A User Manual for Working with RGK

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Preface

If you are reading this document, you are either a prospective member of my group or have already signed your life away to me. :- ) The goal of this manual is to explain the basis for what I see as the covenant formed between the junior researchers (undergraduate and graduate students, post-doctoral research associates) in my group and me concerning our respective responsibilities and expectations. This manual started in 1991 as a simple checklist for graduating students. Through my experiences as well as many insights and suggestions from those who have used it, the document continues to improve.

Many of the items listed and described may appear to be common sense; they have been included for completeness and to try to prevent any misunderstandings. Most items briefly describe the manner in which my research group operates. I ask all prospective and new researchers to carefully read through the entire document. If you have any questions or concerns, please come talk to me about them. I strongly believe that this document has helped the young researchers who have worked with me to structure their professional development on good, fundamental principles.

Periodically, I ask that you review this manual (as I do) to make sure that we remain on the same page and to make sure that none of the items are forgotten. When you are not sure about what might be expected of you in this environment, this manual is the place to look first. In addition, the senior students in my group have experience to which you should listen.

I do not pretend that the approach outlined in this manual is either perfect or optimal. Each faculty advisor manages his/her group in the way s/he sees fit, which constitutes one of the beauties of life in the academe. The approach described in these pages is what seems to work for me.

As a footnote, there are some excellent on-line sources of information about career choices in science and engineering that have outstanding sections on choosing graduate schools, programs, projects, and advisors. These include:

http://www.rackham.umich.edu/downloads/publications/mentoring.pdf - “How to Get the Mentoring You Want”
http://www.nap.edu/readingroom/books/careers “Careers in Sci & Engrg” – a planning guide from the National Academies of Science and Engineering (NAS/NAE)
http://www.nap.edu/openbook.php?record_id=5789 what to look for in an advisor from the NAS/NAE
http://www.phds.org/graduate-school-success/ a means to personalize the rankings from the National Research Council

(Note the due to the dynamic nature of the Web some of these links may be dead)

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In the spirit of full disclosure, I have tried to objectively describe what I believe are the pros and cons of working with me:

**RGK Disadvantages**
1. Can tend to overcommit my time and sometimes that of my students
2. Can be demanding of high performance and my doghouse is not a pleasant place, though clear warnings of impending check-in to that site are given
3. Busy -- some travel, commitments within University, a full and active home
5. Must fight habit of going off on tangents and to solve your research problems rather than helping you solve them

**RGK Advantages**
1. Professional development of students is my highest priority
   a. Skills: Technical, communication, management
   b. Seek to help students develop into colleagues
   c. Provide opportunities for students to travel, publish and present
   d. Carefully select my group to provide both depth and breadth
2. Empower students to make decisions about projects
3. Expectations are high for both students and self
4. Try to be flexible
5. Experienced experimentalist with interest and willingness to get involved in solution to lab-bench level problems

**Current Students**
Mary Lyn Lim (mll4md@virginia.edu)
Cindy Shi (ys6ea@virginia.edu)
Jay Srinivasan (js3be@virginia.edu)
Marybeth Parker (mep8yq@virginia.edu)
Piyush Khullar (pk8bc@virginia.edu)
Chao (Gilbert) Liu (cl5bc@virginia.edu)

**Partial List of Former Students**
Eric Schindelholz (PhD, 2014) (ejschi@sandia.gov)
Mara Shedd (MS, 2012): (sheddm@lunainnovations.com)
Elissa Bumiller (PhD, 2011): (entrueman@outlook.com.au)
Jason Lee (PhD, 2011): (Jason.Lee@nrlssc.navy.mil)
Chris Taylor (PhD, 2006): (dfetchemist@gmail.com)
Kevin Cooper (PhD, 2001): (kevin@scribner.com)
Sean Brossia (PhD, 1997): (sean.brossia@gmail.com)
I. Work Rules
   A. Generally performance driven; i.e., some rules are flexible for high performers
   B. University holidays for classified staff + 2 weeks of vacation/year
      - i.e., student breaks are not applicable for GRA and PDRA
      - A list of staff holidays can be obtained from the CESE secretary.
      - Vacations are bankable from year to year
   C. 8:30 AM to 5 PM as minimum (and is normal). Open to flextime after 4 months,
      if and only if performance is acceptable. At certain times, (approaching
      conferences, other deadlines, when project goals are not being met), extra time is
      needed (evenings, weekends).
   D. Provide RGK with a current phone number, address and e-mail address
   E. Each semester, provide RGK with class schedule including times, titles and
      locations. RGK will provide the same to his group.
   F. Be available during day, check e-mail at least 2x/day for messages from RGK
   G. If special circumstances require an absence, leave a message with RGK (email,
      phone).
   H. Always operate in a manner consistent with safe laboratory practice. When you
      first join the group, you will be required to watch safety videos and get a copy of
      the CESE Lab Safety Manual as well as a UVa EHS Survival Guide from the
      CESE secretary. In general, always assume the worst can happen during lab work
      and prepare for it. Your actions impact not only your safety, but also that of all
      your colleagues and the continued operation of our labs.

II. Course Work
   A. 2-3 courses/semester until course requirements are finished
   B. High levels of performance are expected: B+ or better in all courses
   C. If you are having problems, see instructor or others for assistance
   D. At some point during your tenure, you will serve as a teaching asst. (see below)

III. Research
   A. Meetings
      1. ALWAYS have a research meeting scheduled - generally monthly
      2. Bring two copies of a typed agenda to each meeting
      3. Bring hard copies of all data generated since last meeting
      4. Don't let RGK control entire meeting
      5. Ask questions and challenge technical authority. TAKE NOTES. Ask RGK
         to slow down and give you time to make notes when necessary.
      6. Spontaneous meetings OK unless note on door says otherwise
      7. Maintain "What we know, what we think we know..." list
      8. Maintain an annotated bibliography and use library electronic searches to keep
         up-to-date (see also SciFind Scholar from ACS website, Web of Science). Use
         EndNote to organize references and in writing – see Ashley for our license.
   B. Lab notebooks -see attached
      1. Required - pick up books from CESE supply cabinet or bookstore/stockroom
      2. Must be: (a) neat, (b) dated, (c) organized

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3. RGK will provide examples
4. Fill with details and data - notebooks are cheap.
5. **All work must be traceable to notebook**
   a. includes data files and word processing files
   b. RGK will check periodically
6. When you borrow books from RGK you must sign them out. When you receive papers from RGK, ask if they are copies for you or must be copied.

C. Professional Interactions
1. Be aware of what others in the lab and dept. are doing and take an interest in it. This knowledge and habit will serve you well for a long time.
2. Offer your experience to assist other students, seek the experience of the faculty and other students to help yourself
3. Be active at lab meetings and at conferences, **ASK QUESTIONS.** Do so respectfully, concisely, and often.
4. After each conference, prepare a short, bulleted review of what you learned, who you met, and what you will change in your work or professional approach
5. Review manuscripts submitted to journals and sent to RGK for review. RGK will assist in providing guidance. You should make sure that you review at least 2 manuscripts per year.
6. Prepare your “elevator speech”: a short (30-60 sec) description of your project, including what you are studying, why it is important, what you have found so far, and what you are trying to find
6. At the start of each calendar year, provide a summary of your work via a Graduate Student Activities report (see Appendix).

IV. Leadership/Citizenship
A. I expect each student to **BE A LEADER** in the lab as part of a team. Work together with the other students to identify and solve problems.
B. If you **SEE A NEED, FIND A SOLUTION.** RGK will help you implement it
   i. If it needs to be done, do it, don't wait to be asked
   ii. You will be expected to carry out at least one lab duty in order to help the Center and our group to run more efficiently.
C. Kaizen - constant improvement
RGK Responsibilities as Advisor

1. Adequate funding for stipend, materials & supplies, travel, publications to complete degree
2. Clear delineation of Project
   a. Overall goals and relevance
   b. Time span
   c. Approach
   d. Initial references for annotated bibliography
3. Provision of adequate work space and equipment - JRS as space czar
4. Guidance during Project
   a. Be available for meetings - scheduled and unscheduled and to help with experimental problems in the lab
   b. Teach or provide access to instruction for acquisition of new skills needed for project
   c. Assist in planning of experiments and path of project
   d. Discuss results and analysis
   e. Help over roadblocks
   f. Constructively critique writing and presentation skills as part of professional development.
   g. Encouragement when things aren't going well, praise when they are
   h. Criticize only the action, not the person.
   i. Provide environment and incentives for excellence
   j. Require challenging goals to be set and met
   k. Help frame the questions and give student opportunity to solve
   l. Give students experience in interacting directly with sponsors.
   m. Provide opportunities to mentor undergraduate research assistants including involvement in hiring. See later section on Mentoring for guidance.
   n. Guidance on continual professional development – what to work on learning, especially as classes slow down.
5. Dissemination of Information
   a. Determine when and where results should be presented and published
   b. Provide opportunity for student to present results at a national meeting
   c. Outline paper(s) with student
   d. For undergraduates, write drafts
   e. For graduate students, correct or make suggestions to drafts -- critical review
   f. Work with student when reviews return on revised papers
   a. Provide time and time frame for writing
   b. Provide examples and format
   c. Critique student outline
   d. Critically review drafts for (a) organization, (b) clarity, (c) soundness of discussion and validity of conclusions, and help you develop your own voice.
   e. Assist in formation of committee
7. Administration
   a. Be aware of department, school and university rules regarding graduation requirements

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b. Provide guidance in selection of courses
8. Preparation for Permanent Employment
   a. Annual 360° evaluations - both of student and by student (see Appendices at end of document)
   b. Insights into financial and administrative sides of research
   c. Assistance in job-hunting
   d. Nomination for appropriate internal and external awards
   e. Provision of recommendations to employers

Typical Questions Asked of Me By Prospective Employers:

1. How long and in what capacity have you known the applicant?
2. What job duties were typically assigned to him/her?
3. Assess his/her overall performance, including specific strengths and weaknesses.
4. Evaluate his/her writing and oral communication skills?
5. Evaluate his/her interpersonal skills?
6. How well does he/she respond to supervision? To criticism?
7. How well does he/she work as part of a team?
8. How timely was he/she in completing assignments?
9. How was his/her attendance?
10. Were there any serious problems of which we need to be aware before making a hiring decision?

By your actions and attitudes, give me the ammunition to give a great reference for you with plenty of specific examples to support positive answers to the above questions.
Procedures, Advice and Such

The rest of this manual consists of a semi-organized set of procedures that my group follows for certain activities as well as advice collected from various sources. For example, when I say, “See the manual for how I like to write papers,” this is the place to which I am referring.

1. Lab notebook recordkeeping, including data backup
2. Course Work at UVa
3. Expected Timeline for GRA and Dept/SEAS/UVa deadlines/forms
4. Responsibilities as a Teaching Assistant
5. Responsibilities as Mentor to Undergraduate Research Assistant
6. Preparing:
   - Weekly Reports
   - Preparing for Monthly Meetings
   - Presentations
   - Manuscripts/Theses
7. Reviewing Manuscripts
8. The Graduation Checklist – Do these things and get my signature on your thesis/dissertation
INSTRUCTIONS FOR KEEPING RESEARCH RECORDS

In addition to providing a complete record of your laboratory work which can be understood and repeated by yourself and others, laboratory notebooks have been designed to afford maximum patent right protection. Several practices must be followed to give the notebook value as a legal document in possible patent litigation:

1. Enter all data directly into this book; it is permanently bound with numbered pages so that pages can not be substituted or deleted. These copies should be removed from the book and given to your group leader. Do not record data elsewhere for transfer into the book. Write in ink. Never make erasures. Thus, the integrity of the record will not be in question.

2. Record sufficient information. All procedures, reagents, apparatus, sketches, conditions, references, etc., should be entered into the book as the work is done. The purpose and significance of the experiment as well as observations, results, and conclusions should be made clear. What may seem trivial at the time may later prove of critical importance. Your entries should be clear and complete enough for someone else who is skilled in the art to read and comprehend what has been accomplished. Avoid sweeping negative statements, e.g.: This procedure is worthless, which could later limit the scope of your claims.

3. Not only is the conception of an invention important, but so is the diligence shown in making a working model or demonstrating that the idea works - a reducing to practice. These two elements of an invention, conception and reduction to practice, must be corroborated by a witness. The records of the inventor(s) are not enough. Thus, each page of the notebook should be read, witnessed, and dated (weekly) by someone who is competent to understand it, but who does not claim to be a co-inventor. Charts, tables, etc., should be complete, and lines should be drawn through any blank spaces prior to witnessing. It may be wise to perform key experiments in front of one or more witnesses. Spectra, charts, etc., should be signed, dated, witnessed, and if they cannot be permanently attached to the notebook, they should be referred to with an entry in the book and kept on file. Dates and witnesses can establish your priority of invention.

4. To delete an entry, draw a line through it so that it is still legible. Corrections should be made adjacent to the deleted entry, and they should be initialed and dated by you and the corroborating witness. Changes made after the page has been witnessed should also be initialed and dated by you and the witness. Always use the current date.

5. The notebook and its contents are to be considered confidential and of great value. Exercise every care in preserving them. Report the loss or theft of a research notebook to your group leader immediately.

6. Index the contents and return each book as completed (or when not in use) for filing.

7. New ideas must be recorded and witnessed as they occur to establish priority of invention. Even ideas that do not pertain to the project at hand should be documented in the book.

Keep your research records as if each project were to be patented. Even though the work contained in the book may not result in a patent application, observance of these practices will provide a clear record for reports, publication, or future reference.

Instructions Read and Understood by _____________________________

Dated ____________________________________________

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BACKING UP DATA – One approach

With magnetic storage nearly cheaper than water, there is no good excuse for NOT backing up your data. We have had students in our group lose several months worth of work by having their only electronic copies of data/plots/etc. be lost due to hard drive failure. While backing up can be taken to an extreme, here is a link with advice:

http://www.ukorbit.com/data-backup-advice.htm

UVa has set up secure cloud based storage with Box.com. Each UVa student can have 50 Gb of free, secure storage. See http://its.virginia.edu/box/. You can set up your hard drive to automatically sync with the cloud storage. This should be ONE of your backup strategies as it is dead easy.

No matter what method you decide to use, develop your plan and STICK WITH IT. If there are costs incurred, see me about how we can handle that. Bring various options, the pros and cons, and the costs.
Course Work

Exptd. Tenure:  2 calendar years for M.S. = 8 classes for M.S. degree
4.5 calendar years for Ph.D. + writing + 12 classes for Ph.D.  (total)
  1.5 years of classes (after MS)
  Proposal defense in semester before/after comps (25 p)
  10 months of final research

Everything you need to know about the MSE Department Graduate Curriculum but were afraid to ask: [http://www.virginia.edu/ms/acad/curriculum.html](http://www.virginia.edu/ms/acad/curriculum.html)

Expected Time Line

Ph.D. – 4.5 calendar years for Ph.D. + writing + 12 classes for Ph.D.  (total)
  2.5 years of classes (after MS)
  During the 8 weeks before your qualifiers, you will not be responsible for research milestones.
  Proposal defense in semester after comps (25 pages to committee)

Research Milestones:
  Should average 1 paper and 1 presentation per year, including year of comps
  1st Qtr: (a) Prepare an initial annotated bibliography, (b) Learn any new experimental techniques/analyses, (c) Set up any new experimental station required, (d) Generate data from first test matrix

  By end of first year: (a) Have generated sufficient annotated bibliography for comprehensive literature review, (b) Have generated archival data that allows a phenomenological paper to be written; (c) Select committee

  By end of second year: (a) Acceptance of first paper for publication, (b) Sufficient experimental work to have proposal defense

  By end of third year: (a) Nearly finished all experimental work, including any proof-of-concept experiments; (b) Started outlining dissertation

Dissertation Writing: 12 weeks of writing after final experimental work (date of final experiment will be set by mutual agreement at a meeting ca. Graduation - 3 months).
Responsibilities of and Rewards to RGK Teaching Assistants

Responsibilities

a. Grading of all homeworks, development of annotated solution sets for HW
b. Maintenance of grade spreadsheet, including back ups
c. Assistance in grading of exams
d. Assistance in creation/selection of HW and exam problems
e. Attendance at all lectures -- check comprehension, catch mistakes, contribute to use of alternative teaching methods
f. Office hours for students: ca. 5 hr/week for ug class, 2 hr/wk for grad class
g. Maintenance of GRA duties albeit at lower levels

Rewards

1. Interactions with students refines your understanding of what you know. In all jobs, teaching others (formally and informally) comprises some portion of one’s responsibilities.
2. Networking with participants at short course: future job leads, contacts for information, etc.
3. Opportunity to develop presentation and interaction skills, as well as extend your expertise in your chosen field.
Responsibilities as Mentor to Undergraduate Research Assistants

Mentoring an undergraduate is an important responsibility. In many cases this experience will be their first in a research environment, which makes your role critical. Your interactions with them may well greatly influence their career path; it can truly be life changing.

Aspects of Mentoring:
1. Teaching the skills needed for the project
2. Teaching how one approaches research projects and problems that occur
3. Modeling what professional behavior looks like in terms of work ethic, focus, and interactions with others.
4. Moving them from a set of hands to a colleague

Part of your job as a mentor is to ASK the undergraduate the right questions. Asking the right questions teaches them how to ask themselves the right questions as they become independent researchers. Here are categories and questions to ask. Some have to do with research issues, others more with career questions.

Listen to Clarify
- What would you like to get out of this conversation? (State your issue as a question you are trying to answer for yourself now.)
- What is a good image or metaphor to describe this issue/situation?
- What do you think is really going on?
- What would you like to see happen?
- What is working well? What is not?
- What assumptions are at the heart of your thinking?
- Who do you want to be (what kind of person) as you approach this situation?
- Which of your values are you honoring in this situation? Not honoring?
- What is really important about this to you?
- How does this relate to your personal purpose/vision/mission?
- What does your intuition tell you about this?
- What is another perspective you could have about this?

Create Possibilities
- What would it look like if things were the way you want them?
- What would you do about this if you could do anything in the world?
- What experiences like this have you had before? What worked?
- What is the worst thing that could happen if you did nothing?
- What are you doing to contribute to this?
- In what ways are you stuck? What would it take to get unstuck?
- What opportunities does this issue present?
- What other resources are available to you?
- What are the potential costs? Benefits?
• What other options can you think of? Would you like to brainstorm ideas?
• What do you want to accomplish most in the next six months?
• What do you want to say “yes” to? “No” to?
• What option feels most exciting? Most “right”?

Take Actions
• What specifically are you going to do? When?
• What do you need to start doing, stop doing or do differently?
• What will it look like? How will it feel when you’ve achieved it?
• What support will you need?
• What will be the hardest part for you (in taking this action)?
• How will you know when you have met your goal? How will you measure success?
• What could derail you or keep you from acting?
• What can you do to keep yourself on track?
• What first steps will you take?
• How can I be of help to you?
• How will you be accountable?
• How will you celebrate once you have completed these actions?
Preparing Weekly Reports

Weekly reports should follow the format shown below and be submitted to me by 5 pm each Friday as Word files. I will read them over the weekend and send any comments and questions back to you.

Filename should be of the form YYYYMMDD Initials Weekly Report.docx.
For example: 20131228 RGK Weekly Report.docx

(Name)
(Project Name)
(Project Sponsor)

WEEKLY REPORT
(Date)

Administration
1. Updates on classes or other goings on
2. Questions, issues, heads up on due dates
3. Next reporting deadline

Review of Week
1. Task 1
Text describing what you did, what you found, what you think it means. Include figures in tables as shown below;

Figure 2. Potential distribution along the cathodic boundary with the following boundary conditions: blah, blah, blah.

Micrographs need magnifications and identification/descriptions that allow me to interpret without knowing your code for the sample name, for example.

2. Task 2, etc.

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Plans
1. Next Week
   a. Immediate followups to above, including administrative tasks
2. Next Month
   a. Broader goals for each task, and addition of any other tasks
3. Next Quarter
   a. Goals for next progress report, talk, or paper

Preparing for Monthly Meetings
1. Schedule – You need to make sure that we ALWAYS have a meeting scheduled some time in the next month. Before each semester I will set up the meeting times for the next semester.
2. Agenda and Data for Meetings - make sure you SEND me your agenda and your data ahead of time. I will provide a Powerpoint template. This ppt will be a living document that will have each meeting tacked onto the end. Depending on the size, we may start a new one each 6 months or year. We will have to see.
3. Note-taking - during our meetings, I will often take notes, possibly on the ppt you have provided. That does NOT relieve you of the need to take notes for yourself. I take notes because it helps me think things through as well as provide a record that I can review. You need to develop and refine that same habit for yourself. If I am moving too fast, SLOW ME DOWN. I have not bitten anyone if several years for asking me to slow down.
4. Follow up - Please make special note of any tasks you need to followup on in the near future after a meeting as well as ones that I need to do. Then ping me if I have not let you know that they are done.
5. Reports to sponsors – Your research project (including your stipend) is paid for by some organization. They almost always require some level of reporting. The frequency may be as often as quarterly. You need to know who your sponsor is, what the reporting schedule and format are, what the acknowledgements should say in ppt and papers, and what need to be sent to the sponsors in terms of data, drafts, finished papers, etc.
6. UVA Box - You should immediately sign up for UVa Box which gives you 50 Gb of free, secure, cloud storage. This path should be one of the ways you back up ALL your data automatically through BoxSync. In addition, we can share access to folders, so you each can give me access to a folder with all of your weekly reports AND running Progress Report ppt. See http://its.virginia.edu/box/.
Preparing Presentations
1. Generation of a quality "story" via research and literature analysis
2. Identification of key results to be included and a one sentence "statement of purpose and importance"
3. Preliminary outline and decision on forum
4. Outline of sections of talk, including cut-&-paste figures/overheads
5. Revision 1.0 - first draft of overheads, go over major point of each
6. Revision 2.0 - second draft of overheads, first practice of talk
7. Revision 3.0 - final overheads, polished practice of talk

When submitting drafts to me, use the above numbering scheme to assist me in knowing at what I should look in detail. I will return the drafts with a higher number (e.g., 3.1).

Evaluating Presentations

Pace: Did the presentation include too much information and therefore rush through the material? Did the presentation drag, or become stalled in places?

Clarity: Was the material presented clearly? Was the flow of ideas smooth and logical? Was the terminology well defined?

Organization: Was there a clear overall organization? Did the presentation give an orderly view of an area of knowledge?

Graphics: Did the presentation use graphics appropriately? Did it include unnecessary graphics?

Answering Questions: Did the presenter respond to questions professionally, succinctly, and completely? Did s/he answer the question that was asked, or did s/he avoid direct answers?

Overall: The ultimate measure of a presentation is how much the audience learned. Did you learn a lot from the presentation or not? Did you leave informed or confused?

The next page is a form to be used for all CESE presentations you give (and any others for which you want feedback)
### Presenter:

<table>
<thead>
<tr>
<th>Discussion Topic</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did I present myself well? <em>(i.e., did I speak clearly and loud enough to be heard by all; was my appearance reasonable for this type of presentation?)</em></td>
<td></td>
</tr>
<tr>
<td>Were my materials acceptable? <em>(i.e., organized, readable from a distance, interesting and attractive)</em></td>
<td></td>
</tr>
<tr>
<td>Were questions regarding my presentation answered completely?</td>
<td></td>
</tr>
<tr>
<td>Were excess equations and text kept to a minimum?</td>
<td></td>
</tr>
<tr>
<td>Was the pace of the talk fast, too slow, or just right?</td>
<td></td>
</tr>
<tr>
<td>Was my speaking style enjoyable, or did you have to work hard to stay interested?</td>
<td></td>
</tr>
<tr>
<td>Did I appear comfortable, at ease and in control or is more confidence and experience needed?</td>
<td></td>
</tr>
</tbody>
</table>

### Feedback on Topic

| What questions regarding the presented topic were not covered clearly? | |
| If your knowledge of the presented topic was not strong, were you able to follow the presentation without difficulty? | |
| How well were the figures explained and did the fundamental scientific concepts receive the majority of the discussion? | |
| Do you feel you have learned something or feel more comfortable with the subject matter now that you have seen/heard this presentation? | |

### Tips/Suggestions

| Do you have any general remarks to make? | |

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The ABCs of Scientific Presentations
Eric Z. Chen

INTRODUCTION
Why are scientific presentations vital? The answer is simple: whenever you are making a presentation, you are also presenting yourself. If you are an engineering student trying to land your first job, your future employers would connect the quality of your presentation to your potential to do a better job. If you are a scientist trying to convince a sponsor to fund your research, your sponsor sees the value of your study through your presentation.

For scientists and engineers, giving a presentation is often frightening, however, engineering professionals are not alone in that respect. According to a national survey, on Americans’ top ten list of experiences they most dread, public speaking placed first and death seventh! Many of us remember our childhood terror in school. When singled out by your teacher to speak, did you ever have sweaty palms, shaky hands, dry mouth, quaking voice, and a rapid heartbeat? Adults also experience similar symptoms as stage fright.

A scientist might argue that public speaking is not a necessity of professional life. Admittedly, a company hires engineers primarily because they solve unique technology problems, while a university employs faculty members because they can teach and perform research in their special areas. The story does not stop here, however. If you can be among the few who know how to deliver good scientific presentations, you may be appreciated as a genuine asset beyond your technical expertise.

When I was a graduate student, I attended presentations given by potential faculty candidates. All of the candidates’ credentials were impressive. In reality, a candidate’s credential is the tool only to obtain an interview opportunity, it does not guarantee the faculty position for which the candidate is applying. Those who delivered the best presentation got the offer. Later, working in industry, I interviewed candidates for scientific positions. Again, it was those who gave a better talk in their technical field that got the offers. More often than not, the best presentation was not even the most closely correlated to the position for which the candidate was applying.

In these stories and you get a sense of how important scientific presentations are. Time and again, I watched graduate students, all working hard and wanting to succeed. A student’s inability to make scientific presentations might at first seem a little bend in a twig. As time goes by, the bend exaggerates. Eventually, the bend becomes so pronounced that it interferes with professional well being. At the same time, those who can make better presentations prosper in their career.

In addition to the thrill of general public speaking, scientific presentations pose additional challenges to speakers. For one thing, the audience may not possess the adequate background knowledge to understand a subject, let alone appreciate the value of a finding. For example, a physicist will come to realize that the concept of the refractive index of light is not readily appreciable to the general public. Although there are books and articles on public speaking, there are few sources specific to giving scientific presentations.2,3 Because of the uniqueness of scientific presentations, there are keys to public speaking in a technical field. These keys lead to a successful scientific presentation, which is an integral part of professional life.

ARTICULATE THE THEME OF A PRESENTATION
At first glance, a piece of music and a scientific presentation may have nothing in common. But if you love a piece of music, you probably try to memorize its title. Even if you do not, you are more likely to remember the melodies of its theme. Indeed, there exists a profound similarity between a pleasant piece of music and a lively scientific presentation—each has a clear theme.

Many seemingly polished presentations do not have a clear theme. For that reason, audience members may forget what the presentation was about when they leave the conference room. These presentations may state the goal of some research, list results, and draw conclusions. But without a definite theme, these presentations likely leave no impression on the audience.

Theme differs from the title of a presentation. In general, a good title answers two questions for the potential audience—What is the speaker going to talk about and why should I attend? A theme, on the other hand, is the main point that a presenter would like the audience to take home. Two illustrations of the correlation between a title and a corresponding theme are:

- Title 1: "On the Common Personality of Creative People"
  - Theme 1: They are all distinct.
- Title 2: "On the Unique Properties of Ice"
  - Theme 2: Ice is piezoelectric. Applying a mechanical stress induces electrical dipole moments.

In the two examples, the title and theme are complimentary. Together, they construct the main message. Combining the title and theme, the main message of the first pair is "creative people are all distinct," the second pair is "ice is piezoelectric, applying a stress on ice yields electric dipole moments."

Articulating the theme of a presentation is not only the first important step, it is also the most difficult. Suppose you have done research on ice for years—you may have obtained much interesting data. Your experiments proved that ice can be crystalline, amorphous, and semicrystalline. The data also indicated the ice is piezoelectric. When invited to give a talk about your research, you probably do not have enough time to cover all your data. Even if you do, your audience will not digest all the points. Thus, as the speaker, you have to choose a theme, such as "ice is piezoelectric." In general, the theme can be, among other things, your most important results, a daring hypothesis you made in solving a particular problem, or a prediction based on your conclusions.

For practical reasons, your theme cannot contain too many points. During a scientific meeting, a typical member of the audience attends 20, even 40 presentations. The majority of these presentations are soon forgotten. Thus, if audience members can still recall one main point of your presentation after returning home, you have succeeded in your presentation. As a general rule, one main point will suffice for a 15 minute presentation, while 2–3 main points can be made in a 30–60 minute presentation.

The theme dictates the entire contents of a presentation, as the presentation expands around the theme. Powerful presentations dramatize their themes. Any equations or tables must be eliminated if they do not contribute specifically to the theme you have chosen, no matter how important they are in their own right. To make your theme even more apparent to your listener, it is suggested that you stress your theme in verbatim, in variations, just as musicians do. When a theme is frequently repeated, a listener does not have to be a profes-
DESIGNING A PRESENTATION INTO A DESIGNATED TIME SLOT

In the national meetings of a scientific organization, a speaker usually has a limited time slot (e.g., only 20 minutes). The strict time limit is necessary because of the total number of papers in the schedule and the limited time available. As one might expect, many speakers keep dragging on after their time has sounded. Unfortunately, after the time sounds, the speaker appears either selfish or rude. If one speaks longer than allowed, later speakers must cut out their time in order to keep the session on schedule (the selfish part). Usually, the audience ends up staying longer than scheduled (the rude part). The speaker should be considerate to the audience, particularly near the end of the day as some of them may have evening plans and obligations. To audience and session chairs alike, exceeding your time limit is never acceptable. In technical circles, it is considered a capital crime to speak past your time limit—never, ever speak beyond your designated time slot.

You are not at all in wrestling with the time limit; all speakers have to obey the same rules. Even an invited paper in a plenary session has a time limit. Second, speakers must realize that any subject can be presented in almost any length. One can treat electron motion within an atom for two years or compress the revolution of the solar system into two minutes. Needless to say, neither of these presentations would bring in a large audience. With these points in mind, there are a few steps to help you fit a presentation into a prescribed time slot.

Step 1: Relentlessly Filter the Contents of a Presentation

As stated previously, the theme of your presentation frames the contents. But what should you do if you have 40 minutes of information, and you only have 20 minutes to fit the information into the presentation? Redesigning the entire presentation is the preferred approach; however, filtering the content of a presentation does not mean skipping details. Rather, you should focus on reducing the number of main points in your presentation.

Refer again to the example of research on ice. For a 20-minute presentation, your theme may contain only two main points. The first point is that ice exhibits several forms of microstructures, amorphous and crystalline. The second point is that ice is piezoelectric, applying a mechanical stress produces electric dipole moments. For a 30-minute talk, your theme should contain only one main point; ice is piezoelectric. In both circumstances, your main point can be elucidated in details.

Step 2: Select the Appropriate Visual Media

Selecting from the several visual forms available to speakers is essentially a personal preference. However, the theme of your presentation determines the appropriate visual aid:

- **Transparencies.** Once prepared, transparencies require minimum visual equipment; a good overhead projector, which can be found in nearly all conference rooms, will work fine. During the presentation, the speaker fully controls the transparency and can go back to any desired page at any time. Perhaps the greatest advantage of transparencies is the speaker's opportunity to maintain eye contact with the audience. Since an overhead projector works under moderately bright lighting in a conference room, the speaker exploits the light to keep eye contact while talking to the audience.
- **Color Slides.** If high-quality images are imperative to enhance your theme, use color slides, as they provide drawings and photographs with high image quality. They are compact and easy to carry. Again, most conference rooms are equipped with a color slide projector. One drawback is that the light in the conference room has to be dimmed, making it difficult to maintain eye contact with your audience in a dim room.
- **Computer Displays.** This method allows great flexibility both in planning and during a presentation. A speaker may update visuals up to the last minute before a presentation and may even rotate and magnify a selected portion of a visual. Similarly, computer graphics produce high-resolution images. However, be sure to verify that the hardware and software in the conference room are compatible with your own system before the presentation.

Step 3: Reduce the Amount of Visuals

A common pitfall is to have too much visual aid. To decide on the proper amount, consider the purpose of visuals:

- To make an abstract concept concrete.
- To simplify complicated scientific reasoning.
- To catalyze the audience in absorbing the theme through symbolic connections.
- To provide prompts to yourself so that you follow the structure of the presentation.

Many speakers select their visuals to serve only the last purpose, while overlooking the visuals for the first three purposes. Although there is no correct amount of aids, there can be too many. With that in mind, your visuals should meet three criteria: they should be simple, large, and contain few equations.

The audience needs to respond to your visual. To help them in the orientation process, your visuals have to be simple. Your visuals must be large enough that people in the back row of the conference room are able to read them. Being large also demands being simple. If you jam-pack a transparency, it is impossible to make words large.

In a scientific presentation, it is often customary to incorporate equations into the talk, however, use them sparingly. Equations make a presentation difficult to understand, and they also slow down the pace of the talk. As an equation is visual flushed on the screen, one often hears groans from the floor. When using equations in a presentation,

- Make sure that an equation has to be an integral part of the presentation. If an equation does not contribute specifically to the theme of your presentation, cut it out. Equations alone do not guarantee the scientific validity of a presentation.
- Use the simplest form of an equation. Many equations have vector, tensor forms. Use only the scalar form, save the tensor form for the textbooks. Explain every symbol in the equation.
- Do not drag your audience step by step through how you solved an equation. The audience will have difficulty seeing that you can do algebra, are proficient in computer programming, and have adequate precision in your numerical calculation.

Instead, you should dramatize the assumptions that lead to the equation, carefully explain the physical meaning of the solution, and clarify the predictions based on the solution.

Finally, the speaker should dramatize the assumptions that lead to the equation, carefully explain the physical meaning of the solution, and clarify the predictions based on the solution.

1999 December • JOM

DETERMINE THE LEVEL OF A SCIENTIFIC PRESENTATION

In a scientific presentation, a speaker always faces a classic dilemma: what level should the talk be pitched? This dilemma spells nightmares for many speakers, particularly when the audience consists of both experts and novices. On one hand, the speaker cannot afford to play only to the experts. Besides, being an expert is a relative term; in a given discipline, experts in one branch may not have enough time to keep abreast of the developments in other branches. On the other hand, the speaker cannot afford to play only to the novices for the risk of appearing amateurish.

A common mistake is to talk only to the few experts in the audience. The assumption is that only experts’ opinions matter; even though other listeners cannot understand a presentation, they should at least admire the speaker’s esoteric knowledge. Why? If you make your presentation so technical that the majority of the audience fails to follow, the audience resents you for wasting their time. An audience comes to the presentation to learn something new; when they do not catch even a little bit, they are hopelessly disappointed and will not appreciate your research, no matter how significant your results are.

Most listeners will be able to grasp the theme of your research if you provide them with adequate background knowledge. Many of them must have some exposure to the subject, otherwise, they would not have come to the presentation in the first place. With this in mind, it is recommended that you devote at least one half of your allotted time to a careful introduction of the subject. The introductory material should be aimed to help listeners understand the subject, put your theme in perspective, and appreciate the significance of your theme. At the same time, save the highly scientific contents to the last one third of your presentation. At this stage, you may lose a portion of your audience, but at least these people have learned about the subject from your introductory part. By presenting the scientific contents, the experts appreciate a few fine points in your research and are satisfied knowing that they can follow the speaker to the end of the talk. Most importantly, the entire audience group perceives the speaker as competent and considerate to listeners with varied needs.

MAINTAIN EYE CONTACT WITH THE AUDIENCE

A novice speaker looks away from the audience, focusing on the floor, the wall, or the ceiling. Most of us recognize the importance of eye contact; during our everyday life, we look directly at the person to whom we are talking. Let us do an experiment. Begin to talk to someone and purposely look away. You'll soon realize how awkward this is. In U.S. culture, when a speaker keeps looking away from the audience, the speaker is perceived as insincere, evasive, and incompetent—not a positive image.

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In reality, there exists a gap to eye contact; as you are the only speaker and there are many listeners, true eye contact with every member of the audience is impossible. Nevertheless, your skills can bridge the gap. First, scan the entire audience in the conference room, and mentally divide them into a few sections. In each audience section, identify a friendly face and establish sole eye contact with that person. Turn your eyes from one section to another, making sure no section of the audience group is ignored. Do not ignore any section of the audience. Your eye contact should be equally partitioned among audience subgroups regardless of their rankings, titles, and positions. While making eye contact with a friendly face, hold the contact for a few seconds until an impression is made.

Effective eye contact builds rapport between the speaker and the listeners. Powerful eye contact connotes: Do I make my points clear? Should I slow down or speed up?

**ANSWER QUESTIONS FROM THE AUDIENCE**

At the end of a presentation, the speaker generally has to answer questions from the floor. Believe it or not, speakers usually dread this moment. They are afraid of not being familiar with a paper an audience member may know or of not being able to answer a tough question, invalidating the theme they have built. This scenario is quite likely given the fact that listeners collectively possess a diversified background. Answering questions from the audience is not as frightening as it appears provided that the speaker obeys, among other things, four fundamental rules.

Rule one is to let your questioner finish the question. Sometimes, a speaker becomes so excited or so nervous, he or she interrupts the questioner and jumps to an answer. Often, the speaker answers the question they think is being asked. This habit is irritating to the questioner as well as to the audience. Always let your questioner finish.

The second rule is repeat the question to the audience. When a conference room is large and the questioner does not have a microphone handy, the majority of the audience may not even have heard the question. The audience thus appreciates you repeating it. You should paraphrase the question briefly.

Third, keep your answer short. For closed-ended questions, such as "is", "does", "have", etc., a yes or no answer is adequate. For an open-ended question, two sentences suffice. In any event, keep your answer shorter than two minutes.

Finally, never argue with your questioner. If a questioner brings a view contradicting to yours, do not respond defensively. Rather, praise the questioner’s points (praising does not necessarily mean agreeing) and admit that there is a difference of opinions, then propose to discuss the differences in private. Your goal is not to appear domineering. In the audience's eyes, the balance is so tipped in your favor that even if you reveal a hint of condescension, you’ll be regarded as bully. Nobody likes a public display of belligerency.

**ACKNOWLEDGEMENT**

I am indebted to James C. Garland for his private communication with the author regarding scientific presentations and for his article "Advice to Beginning Physics Speakers." It was that article that ignited my enthusiasm on scientific presentations. Of the keys introduced in this paper, credits should go to Professor Garland whereas his article is referenced. I also owe thanks to Cheryl Reimold for her advice on how to deliver a winning presentation.

**References**


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See also, “The Art of Scientific Presentations,”

[http://www.writing.eng.vt.edu/courses/presentations.html](http://www.writing.eng.vt.edu/courses/presentations.html)

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Writing Papers/Theses

1. Generation of a quality "story" via research and literature analysis
2. Identification of key results to be included and a one sentence "statement of purpose and importance"
3. Preliminary figure outline and decision on forum
4. Second stage outline -- subsections
5. Final stage outline -- topic sentence for each paragraph
6. Revision 1.0 - capture key ideas and basic flow - especially results and discussion
7. Revision 2.0 - refinement of results and discussion, including second generation figures; focus on development of background and introduction -- what key papers to include, which ones to highlight in background vs. discussion section
8. Revision 3.0 - focus on quality of discussion -- internal and external consistency, third generation figures including figure captions.
9. Revision 4.0 - add abstract, check title, read entire manuscript for flow, grammar, final figures and captions.
10. Revision 5.0 - final form for submission, review relation to one sentence "statement of purpose and importance"
11. Revision 6.0 - highlighted portions in , draft which are focus of reviewers' comments and questions; self-review for (a) organization, (b) clarity, (c) soundness of discussion and validity of conclusions, (d) flow.
12. Revision 7.0 - inclusion of changes due to external and self-review in rough form, check again for internal and external consistency; draft of response to reviewers points
13. Revision 8.0 - final, revised submission including response to reviewer(s) and cover letter

When submitting drafts to me, use the above numbering scheme to assist me in knowing at what I should look in detail. I will return the drafts with a higher number (e.g., 3.1).
Other advice (from UVa CS website):

The Graduate Student's Guide to Writing Scientific Papers

Motivation
Becoming a good writer is perhaps the single greatest thing you can do to further your research career. Your ideas and engineering, algorithmic, or theoretical solutions can be strong and original, but if you communicate your ideas poorly then you will diminish the impact of your ideas and solutions. A cogent and concise description of your research helps readers to understand the core issues which you are dealing with, rather than getting bogged down in the details of their communication.

It is sometimes helpful to think of your paper as the user interface to your research. If it is confusing and poorly presented then nobody will take note of it. By contrast, a clear, fluid, compact, and visually inviting presentation will entice your audience to

• actually read the paper
• remember the text they have read and the images they have seen
• tell others about the work which (by virtue of the two previous bullets) they have read and remembered

Executive summary: good writing is your ticket to fame, glory and funding. Understand that the process of writing almost always leads you to a more thorough comprehension of your topic. You should never consider the process of writing as an extraneous task that prevents you from doing the very work which you are trying to describe. If you want to describe a theory or algorithm well, you must understand it completely. By seeking to cogently describe your work, you will come to understand it better, and thus will improve on the work itself.

The bulleted list is your friend!
The bulleted list is a compact, effective, and eye-catching way to get lots of information across to your reader in a hurry.
Use bulleted lists for 3 or more items. Sometimes bulleted lists are appropriate for 2 items, but if so set it up such that the reader expects only 2 items. A bullet should almost never be used for just 1 item, unless you are really trying to call attention to it... and in most cases you'd want a label instead e.g. Thm #1: or whatever.
If you can summarize the bullet in just one or two words, do so and bold or italic those words.

Be concise
First, you should admit to yourself that almost nobody is going to read your whole paper. Most will just read the abstract. This means that the more good stuff you can cram into these 200 words or so, the more you will be able to convey about your work. Heck, you may even be able to connive someone to read your introduction as well. In fact, you should make certain that your main idea / contribution is right there in the first sentence of the abstract.
Use no unnecessary words. As you read your draft, always ask yourself, "could I convey the...
same ideas with fewer words?" From an engineering standpoint, you want the text of your
document to have a high signal to noise ratio.
Keep paragraphs fairly short. Look to break up long paragraphs. If the paragraph is lengthy b/c it
addresses a series of points, break it up using a bulleted list.

**Good writing is knowing bad writing when you see it, and fixing it**

A good writer is someone who is good at seeing where the mistakes are, and fixing them. Learn
to find chunks of text that don't meld well. Have people read your draft. Places where they
suggest edits, or ask questions, are likely tripping points. Focus on these first.
Read Marc Raibert's paper.
For scientific papers, pay particular attention to his points about "spilling the beans." Don't make
your paper a mystery; divulge everything from the start. If you have good stuff that someone
should be interested, put it right up there in the abstract and introduction, to try to hook your
reader. Put your most important idea(s) right into the title.

**Summaries, Conclusions, and Future Work sections**

Avoid summary/conclusion sections that merely reiterate the points that you have raised
previously. Your central message might be retreated, but don't give an exhaustive revisit of your
paper. In particular, don't paste sections of text or sentences the reader has already seen into your
conclusion. At worst, the reader may feel insulted; at best, the reader will stop reading the paper
or will just skim the rest, since they've already seen everything you're telling them again.
The conclusion is a great place for bulleted lists that quickly (in a few words per bullet)
summarize your main ideas or, for example, the main advantages of your technique.
Also use your conclusion as a point to jump off into your future work section. You might point
out some of the shortcomings of the work (if you haven't already done so) and then quickly (in
the future work section) follow with how you plan to fix or ameliorate the problems you
encountered.
For future work, be sure to suggest some fairly trivial extensions that you already are planning or
even starting to implement. Use these to lead in to your more radical or futuristic extensions.
Writers often like to end their scientific papers on visionary note. **be extremely careful if you
do this.** It is okay to hint at where your work might go in say, 2 or 3 years. It is also okay to
suggest where your work could go if a tractable technological impediment were removed **add
concrete examples** . But **do not** turn into a science fiction geek here. Don't suggest there's a pot
of gold if you know darn well that it probably doesn't exist.

**Eliminate Weasel words**

simple (simply), very, quite, obvious, basic (basically), almost, ...
With rare exceptions, these words will weaken your text. Find all occurrences and eradicate
them, even if it means recasting your sentences a bit.

**Be concrete**

Don't be too abstract, even when you are explaining abstract concepts. Be sure to give concrete
examples of what you mean...
Write using verbs and nouns. In scientific papers it is especially important to Avoid unnecessary adjectives and flowery prose. This is one of the most difficult guidelines to apply... it will take practice. Give examples
Read Strunk and White.
Don't open yourself to attack by the reviewers.
Unless you are absolutely certain you can defend yourself against all attacks, do not make overly definitive statements, unless they specifically describe your work:

nobody has tried the research we are aware of has not
there is no existing evidence suggests that...

etc...

Better Examples

Don't flame out the work of your colleagues. Just politely explain (perhaps using a bulleted list) the difference between your approaches and design tradeoffs. Be sure to mention what your colleague's work handles well. Your colleague may very well end up reviewing the paper, so be diplomatic. And, if you have made a mistake, you at least have a path to escape...

Use Lots Of Figures And Photographs

Use figures and photographs wherever possible. You can frequently express ideas that would take whole paragraphs with using one simple figure. If a picture can be used to help explain your main idea, (1) be sure to make a good figure and include it, and (2) put it right on the front page of your work, right below the abstract or in the introduction. The picture will become a sort of symbol for your paper that will help people remember it, and the picture itself will attract attention.

If you're clever, figures and photographs are a good way to provide a "digest" of your paper. Many people will read only the abstract and then flip through, looking at the just the pictures. If the pictures provide a high-level overview of the paper, you may draw the reader's interest and get him to read the whole paper, or at the very least, you will succeed in communicating your main idea to the reader.

A Few Graphic Design Guidelines

find someone with artistic skill or taste and get them to comment on your figures. If you're really lucky, there will be such a person to help you draw such figures: except for graphs / charts, a photograph or hand-drawn image almost always looks better than a computer drawn image (some modern paint programs excepted)

This is even more true for slide presentations of your work...

Iterative Design

Start with bad writing. Keep iterating until it is good writing.
A very gifted writer might be able to write a decent paper with as few as 6 iterations. A skilled English major could probably get by with about 12 or so. For the rest of us mere mortals, and

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graduate engineering students in particular, 20 or more iterations of the document would not be an unreasonable number.

If you are out of practice, set aside 2-3 weeks to work on your paper, and try to iterate on the design of the paper almost every day (even if you just re-organize a couple of paragraphs). You will find that not only does the writing improve, but the scientific merits of the work that you are describing will improve as well.

To explain something clearly requires that you understand it thoroughly. The process of writing the document will help you to discover errors and weak spots in your work. By setting aside lots of time to write the paper, you are also allowing yourself time to patch up the weak areas in your work.

**Appeal**

Like a good film, your paper needs to have appeal. You've got to hook the reader in and keep them interested. The paper has to have a certain sense of momentum. "phrasing" borrow techniques from theatre/film. visuals are one example.

Also from CS Website:

**The Ten Commandments of Good Writing:**

I. Each pronoun should agree with their antecedent.
II. Just between you and I, case is important.
III. A preposition is a poor word to end a sentence with.
IV. Verbs has to agree with their subjects.
V. Don't use no double negatives.
VI. A writer musn't shift your point of view.
VII. When dangling, don't use particles.
VIII. Join clauses good, like a conjunction should.
IX. Don't write a run-on sentence because it is difficult when you got to punctuate it so it makes sense when the reader reads what you wrote.
X. About sentence fragments.

Part I -- Before Writing
1. Innovate -- and if you can't think of anything brand new, do something unexpected. This is your angle; now feature it.

2. Do your homework. Find your niche. What are others doing about this issue? Show that you know, and place your project within this context.

3. Build a team. Mix things up. Build and cross bridges--among departments, disciplines and schools. Between academia and business. Between schools and colleges. Include students and administrators. Be generous: share work and ownership. Appoint an advisory committee of famous people in your field--to get a head start on dissemination--but don't give them much work to do, and you won't need to pay them very much.

4. Find the right funding agency. Know agency interests, culture, and style. Submit applications to more than one agency (but, of course, don't accept multiple grants supporting the same activities).

5. Use the phone. Call a program officer, briefly summarize your idea, and prepare specific questions. Take the program officer's advice very seriously, but exercise your own best judgment. Some agencies are more directive than others.

Part II -- While Writing.
6. Use a journalistic writing style. Use the "W" words of journalism: Who, what, when, where, why and how. Also use bullets, lists, outlines, diagrams, tables. Don't obsess on any topic, even if important. Make it interesting; let every sentence do a job. Assume that your reviewer is reading in bed, falling asleep--which is very likely true.

7. Follow guidelines to the letter. Keep them before you as you write (but don't quote them back to the agency). Match headings in the proposal to headings in the guidelines so the reader doesn't have to hunt for needed information. Use "signposts": I am about to explain why... I have just argued that...

8. Build in continuation, evaluation, and dissemination. Factory installed, not an add-on and not postponed to the last year. Continuation plans are an indicator of institutional commitment. Evaluation should be independent and objective, but doesn't need to meet standards of the Journal of Psychometrics--use common sense. What would you want to know about the success of an idea before you would consider adopting it? Evaluate "politically" -- i.e., with an eye toward later publicity. What would you want to see in headlines? Note the difference between passive and active dissemination. (The first disseminates admiration, not innovation.)
9. Watch the bottom line. Share costs. Know how to cut costs without hurting the project: request replacement salaries instead of released time, charge actual instead of estimated benefits, follow agency recommendations on indirect costs.

10. Leverage funds. Solicit funds from third parties, contingent on grant funding. This can be done in advance (to beef up cost share and make proposal more attractive), as well as after project is funded.

11. Get a sharp (toothed) reader. Best: someone unfamiliar with your field, your project. Not an editor/proofreader. Have them read final draft without taking notes. Then ask them to tell you--from memory--what the project will do, how it will do it, why it is significant, and how it is different. Rewrite proposal if these answers aren't clear and correct, or they don't flow effortlessly.

12. Write the abstract last. Put in your key innovation. Write 3 versions: one page (first page of proposal, whether requested or not), one paragraph (if requested), and one line, the proposal title—which you should think of as a mini-abstract (descriptive and intriguing). Don't repeat abstract or proposal text. Prepare for the possibility that some sleepy reviewer might read only the abstract.

Other good advice:
Request reviews. Use the phone to ask agency staff why the project was or was not funded. If you are rejected, you can always try again. If you get funded, let your agency help you. Brainstorming. Troubleshooting. Running interference with administration. Leveraging funds. Making you famous.

Help your agency.

Joan Straumanis
Former FIPSE program officer
and currently Dean, College of Arts and Sciences,
Lehigh

See also: “The Art of Scientific Writing,”

http://www.writing.eng.vt.edu/courses/grad_writing.html
Reviewing Manuscripts

1. Read abstract carefully to identify goals, approaches, and key results of study.
2. Read text through once quickly, noting subsection titles, key topic sentences
   A. Focus on figures, captions and conclusions.
   B. Try to develop overall feel for arguments being made, strength of data
3. Read text through again carefully, making notes in the margins
   A. Look for positives and negatives
   B. Introduction - should be concise literature review of relevant papers that can lead interested reader back through previous work in area, not just authors'. Should set the table for importance of what was studied.
   C. Experimental - should be concise review of what was done. Sufficient detail to allow reproduction by others. Reference to other available literature (incl. theses) is OK. Ask yourself: Are these the methods that I would use to answer the questions posed in the Introduction? What are the common weaknesses or limitations – look for evidence of these in the Results.
   D. Results - an organized stating of the experimental data or calculations. No interpretation should be included, that is the province of the Discussion. The figures should be able to stand on their own due to good design and a descriptive caption.
   E. Discussion - a concise analysis of the data presented in light of the questions posed in the introduction and the relevant literature. Ask yourself: Do the authors present discussions that are consistent with ALL of their data? Are the points raised well-reasoned and consistent with what you know of the literature and basic principles? Are conclusions made that are NOT reasonable based upon the results presented and the literature cited?
4. Draft review
   A. If given specific format, use. Make sure that all questions posed are answered.
   B. Where appropriate, enumerate comments and questions to the authors. This approach allows the authors to address each in turn and helps the editor determine the quality of their response.
   C. Be as specific as possible with questions and comments. Note the page, paragraph, and line number to which your comments refer.
   D. Remember that there are lots of ways to tell someone you think that they are full of it. Choose the least offensive, if for no other reason than you could be wrong. Do not give the authors a free pass, but remember that one of your responsibilities as a reviewer is to help the authors make their manuscript better.
   E. Set aside for a day, then review your review. Try to clarify any potentially confusing points. Check tone for high level of professionalism.
5. Send review to editor/program manager online
   A. Make sure you fill out the proper form.
   B. Include a brief summary of your decision in Comments to the Editor (make sure these are confidential)
   C. Destroy your review copy – you can extract references of interest, but the rest should be disposed of.

Last Revision: 2/15/15
Graduation Checklist

i.e., RGK will sign thesis if and only if ALL of the following are completed:

1. Completed corrections in thesis, checked off by each committee member

2. Order placed for copies of thesis (including leather binding):
   a. Those required by University (3: Alderman, Clark, Dept.)
   b. One for Lab
   c. One for RGK
   d. One for you

3. All files removed from network onto permanent media
   a. Labeled, with a printed directory in addition
   b. An explanation of what each file contains, including any relevant references to thesis figures/text or page numbers in lab book

4. Draft(s) of papers agreed to with RGK, including figures, on separate media

5. Provide RGK with copy of completed resume and next location (address and phone number)

6. Copies of literature papers used, including bibliographical information
   a. Any loaned books, etc. should have cover page copied and source noted before being returned.

7. Agreement on date to vacate both lab and desk space with lab materials boxed, distributed or disposed of properly, INCLUDING CHEMICALS

Last Revision: 2/15/15
Appendix A

Graduate Student Activities Report

January, YEAR - December, YEAR

Name:

Current Degree Program:

Start Date:

ACADEMIC

Courses Taken/Grades:

Degree Program Cumulative Credits and GPA at Year-end:

Comprehensive Examination Passed:

Teaching Assistantship:

RESEARCH

Ph.D. Proposal Completed:

Journal or Book Papers Published/Submitted:

Last Revision: 2/15/15
Progress Reports and Proposal Sections Written:

Talks Presented:

PostersPresented:

Equipment Designed:

Computer Programs Written:

Papers Reviewed:

SERVICE

Group:

CESE/Department:

National Society:

Name up to 2 students whose assistance has had a major positive impact on your research. Briefly describe the interaction.
OTHER

Awards:

Description of Important Accomplishments:

Primary Goals for Upcoming Year:

Anticipated Graduation Date:

Last Revision: 2/15/15
## Appendix B: Feedback on Kelly Mentoring

<table>
<thead>
<tr>
<th>TOPICS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intellectual Growth and Development</strong></td>
<td></td>
</tr>
<tr>
<td>• Encourages my imagination and creativity</td>
<td></td>
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<tr>
<td>• Encourages my inventiveness including the identification of new research topics, discovery of new techniques, development of new apparatus and patentable inventions</td>
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<tr>
<td>• Helps me develop my capacity for logical reasoning including abstract and theoretical reasoning as well as my ability to draw logical inferences from observational and experimental data</td>
<td></td>
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<tr>
<td>• Helps me to be critical and objective concerning my own results and ideas</td>
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<tr>
<td><strong>Research</strong></td>
<td></td>
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<tr>
<td>• Shows me how to do original research</td>
<td></td>
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<tr>
<td>• Takes steps to improve my ability to conceive explanatory hypotheses and design critical tests of such hypotheses</td>
<td></td>
</tr>
<tr>
<td>• Takes steps to improve my observation of natural, technical, or social phenomena</td>
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<tr>
<td>• Provides constructive feedback on my experimental designs</td>
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<tr>
<td>• Provides thoughtful advice on my research</td>
<td></td>
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<tr>
<td><strong>Professional Career Development</strong></td>
<td></td>
</tr>
<tr>
<td>• Provides counsel for important professional decisions</td>
<td></td>
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<tr>
<td>• Is instrumental in building my professional networks</td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Feedback</td>
</tr>
<tr>
<td>--------------------------------</td>
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<tr>
<td>Provides guidance on professional ethics</td>
<td></td>
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<tr>
<td>Promotes collegial relationships with professional community</td>
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<tr>
<td>Helps me to envision a career plan</td>
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<tr>
<td>Provides guidance on finding a job or postdoctoral appointment</td>
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<tr>
<td>Provides guidance on a full range of career options or referral</td>
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<tr>
<td><strong>Academic Guidance</strong></td>
<td></td>
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<tr>
<td>Provides sound advice in planning my courses and curriculum relative to my career goals</td>
<td></td>
</tr>
<tr>
<td>Provides sound advice on my academic goals relative to my career plans</td>
<td></td>
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<tr>
<td>Discusses pitfalls in my academic growth</td>
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<tr>
<td><strong>Skill Development</strong></td>
<td></td>
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<tr>
<td>Takes steps to develop my planning and organization, communication, teaching, and team-leadership skills</td>
<td></td>
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<tr>
<td>Provides constructive feedback on presentation skills</td>
<td></td>
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<tr>
<td>Provides constructive feedback on writing skills</td>
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<tr>
<td><strong>Personal Communication</strong></td>
<td></td>
</tr>
<tr>
<td>Listens carefully to my concerns</td>
<td></td>
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<tr>
<td>Keeps in touch on my progress</td>
<td></td>
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<tr>
<td>Requirement</td>
<td>Feedback</td>
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<tr>
<td>-------------</td>
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<tr>
<td>Takes into account gender, ethnic, and cultural issues</td>
<td></td>
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<tr>
<td>Takes a respectful attitude toward my interests and work</td>
<td></td>
</tr>
<tr>
<td>Does not abuse power--does not take advantage of my time and abilities</td>
<td></td>
</tr>
<tr>
<td>Provides feedback in timely fashion</td>
<td></td>
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</tbody>
</table>