA microfabricated array of clamps for immobilizing and imaging C. elegans. Lab ChipLRPPWW7H 1IZpNI UI UNRSN
WN KuralLCNLMNLNNonetLand PNRNSelvinLFIONA on Caenorhabditis elegans. BiochemistryLRPPYN 48HRRIZpNTVVSNUN
8N ZhangL RNL ENRothenbergLGNNFruhwirthLINGoldingL TNNgL WNLopesLand PNRNSelvinL Rapid Two-Photon Imaging with Nanometer Accuracy of Individual Quantum Dots in a Biological Environment. Nature MethodsLRP1PLsubmittedN

...and careful with your fonts (driver-specific)

Sometimes before the Proposal…

There may be calls for

✓ A "**White Paper**"
  - a short – sometimes only one page –
  description to sell your work to the agency

✓ Then, if that passes, a "**Pre-Proposal**"
  - a mini proposal that must have MOST
  of the information to win the competition

✓ Then the full proposal submission.

The white paper and pre-proposals are used for private foundations and for block grants from the agencies.

All the rules and tips discussed apply here!

To recap:

Don't neglect other sections of the proposal by focusing only on the technical narrative

Make the reviewers' job easy

Read the directions (and follow them witlessly)

Remember $t = 3H + \varepsilon$!

Never stop selling, and…

NEVER GIVE UP !!!