Report on the NSF CAREER Workshop for Materials Scientists and Engineers

June 17-18, 2013

NSF Headquarters, Arlington, VA

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# Table of Contents

- Workshop Objectives and Motivation ........................................ 2
- Workshop Participants and Organizing Committee ...................... 3
- Workshop Format ........................................................................ 5
- Topical Summaries ..................................................................... 6
- Workshop Survey Results ............................................................ 26
- Recommendations for Future Workshops .................................... 27
- Appendix .................................................................................. 32
1. Workshop Objectives and Motivation

The Faculty Early Career Development program is NSF’s most prestigious award in support of early-career faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. CAREER awards are given to PIs who are deemed to have the potential to be leaders in their field. However, not all CAREER awardees achieve their potential. Some of the reasons may be: a lack of mentorship and/or role models, not having the skills or confidence to pivot to new areas, lack of information on how to develop other creative outlets, like entrepreneurship, or trouble achieving the right work-life balance. This workshop sought to build upon NSF’s initial investment in these early-career faculty and to assist CAREER awardees in continuing their paths to research and teaching leadership in their fields by providing them with information and support that would allow them to successfully transition beyond the CAREER award in terms of their ability to obtain further funding and become part of the next generation of leaders.

The workshop aimed to accomplish this in two main ways. First, the participants (CAREER awardees involved in materials-related research and finishing the 3rd year of their award) were provided information about NSF operations, funding priorities, and initiatives that would better position them to promote their research and take advantage of funding opportunities. Secondly, the participants received mentoring from renowned professors, department chairs, and former CAREER awardees, along with NSF program directors. Establishing connections with these role models provided an opportunity for career advice that will hopefully develop into meaningful and sustained relationships. Additionally, we hope this workshop encouraged the CAREER awardees to network among themselves to form connections, which may lead to new research collaborations.
2. Workshop Participants and Organizing Committee

The primary workshop participants were CAREER awardees completing their 3rd year of funding (those with start dates in 2010) in the Division of Materials Research (DMR) and selected year 3 CAREER awardees in the Divisions of Chemistry (CHE), Mathematical Sciences (DMS), and Civil, Mechanical and Manufacturing Innovation (CMMI) who perform materials-related research. The total number of invited participants was 78, with 44 participants from 37 different institutions choosing to attend the workshop. In addition, the four organizing committee members and five additional senior scientists with a strong track record of success in research and education served as mentors. Finally, a graduate student and a postdoc served as scribes. (Please see the full participant list in the Appendix.)

The pie charts below highlight additional information about the participants, specifically A) male-to-female ratio of CAREER awardees attending, B) CAREER-awarding NSF division of the participants, and C) CAREER-awarding NSF programs of the participants funded by DMR.
The organizing committee consisted of four members, including the two co-chairs (Joe DeSimone and Vidya Madhavan).

**Joseph DeSimone** (Co-Chair), Chancellor's Eminent Professor of Chemistry at the University of North Carolina at Chapel Hill (UNC); William R. Kenan, Jr. Professor of Chemical Engineering at North Carolina State University and of Chemistry at UNC; Director, Frank Hawkins Kenan Institute of Private Enterprise at UNC. DeSimone emphasizes diversity as a fundamental tenet of innovation and has managed his research group based on this principle throughout his career. He has mentored over 50 students through the completion of doctoral degrees in the fields of Chemistry and Chemical Engineering; half of these students have been from underrepresented groups in the sciences. This record formed the basis for DeSimone’s receipt of the AAAS Mentor Award in 2010. He also received the prestigious Lemelson-MIT Prize in 2008, known as the “Oscar for Inventors”. DeSimone is a member of the National Academy of Sciences (2012), the National Academy of Engineering (2005), and the American Academy of Arts and Sciences (2005).

**Vidya Madhavan** (Co-Chair), Associate Professor of Physics, Boston College. Her research is focused on scanning tunneling microscopy and spectroscopy of quantum materials like complex oxides and topological insulators. Her outreach activities have been focused on high school students as well as teachers. She has been collaborating with the Lynch School of Education at Boston College with whom she has an NSF-NOYCE grant, to place trained science teachers into urban schools in the Boston area. She was awarded the NSF-CAREER Award in 2007.

**Sarah Heilshorn** (Committee Member), Assistant Professor at Stanford University in the Departments of Materials Science and Engineering, Bioengineering (by courtesy), and Chemical Engineering (by courtesy). Her research focus is the design of multifunctional materials that are inspired by biology for applications in energy and medicine. She was awarded the NSF-CAREER Award and the NIH New Innovator Award in 2009.

**Eric Hudson** (Committee Member), Associate Professor of Physics, The Pennsylvania State University. Prof. Hudson’s research focuses on atomic scale investigations of complex materials, such as high temperature superconductors, using scanning tunneling microscopy. His education focus is on transforming introductory science courses using research-based scientific teaching, with a focus on peer mentoring enabled active learning. He received the NSF-CAREER in 2003.
3. Workshop Format

The workshop was spread over two days and consisted of a combination of talks from mentors and NSF personnel, as well as panel discussions and interactive sessions with mentors in interdisciplinary, small-group formats. The technical content of the workshop focused on professional development topics common to a wide range scientific disciplines (e.g. entrepreneurship, social media, the NSF budget process, innovation in teaching). This was conveyed through three main mechanisms – oral presentations, panel discussions, and breakout sessions.

For the breakout groups, participants were divided into interdisciplinary groups of 5-6 led by a mentor. The mentors were given a list of guiding questions for each breakout topic (see section 4 on topical summaries). Each group designated a scribe, whose job was to type notes during the discussion into a shared Google Drive file, which could be viewed by all workshop participants. A designated synthesizer wrote a few brief key points on flip charts and reported a summary of their group’s discussions to the group at large. The breakout groups were rotated the second day of the workshop so that each participant got to interact with at least two mentors, and no two people were in the same group as one another both days.

Social time was provided, including an ice breaker at the hotel bar the night before the workshop, time to mingle during breakfasts and morning and afternoon coffee breaks, a wine reception and dinner after the first night of the workshop, and small group lunches. Participants were allowed to sign up in groups of 6-8 for lunch reservations each day at different local restaurants, with one mentor joining each lunch group. Additionally, there was a meet-and-greet session with program directors to allow participants to interact with NSF employees in a casual setting.

A full agenda is available in the Appendix.
4. Topical Summaries

Session 1: NSF Initiatives and Operations

NSF Initiatives Related to Materials Science
Mary Galvin, DMR Division Director

• Science is social! You’re not signing up to be a monk. Networking enriches your life and your science.
• NSF has already made a substantial investment in you – they want to see you succeed and put their money to good use.
• NSF is an extension of the executive branch, with seven research directorates.
• Info about program directors is online – please reach out to them with questions about where you should be applying and what options for supplements are available to you.

Group/Institutional Awards
• **MRSEC** – Materials Research Science and Engineering Centers
  o High impact, high visibility
  o New proposals will be due in Aug 2013 (every 3 years for 6-year grant)
  o Reach out to use their facilities! Have large infrastructure open for others to use
• **PREM** – Partnership for Research and Education in Materials
  o Minority serving institutions, long-term collaborative partnership with DMR
• **DMREF** – Designing Materials to Revolutionize and Engineer Our Future
  o NSF response to Materials Genome Initiative – “twice as fast at a fraction of the cost”
  o Submission window Jan 15 – Feb 15
  o Go beyond simple collaborations to accelerate discovery
  o Iterative process between theory/simulation and experimentation
  o You may submit both an individual investigator award proposal and a DMREF proposal in the same fiscal year.

Individual Awards and Supplements
• **SusChEM** – Sustainable Chemistry, Engineering, and Materials
  o Preservation and extension of natural resources
  o Material replacement for a safer and more secure future
  o Improvements for extreme operating conditions
  o Zero-waste goal
• **I-Corps** – testing the commercial viability of NSF-funded research
  o $50k to “get out of the lab”
  o 3-month curriculum, entrepreneurial boot camp
• **EAGER** – EArly-concept Grants for Exploratory Research
  o High risk, exploratory, and potentially transformative research
Internally reviewed, may be submitted any time. Contact program officer before submitting.

- **RAPID** – grant for rapid response research of great urgency
- **AGEP** – Alliances for Graduate Education and the Professoriate
  - Projects focused on underrepresented minority grad students or post-docs
  - Supports 1 additional PhD student in an ongoing MPS-funded project
  - Must be affiliated with an institution involved in the project
- **CAREER**
  - Most prestigious award for junior faculty
  - Selected based on a plan of outstanding research and education
- **Career-Life Balance:**
  - No cost extensions or temporary extensions for family leave
  - Flexible due dates
  - Supplemental funding for personnel to sustain research when PI on family leave (CAREER and NSF post-doc programs) – up to 3 months of salary support ($12,000)
  - Remote panel participation
  - Child care recommendations for panelists
- **Research opportunities in Europe**
  - ERC maintains a list of research groups in Europe wishing to host CAREER awardees
  - NSF covers travel expenses for PI and qualified family members (for long term visits)
  - ERC provides subsistence costs and other project costs
- **CNIC** – Catalyzing New International Collaborations, run out of Office of International Science and Engineering
  - Supports participation of US researchers and students in activities intended to catalyze new international collaborations
  - Up to 12 months, proposals accepted any time
- **PIRE** – Partnership for International Research and Education
  - NSF-wide – all NSF supported disciplines
  - Supports high quality projects that **could not occur** without international collaboration
- **RUI** – Research in Undergraduate Institutions
- **GOALI** – Grant Opportunities for Academic Liaison with Industry
  - Promotes university-industry partnerships
  - Can send student/post-doc to work in industry, NSF only funds academic institution
  - Discuss with program manager before submission

Opportunity to mix these initiatives (individual and group, multiple individual supplements) if you can convince your program officer you qualify for both

Ideas for new grants and initiatives are based on agenda of the current administration or arise from the community. Workshops, meetings, and program officers can also direct initiatives. Must be a broad idea if you’re going to try to sell it “up stream.” Example: “Brain” project.
The Federal Budget Outlook and NSF
Beth Blue, NSF Budget Division Analyst

- The budget is basically a policy statement on what the administration cares about and the resources needed to achieve their goals.
- NSF budget request is made to Congress annually, followed by hearings on the Hill and briefings with staffers about why the NSF needs the funding where it was requested.
- While hearings are going on, the following year’s budget is already being drawn up.
- Available online:
  - Budget guidance memo from President’s budget office (OMB)
  - R&D guidance memo from OMB and Office of Science and Technology Policy (OSTP)
  - NSF and President’s budget request to Congress
- These documents may give insight on new initiatives coming down the pipeline at NSF. Ex. If there is a large allocation for sustainable chemistry in the budget, there may be a new directive that will soon be looking for proposals for sustainable chemistry grants.
- AAAS and other scientific societies will release their analysis of the budget each year
  - Especially good at highlighting these potential upcoming directives
  - Condense ~400 page budget to relevant parts for your scientific community
- NSF falls within the non-security, discretionary portion of the federal budget, which was about 12% of the total budget in Fiscal Year 2012. NSF makes up only a small portion (less than 2%) within that area.
- NSF is facing constrained funding in Fiscal Year 2013 (down 2.1% from Fiscal Year 2012); this is chiefly due to sequestration. By current law, sequestration is set to continue into Fiscal Year 2014, potentially resulting in an additional cut of an unknown amount.
- It is up to each directorate whether cuts result in fewer grants of larger size or the same number of smaller grants – up to each program director.
- NSF has made a commitment with 2013 sequestration not to decrease the size of existing awards at the expense of new awards, but this may not be the case for 2014. Fine print of grants says they’re always subject to re-budgeting.
- On the bright side, NSF is generally well liked on the Hill and has done relatively well in this difficult budget environment. NSF is viewed as being important to the country and has a good amount of support moving forward.

Session 2: Implementing Innovation

Strengthening Our Economy by Fostering “Convergent” Strategies in the Academy
Joseph DeSimone, University of North Carolina at Chapel Hill

This talk intertwined innovation, entrepreneurship and diversity. A number of key points were:
• There are significant unmet needs in society that creative, cost-effective solutions would be truly transformational towards improving the human condition and our economic well-being.

• There is an opportunity for faculty and students to take their careers and futures into their own hands and control their own destinies by considering entrepreneurial approaches to their research.

• It is imperative for our Nation to maintain a balanced research portfolio between mission-oriented and basic research focused on the pursuit of knowledge and understanding. There are opportunities for those of us principally focused on basic research to consider taking the initiative to apply our craft entrepreneurially.

• There are some clear entrepreneurial mega-trends that everyone should be aware of:
  o Individuals have never been more empowered considering the access to the internet and cloud computing and the opportunities to crowd source resources and ideas.
  o There is a tectonic shift to technology underway in society around the competitive advantage of clean technologies, massively distributed sensor arrays and big data; smart, mobile technologies (e.g. Google Glass); the mapping of the human genome; and the opportunities for technology to drive DOWN health care costs and enable global access.

• Researchers, just like businesses and thoughtful organizations, can apply Jim Collins’ “Hedge Hog Concept” to structure and leverage the impact of their work by focusing on Big Hairy Audacious Goals (BHAGs) that emanate from the cross section of the three lenses of passion, expertise and economic drivers.

• A key blueprint for innovation is the use of convergent strategies that bring together the life sciences, physical sciences, social sciences, engineering, humanities, and even the performing arts. Building off the idea of convergence, there is a key recognition that diversity is a fundamental tenet of innovation since we learn the most from those we have the least in common with.

• Building off of Hoffman and Casnocha’s book The Start-Up of You, individuals can manage their careers as if they were start-ups: Invest in yourself, build professional networks, take intelligent risks, make uncertainty and volatility work to your advantage; especially when you focus on the necessary skills of being a systems thinker, thinking globally, and being competitive.

• There are significant benefits to academics being entrepreneurial beyond the obvious ones of improving the health and well-being of society and economic development that includes:
  o Entrepreneurial activity can improve one’s science since it is actually peer-review on steroids.
  o It can be a compass for where important problems are.
  o Entrepreneurship provides a mechanism to improve grantsmanship including fostering more articulate value proposition statements.
  o Entrepreneurial success is a vehicle for translating research into the market place where one can improve the health and well-being of society.
Panel Discussion #1: How to Be Competitive in Future Proposals
Joseph DeSimone, University of North Carolina at Chapel Hill
Paul Weiss, University of California, Los Angeles
Arun Bansil, Northeastern University
Andrew Lovinger, NSF Polymers Program Director

Core of a good proposal:
- Start with an idea that gets the reviewers excited; present your science in a way that draws people in. If you can get people to care about what you’re doing, they’re more likely to get behind it.
- Make the scientific impact of your project clear to both experts and non-experts.
  - Choose projects that look like they will have an impact, broadly or in advancing your community.
  - Choose relevant topics, paying attention to current environment.
- Keep your broader impact statements fresh – don’t keep reusing the same impact statements. Individualize your broader impacts.
- Be very careful and follow all directions and requirements for the solicitation and granting agency.
- DON’T HESISTATE TO TALK TO PROGRAM OFFICERS!!
- Serve on panels that are reviewing proposals for other grants – this will give you a great idea of how proposals are looked at and what basic mistakes you can avoid.

Renewals and Multiple Grants:
- Point out what the unsolved questions are and what the impact moving forward will be.
- If you have a previous NSF grant on the same topic, talk about where the research has made an impact due to that funding.
- While funded by a CAREER award, you can still get other NSF funding. Funding is always at the discretion of the program manager/director, so talk to them about whether they hold CAREER awardees to a higher standard (since they already have funding). You are more likely to get a second NSF award (while on the CAREER award) from a different program or division.
- Applying for a 2nd NSF grant while you have another one going on will always be more difficult – they will hold your proposal to a higher standard to attempt to spread the money around, but if you have a brilliant idea, it can still get funded. (This is most applicable if you apply to the same program.)
- Make sure concurrent proposals are different!
- Reviewers will judge success of prior results/grants when considering new grants
  - Did you use your money wisely?
  - Was there a return on their investment? (papers, patents, advances in the science)

Instrumentation Grants:
- Show how an instrument will influence your work, other faculty at your institution, and faculty/scientists in the surrounding area. “Me, me, me” will not get a large instrument grant funded
- Consider involving multiple PIs.
• What is the geographic need vs. availability?
• FOLLOW DIRECTIONS – address all points asked for in a grant – don’t get disqualified for trivial reasons.
• Address why this hasn’t been done before and how you plan to avoid and overcome the pitfalls of the past.
• Get comments, especially from people outside your field.

Avoiding Overlap with Established PIs
• Strategy is all about being different – highlight what new technique or aspect of the research you will focus on.
• Integrate a social science component into the physical science problem
  o Leadership training for students/post docs
  o Community outreach
  o Applications to teaching/education
• Focus on having an element of renewal to your project, where the science is going not only in the next 1-5 years covered in the grant, but beyond that – sustainable science.
• Be nimble about where you and your colleagues are uniquely capable
  o May involve bringing in other faculty at your institution
  o Utilizing resources in your area
  o Why does this grant make more sense given to someone in your position instead of someone at a similar institution elsewhere?
• Adversity builds character – failures will help you learn and will improve future proposals, papers, etc – don’t rest on your laurels

International Proposals
• NSF and other federal agencies are reluctant to fund international projects – look outside of these areas for support:
  o Industry
  o Other country’s government (especially if they are sending students here)
• After being awarded an NSF grant, you can apply for supplements for international collaborations
• Sabbaticals are very important – your department should offer funding support, either a percentage or a certain time allotment
• Humbolt fellows – funded postdocs from Germany
  o May be good outreach

Funding outside of the NSF
• Think broadly – where can you accelerate advances with the right program put together? Can your technique be applied to multiple different problems?
  o Other big agencies – ONR, DARPA, other DOD, DOE, NIH
• Be proactive: If you see a big potential breakthrough on the horizon, don’t be shy about shopping it around. When a funding opportunity for that arises, your name will be associated with the idea already.
• Know how to leverage what you’ve done and what grants you’ve already gotten when approaching other agencies.
Session 3: Publicizing Yourself and Your Research

Science Storytelling
Maria Zacharias, NSF Public Affairs Specialist

The focus of this talk was on how to publicize your research, in particular in discussions with the media. Highlights included:

- **The Elevator Pitch**
  We must communicate with people who don’t have a science background as well as those who do, so being able to quickly summarize your research interests in a variety of short pitches is crucial.

- **Making it Interesting**
  To capture the attention of non-specialists, good visuals are really important, as are connections – why is the research relevant to the listener, how might it connect to their lives now or in 20 years?

- **Working with Public Information Officers**
  Most institutions have a public relations office, and it is worthwhile to take advantage of this resource to publicize your work. Make sure that you give them lots of time to get the word out (contact them as soon as you have some exciting research, not a day before the publication is to appear).

- **Talking to the Media**
  A number of participants had experience talking to the media (NY Times, Washington Post, NPR) and several had unfortunate experiences where they felt their words weren’t accurately represented. Some places will allow you to vet the article before publication, but even those that typically won’t (like NYT) will often appreciate an offer of help for fact or quote checking. It is helpful to keep it friendly – think of the interview as a discussion rather than an interrogation. Make sure to PREPARE – know what they are going to ask, have multiple ideas of how to answer it, and have prepared three main points you want to convey. Finally, never say anything (even “off-the-record,” which the speaker strongly advises against) you wouldn’t want to read on the front page.

- **Social Media**
  Facebook is a good way to communicate, especially with images and videos. On NSF’s page they get many ‘likes’ and comments. Twitter is an effective way of driving traffic to websites – just make sure that your website is ready for it.

Listed below are contact information for NSF public affairs personnel and some useful websites:

Contacts: Maria Zacharias – mzachari@ NSF.gov ; Ivy Kupec (new OLPA liaison to MPS) ikupec@ NSF.gov


Science Nation video re: metal foam:
Defining Yourself and Your Work
Paul Weiss, University of California, Los Angeles

Paul Weiss spoke on the topic of defining yourself and your work. A key point of emphasis was that science is a social activity. A consequence of this is that your online presence, in person presence, and published scientific presence are inseparable. Therefore, you need to take responsibility for your scientific and academic image. This means consciously deciding how to define and to promote yourself and your science. In order to be impactful, this must go beyond facts and numbers to include a personal and memorable connection. Specific pieces of advice included:

- Establish networks of people you trust.
- Choose tasks that are fun and rewarding for you.
- Choose collaborators that are experts AND people you like.
- Your biosketch is boring; define yourself beyond facts.
- Define your own comfort level with social media. If you are comfortable with it, social media can be a great tool to enhance your scientific network.
- Take what you do in science and translate it into English, *i.e.*, non-technical language.
- Higher functioning scientists and engineers do EVERYTHING (they choose to do) well, efficiently, and quickly. Become known as someone who is effective. For example, higher functioning scientists tend to respond to journal referee requests much more quickly than others.
- You are responsible for your scientific and academic image – you, your career, your science, your presentation, and your online presence are inseparable.
- Become a good communicator. Strategies include taking an improv class (learn to say, "yes, and...") , going on development trips with your dean, taking a workshop on science communication, developing relationships with science reporters, getting videotaped and watching it, and working with journal media offices.

Breakout Session #1: How to Be Strategic About Planning for the Promotion Process

The objective of this break out session was to stimulate a discussion on the tenure process, provide feedback and advice to pre-tenure PIs on obtaining tenure, provide feedback to post-tenure PIs on the promotion to Full Professor and discuss best practices. The following were some suggestions for questions to be explored although each group was free to pursue any related topic.

1) What are the common reasons to get denied tenure?
2) How do you recognize the warning signs that things are not going well?
3) When should you start looking for another position?
4) When should you apply for promotion to full professor?
5) Who are your best advocates/mentors inside and outside your department?

Below are some common themes and strategies for the tenure/promotion process, as summarized from the reports provided by each small group.

- Letters are extremely important. The PI is always provided with an opportunity to suggest names and these names must be picked wisely. Good reviewers/letter writers should be ‘arms length’ from you (i.e. not your father as an extreme example).
- It is important to have a senior person in your department who is your advocate.
- Know the system, and don’t worry about looking to faculty ahead of you for the standards, because all departments are trying to get better. There is no universal checklist, so it is important to familiarize yourself with the culture at your institution. Find out if you are allowed to see the letters that come in for you, are you allowed to see summaries from the committee, etc. While it is important to publish well and get well funded the details of what this means may differ from department to department.
- When you first start writing proposals make sure other people in the department read them and give you advice.
- The important role that mentors play was emphatically emphasized multiple times. You should have mentors both within and outside the department. The role of a departmental mentor is to help you navigate many aspects of the tenure and promotion process. There is nothing that can’t be undone given sufficient time, so a mentor can help you figure out if you need to correct something early on.
- It is important to be a citizen in your department or community. Make sure you perform department wide and university wide service as well as service to your scientific community like organizing symposia (to demonstrate leadership for promotion). Mentors can help facilitate this since senior people get flooded with requests to organize and they are more than happy to hand it off or get help.
- A third-year review can be extremely useful. You could request one if there is no official review in your department.
- Graduate as many PhD students as you can.
- Find ways to make yourself visible to your community other than publishing papers. Invite renowned scientists for seminars who may serve as your references for your tenure promotion. Serve as a reviewer for proposals; know experts in your field. Get yourself invited to give seminars and talks at meetings. You can promote yourself by asking friends and mentors to invite you and also writing to meeting committee chairs and publicizing your work.
- Going up for tenure early has the risk that higher standards may be applied to you. This should only be done with the full support of the chair and the department.
- Anecdotally, the typical time to apply for promotion from Associate to Full is approximately one to five years after tenure, although the standard deviation on this is very large. But this timing depends on many factors like your leverage in the department, star status, grants, leadership roles – can you champion large scale grants; service, etc. It is important to talk to your department chair and ask what the expectations are. It is also important to make sure you have a mentor for this stage.
**Keynote Talk**

**A Career at MIT – the Things I Did Wrong and Still Survived**  
Marc Kastner, Massachusetts Institute of Technology

Marc shared a host of information about his career and provided a number of specific examples and entertaining stories highlighting his path from 16-year-old aspiring lawyer to an undergraduate degree in chemistry to graduate school in physics. Perhaps a unifying theme of his talk was his humble admission of his total lack of research “hands” but absolute devotion to the success of his students and postdocs, and as an administrator, his fellow faculty.

- Marc grew up with a father physicist in a working class neighborhood surrounded by neighbors working in the steel mills of Cleveland.
- In high school junior chemistry, Marc and his lab-mate were waiting for something to come to a boil. His friend expressed that he wanted to go to MIT. Marc said he would never go to such a nerdy place. The teacher overheard the conversation and quickly put in his two cents “Kastner, you’re not smart enough to go to MIT.”
- Marc’s father advised majoring in science, because you could still do patent law, and still have additional career options if law didn’t work out.
- Several times throughout his talk, Marc explained his capacity to break everything. “I was all thumbs.”
- Marc shared a story when he had applied for a Hertz fellowship, which at that point was administered by Edward Teller himself, the father of the hydrogen bomb. He thinks his asking many questions about Teller’s research played a role in his winning the fellowship. The key point being that you should ask about other peoples’ research, and actively listen to the response, probing deeper to show your interest and comprehension.
- Marc shared several times how important it is to have good mentors. He received significant help from his in identifying career paths.
- Marc pointed out several instances when he got lucky in his research. He said that you need to have some luck, but you also need to recognize when you have been lucky.
- When through with his postdoc, he sought a faculty position at MIT. After interviewing there he didn’t hear back for months. Eventually, upon calling the chair, he learned the position had been offered to someone else. Months later, out of the blue, he got a call asking if he was still interested as the other person had turned it down. So he headed off to a faculty position at MIT, with one condition – he was told he had to stop working on amorphous semiconductors. The chair felt he was looking out for Marc because his contacts at Bell Labs thought the field was not very exciting. After a couple of years trying other things, he returned to working on amorphous semiconductors and did the work that earned him tenure. The key point is that you should seek advice, but you don’t always have to listen to it.
- A key to this work was the importance of lone pairs of electrons in group VI elements. The main point is that it’s important for you to have something unique. Chemists know all about lone pairs of electrons, but the physics community hadn’t brought in that knowledge, and Marc only made the connection because of his unique background of having a chemistry bachelor’s degree.
• In his first few years, Marc was worried that he might not survive at MIT. He was trying to keep two projects going, one project himself and one for a grad student. But Marc wasn’t good in the lab and couldn’t get enough continuous time in lab to get anything done. He realized he would have to delegate all research to grad students, which worked, because he has had excellent ones. At that point he realized he was becoming a research administrator.

• Marc offers new students a 6-month trial period in his group. This time allows both Marc and the student to assess if they’re a good fit for one another.

• Despite his success, Marc had little advice about time management. He said there are no magic bullets. All you can do is work at it very, very hard.

• By three years after he started, Marc was starting to get really fantastic graduate students and for the next five years sending trainees off to IBM or Bell Labs. This was when he started to get cocky. He made some comments at a conference that angered senior people in his field and, he later learned, complicated his tenure case. The take away from this story is that you must be very sensitive about how you discuss the work of your competitors. This includes paying special attention to references in papers and grants to avoid unnecessarily aggravating any of your colleagues.

• Marc highlighted the importance of having friends in the field. You may not need many, but they must be close and reliable. He recalled Dan Kleppner telling him that when you receive a prize, “It means you’ve done some pretty good work, and you have some really great friends.”

• Marc shared several thoughts about mentoring. He indicated that all PIs worry if they’re doing it adequately. At one point Marc tried to talk a junior faculty member out of a crazy experiment that Marc thought would ruin his career. The faculty member ignored him, but the experiment worked, and was what essentially got him tenure. Again, you should listen to offered advice, but you shouldn’t always follow it.

• Marc says it is a joy to help students and postdocs build their careers, so he was reluctant to do other things, beyond being a faculty member. The first time he took an administrative position it was simply because he was afraid of who else might take it. But an additional joy is that as an administrator you learn about parts of science you didn’t know existed.

• In order to run things, you must have fantastic staff to whom you can delegate work. A big failing in the research community is that we don’t teach management skills. But from the day you start as a faculty member, you’re running a small business, and you don’t get trained for it at all. Marc suggested finding an administrative assistant and learning how to use that person to offload anything you can. He pointed out that his success as an administrator is primarily because his first response to any task is “Who can I give this to?” Only if there is no one else, will he do it himself.

• In closing, Marc indicated that there are lots of ways to succeed. Intelligence is only part of it. Marc believes that his greatest skill was not doing science, but managing scientists by choosing great students and postdocs to whom he gave impossible problems. They solved those problems, and then gave Marc lots of thanks.

• In response to a request for advice on transitioning from associate to full professor, Marc said that once you have tenure, you should only think about what is most exciting to you. It is very difficult to break new ground in science – you have to be really passionate
about what you’re doing. Many researchers only become famous after they get tenure, and it’s because of their work in a new area.

- When asked about how he became such a fantastic mentor, Marc replied that he didn’t really know. He said he spent a lot of time with his trainees. He listened to them. He treated them like equals. As soon as they join Marc’s group, he treats them the way he would treat a colleague. They should be encouraged to tell you when you’re pushing too hard (or not hard enough.) Marc believes that only if you treat them this way will they have room to grow.

**Session 4: Effecting Change in the Classroom and in Research**

**Pivoting to New Areas of Scholarship**

Bennett Goldberg, Boston University

This talk was focused on formulating career goals and finding pathways to achieve them.

The speaker designed a survey, which the participants filled out on the day prior to the talk (results of the survey can be seen here: [http://prezi.com/r6agqghjkgjar/?utm_campaign=share&utm_medium=copy](http://prezi.com/r6agqghjkgjar/?utm_campaign=share&utm_medium=copy)). The survey had questions on the current percentages of time spent in various aspects of scholarship, size of group, current funding level, and output in terms of papers published. The participants were then asked to project answers to these questions into the future (5 years from now). The participants were also polled on what they constituted as change and what they determined to be pathways to change. In general, the participants felt that the percentage of time spent of research, proposal writing, training and service was unlikely to change much in the future. On average, the participants projected a 35% increase in funding level and a corresponding increase in group size from 7 to 10 people (including undergraduates, graduates and post-docs). The participants also reported that while a large percentage of their current funding was coming from NSF, they would like to diversify to other agencies like DARPA and DOE in the future.

Most participants thought that their mix of research, teaching and service was likely to change in the next 5-7 years. The pathways to change that were determined to be most effective were collaborations within and outside the department, hiring expertise, and sabbaticals. Surprisingly, the driving forces for change stressed new science, new collaborations, and new approaches to solving problems over new funding opportunities.

After summarizing the survey questions, the speaker presented some career advice:

- Lesson #1: make friends/collaborators and share everything – share space, share students. You learn more from your peers than you can on your own.
- Lesson #2: with a little reading, some chatting, and a lot of chutzpa, you can be an expert in anything. It is useful to think about your “scholarship” as you think about your other research problems. What is your hypothesis? What are the learning outcomes?
• Lesson #3: train the next generation – graduate students and post-docs need training in teaching
• Lesson #4: find your own lessons

In the discussion afterwards, the following question was raised:

*Why would someone want to come and administrate? Dean, provost, etc.*
The answer was: Doing science is interpretable in many different ways. Learning about new ideas and engaging in them at many levels. Playing a small part in bringing together scientists and enabling science that goes beyond his laboratory walls can be really rewarding. Administration enables you to do things you can’t do on your own. Administration may enable you to solve the problems you care about? You want to give people problems that are too hard for them to do so they learn. Service is a big part as well.

**Breakout Session #2: Your Pathway to Change: Critical Junctures and Appropriate Balance**

This breakout session was focused on transitions in one’s career and the approaches and tactics that individuals take along the way. The discussion was prompted by the organizers who asked the breakout groups to consider two questions:

1. What do you think you need to be doing 5 years out?
2. How will you get there?

There was a wide range of responses. Several general comments emerged from many of the participants, and these included:

• There was some discussion regarding what we meant by change. What constitutes a significant degree of change? Does changing research directions mean going after something completely new? Does taking one’s own technique into a different field or context constitute a “significant” degree of change?

• There was significant discussion around how one actually breaks into different funding agencies. It was identified that each funding agency (e.g. NSF, NIH, DOE) has its own norms and approaches to grant writing and that many of these are not easily discernible from reading the RFAs. As such, it was suggested that one should actually get examples of successful grants written by others to use as examples and to ask successful grantees to read your drafts for critical assessment, especially pointing out the compliance with norms of the identified agency.
  
  ○ It was suggested that one shouldn’t wait for BAAs (broad agency announcements), but rather look at what workshops agencies are holding as a way to stay ahead of the curve.

• There was significant discussion regarding how one should approach entering into new fields. Should one do this on their own or in partnership with collaborators? Does it make sense to hire a postdoc into your group who has expertise very different than yours?
o There was an example given where one materials scientist tried to take their expertise in materials science and apply it to nano-medicine. The materials scientist found a “collaborator” in the School of Medicine and they decided to collaborate. The materials scientist’s group made some materials and sent them to the physician’s group for analysis. Many weeks later the materials scientist called the physician to check the status. The physician said it didn’t work and so the materials scientist asked, what do you mean? The physician said simply that it didn’t work. The point of the story was that to truly bridge into new fields one often has to commit to learning much about that new field in order to really make a contribution.

o There was a question regarding how one could recruit great graduate students or post-docs to do something you yourself didn’t know anything about. It was suggested that one could reach out to friends and collaborators in other departments and agree to fund their students for a period of time (6 months - 1 year) in order to collaborate with that colleague through the new joint student. It was discussed that you can also be successful by hiring a post-doc for a new project if you find someone who wants to learn something new.

o Sabbaticals were also discussed as a really attractive way to learn about a new field. It was identified that this can be a great experience for “reinvigorating your research” and getting proposals done.

• There was a wide-ranging discussion of how one decides who to collaborate with. The challenge is that you’re always thinking, are we going to have more success together or do you really need this other person to make this work? Can I do it on my own? Do you always look for collaborations that are far enough apart that you need each other? “Positive interdependency” was identified as an important way to consider the situation. And that it is important to find someone you like to work with - “life is too short to work with assholes.”

o It was also asked, when you’re working with friends, how do you distinguish friendship from work? People suggested that you want to be in a collaboration that is mutually beneficial and that you should talk about expectations before getting into the work/publications. Author lists are a great place to discuss expectations. Who is the lead author? Lead institution? Senior author? May divide by what area/field the paper will be published in. Always share the potential down the road.

• One last point to make related to the motivators for change, it was surprising to some of us that most people didn’t think new funding opportunities wouldn’t drive change. It was postulated that some funding opportunities come too late to get into a new field; basically suggesting that once a funding opportunity is committed to an RFA, that those monies are destined for groups already in the field and if you are not yet, you are too far behind and it is too difficult to catch up.
Innovations in Classroom Teaching and Effecting Change  
Eric Hudson, Pennsylvania State University

This talk and discussion focused on introducing active learning techniques into the classroom, with a more intensive discussion on the use of clickers. Participants were found to teach a variety of classes, with about 60% teaching a mix of undergraduate and graduate classes and the others split roughly evenly between a focus on undergraduate and graduate courses. 10% focused on large, introductory courses. Only about a quarter of the participants indicated that they had used innovative teaching techniques themselves (of any kind).

- Research-Based Teaching
  Evidence was presented on why lecturing isn’t an effective teaching technique (low retention, rapid loss of attention). This is also evident in other fields, like sports and music, where people learn through doing, not through passively watching.

- Active Learning
  A wide variety of active learning techniques exist, and they were not discussed in any detail. However, the speaker presented evidence from his own work at MIT and PSU that changing from lecture-based to active learning techniques dramatically improved student learning gains.

- Clickers
  This one technique was discussed in detail. About a third of the participants had used clickers themselves and another third had seen them used by others. Many benefits of using clickers were discussed – particularly in increasing transparency of student understanding (to the faculty, to other students, and to themselves). Several concerns about clicker usage were discussed:
    - Too many student issues (dead battery, forgotten clicker) – the speaker addresses this by allowing full credit for attending half the classes.
    - Too expensive for students – not compared to textbooks, and much less so if your university can standardize so students can use them in multiple classes.
    - Challenging to write questions – yes, it is, but there are many resources available, particularly for intro classes.

As with all changes, there is a barrier to changing the way we teach in the classroom. But enough people have paved the way on many active learning techniques that the barrier is pretty low. Find a technique that you feel will work best in your situation and try it!

Panel Discussion #2: Effecting Change in the Classroom and Outreach  
Eric Hudson, Pennsylvania State University  
Bennett Goldberg, Boston University  
Sarah Heilshorn, Stanford University  
Arun Bansil, Northeastern University  
Frank Snowden, University of Minnesota  
E. Dan Dahlberg, University of Minnesota
This panel was intended to help participants think about “broader impact” activities of education and outreach. Though the title of the panel discussion was “Effecting change in the classroom and outreach,” virtually all of the discussion was a continuation of the previous discussion on transitioning to the use of active learning. Below is a summary of the highlights of the session.

- **Using Active Learning**
  Participants expressed widespread interest in active learning techniques and addressing possible difficulties. For example:
  
  o *How do you cover all material when using a more disruptive technique?*
    As a professor it is your responsibility to manage the discussion and keep it on track. Of course, less material will be “covered” in this technique, but the material covered will actually be learned. So don’t try to squeeze in extra material quickly, instead give students the resources to learn that material outside of class (through the textbook, office hours, homework assignments).
  
  o *How do you justify to students the extra prep time they must expend?*
    Experience shows that the total time expended is similar in active and passive learning populations. Students need to be told (shown data) that pre-class reading enhances their performance.
  
  o *How are high achieving students helped by these techniques?*
    The extent of this improvement was debated by the panel with some saying they aren’t helped as much (but not hurt) and others saying that they make large gains because teaching (in a peer tutoring situation) is the best way to learn.
  
  o *Are active learning techniques beneficial in smaller-scale classrooms?*
    Yes, though you may change which techniques you choose to use. One panelist, for example, teaches a small class where students work together to solve open-ended problems based on real-world issues, taking advantage of peer learning.
  
  o *How about in advanced classrooms, like graduate classes?*
    Absolutely. One of the panelists uses it in a graduate class with students from many different backgrounds, enabling her to do meaningful, deep problems by having students work together, teaching their peers based on their own varied backgrounds.

- **MOOCs**
  The use of other educational innovations were also discussed. The benefit of Massive Open Online Courses (MOOCs) was questioned. Although at the early stages they were often no more than “video lectures” and thus not taking full advantage of the interactive possibilities of the web, platforms are rapidly evolving. Even in this form they can be useful in a blended classroom, using them as alternatives to pre-class reading (essentially replacing the textbook) and pairing them with high-engagement in-class activities.

- **Online Homework Systems**
  The usefulness of online homework systems was questioned, perhaps encouraging students to revert to guessing and Googling rather than thinking. The response to this question paralleled those questioning MOOCs and clickers – any technology can be used improperly so it is important to focus on how to use the technology effectively.
Panelists highlighted that it is essential to have visibility in order to get promoted and to get funded. There are various ways to increase your visibility in the community, particularly in the realms of publishing, conferences, and your online presence. It was recommended to pursue many and varied ways to secure visibility in your institution, your field, and globally. A particularly useful tool is to uniquely define yourself and your research such that you are breaking ground in new areas, thinking about what your field will look like in 10 years, trying to get somewhere where no one else is currently. Seek good mentors and ask them to recommend you for things such as journal editor, journal referee, study sections, invited talks, and award nominations. You do have to ask for this help as your mentors may not realize you need it. In many cases, simply enjoy the research you are doing and work hard at it. The visibility and promotion will come, but you cannot ignore opportunities to promote yourself in the ways listed below.

Your online presence:

- Your visibility, and especially your visibility online, starts with a great website. Joe highlighted the aspects of a great one, most importantly keeping it current. It should include sections for research, personnel, awards, publications, updates/news. His example can be accessed at [http://desimone-group.chem.unc.edu/](http://desimone-group.chem.unc.edu/).
- There is no good reason not to have a great website. It is cheap, easily accessed by people around the world, and extremely highly visible.
- The website can easily be run by staff or a junior graduate student.
- Include real-time information about student achievements. This celebrates your trainees and directly promotes you as a mentor to potential future group members.

With regards to publishing articles:

- The impact of a high visibility paper cannot be underestimated. It will likely lead to invited talks, promotion, and funding.
- There are now a host of options for high visibility journals. You are not limited to *Science* and *Nature*. There are the “*Nature* babies,” *ACS Nano*, *JACS*, *Angewandte Chemie*, etc.
- Sometimes it is worth a calculated risk in allowing a slower publication process in order to get the higher impact journal. To increase the likelihood of publishing in such journals, argue clearly and concisely in your cover letter.
- These types of articles do result in higher publicity. They are highly visible and can be career defining. However, the community does have an understanding of the veracity of
articles in these journals. Keep in mind that publishing in *Science* and *Nature* is often determined by factors outside your control – it’s a crapshoot.

- Cover your bases by ensuring that important work (and important researchers) in your field is sufficiently highlighted and contrasted in your article. Avoid unnecessary controversy by appropriately acknowledging previous work and groups.
- There is an element of maintaining safety in your publishing record as you do need to publish in journals with a stamp of approval from your community and/or department.
- Paying a bit extra to make your articles open access can be worth it as it will help increase visibility a bit, however most academics have access via their institutions.
- To overcome a controversy in the field, such as incorrect results repeatedly being cited, write a review article with perspective. If you’re willing to write them, reviews are often needed. Appropriately point out that earlier work might be challenged by sample purity, for instance. Some fields are simply growing too fast and results may be sample dependent. It may take a little time for that to be overcome.
- The silver lining is that your success is not about publishing, but about the problems you solve.

With regards to conferences:

- Gordon Research Conferences (GRCs) are an especially important place to build your reputation.
- Aspire to chair a GRC at some point in your career. This process begins with giving talks. Many people are actively seeking these talks by petitioning the conference chair immediately after their election, so you need to be proactive. Be active early in your career, seek roles like serving as a discussion leader.
- Be active in asking questions and providing answers at conferences.
- Seek out colleagues at conferences for coffee or meals, and promote this ideal to your trainees as well. You can also incentivize this philosophy: Dan shared his philosophy that if he catches one of his students having a meal with someone from their university, he will not reimburse their meal.
- It can help to be blunt and self-promoting. For instance, you can send a recent important paper to a conference chair highlighting your work. In many cases this can lead to an invited talk.
- It is absolutely appropriate to address diversity as an important topic to highlight for speakers, panels, and awards. You can be explicitly vocal about the lack of diversity in these situations. The panel recommended that you be proactive about such issues because they have negatively impacted the field for too long and continue to do so. In these situations, you can alternatively contact an ally, perhaps someone more senior, who you know is willing to speak up and address these issues.

At your institution:

- Take your department or award nominations chair to lunch and explain the awards that may be appropriate for you to seek. Indicate who may be an ideal person to nominate you for the award. There exists a machine at every venue to promote their candidates and you need to tap into it.
- You are representative of your students’ achievements. Focus on getting the best graduate students.
• Celebrate everything your students do, and you can do it in real time on your website. This translates into attracting great students and enhanced group longevity.
• Attempt to get invited speakers in your area to stay an extra half day to spend meeting with your group.
• Ensure that your colleagues know the journals and impact factors of the journals where you are publishing. Make sure to communicate their value. Don’t worry about the lack of recognition, but keep addressing it.
• When it comes to tenure, Dan said that often 3-4 of the outside letter writers will pick out the same 2 papers and highlight specific contributions. You have to make sure these contributions are known well.

**Breakout Session #3: Strategies to Balance Work and Life**

The goal of this breakout discussion was to brainstorm best practices, skills, and techniques to optimize the mix of research, teaching, service, and personal time to achieve your career and personal goals. A specific topic of conversation included strategies to achieve and maintain a balance between home life and work life. Another dialogue focused on strategies to improve time management skills at work. Another key discussion point was techniques to mentor and achieve success with your research team.

• Learn to politely but firmly say, "no". One strategy is to postpone giving an immediate answer when asked to do something. This allows time to carefully consider priorities and potential cost/benefits of saying yes versus no. Consider negotiating for benefits (e.g., teaching relief, staff support, increased overhead return) in exchange for additional service. When declining, do not simply ignore a request - reply with a firm no and then suggest an alternative person if possible.
• Be proactive in finding ways to have shared experiences (e.g., coffee hour) with senior colleagues to learn about departmental and university culture and expectations of service, teaching, and research.
• Reflect on your scheduling choices to see if your distribution of time spent on various activities is in line with your priorities. If not, reassess how you schedule your time.
• Be firm in asking for contractual obligations (e.g., teaching relief) to be in writing and to be honored.
• Schedule and respect personal time.
• Consider combining work and personal events in your travel schedule.
• Learn to efficiently delegate. For example, students can assist in manuscript reviewing, which is a valuable experience for them. Assign lab tasks to students, which encourages group responsibility. Ask for administrative assistance and train your administrators to work with you effectively.
• Learn to be an efficient writer. One strategy included blocking out a "writing time" each day. Another strategy was to rewrite the last paragraph written when starting a new writing session.
• Teach your students to be efficient writers. One strategy is to make use of university resources like writing centers and peer review. Another strategy is to give students
writing exercises; for example, ask students to write an abstract for already published manuscripts.

- Develop a management strategy to help keep students on track. One strategy was to require bi-weekly research reports. Another strategy was to ask for two-line daily emails that quickly describe the goals for the day.
- Avoid distractions during key work time. Ideas included turning off email and other communication methods, closing office door.
- Develop methods to motivate students. Ideas included celebrating successes (fellowships, manuscripts, grants submitted), using group meeting time to motivate, and using conference travel as a reward.
- Ask students to actively participate in setting their research and career development goals. Ask students how you can effectively help them reach their goals.
- If students are not a good fit for the group, have them leave as soon as possible. Unproductive students can take up a lot of time and impact group motivation. They may be more productive in another group that is a better fit.
- Run efficient group meetings. Google Ventures has training videos on best practices.
- It is okay to look occasionally for other positions to find a place with a research/service/teaching balance that matches your expectations and/or to negotiate a retention package with improved benefits.

As discussed earlier in the workshop during Prof. Bennett Goldberg's presentation of participant survey results, most workshop participants were satisfied with their current mix of time spent on research, teaching, and service. However, skills to maximize efficient use of time and to protect personal time were common topics of discussion. During the report-out time, all eight discussion groups stressed the importance of learning to say "no" effectively. Another point of emphasis was the importance of blocking out and protecting personal time, whether that involved family dinners, vacations, hobbies, physical fitness, etc. A final key idea was to prioritize demands on your time so that you can thoughtfully plan out and schedule your day, week, month, and year to match your career and personal priorities.
5. Workshop Survey Results

Respondents were asked the following question: “On a scale of 1 to 6 (1 = not at all confident and 6 = completely confident): To what extent do you feel confident in your ability to do the following things?” Respondents evaluated themselves on 13 skills. The responses of individual participants were tracked by anonymous identifiers, which allowed us to measure the change in confidence level from before the workshop to after the workshop for each person.

The questions were geared towards gauging the participants’ gains in knowledge and confidence on the topics discussed during the workshop: 1) pivoting to new research areas, 2) commercializing research, 3) publicizing research and increasing visibility in the community, 4) developing strategies for promotion, 5) being competitive in future proposals, 6) balancing work and home and, 7) innovations in classroom teaching.

Overall, comparing the mean level of confidence for each of the 13 questions before and after the survey, we found that the mean went up for all questions, indicating a greater degree of confidence on all fronts. The gains were highest (~1.0) in the areas of commercializing research, making effective use of social media and increasing visibility, utilizing knowledge of the budget process to enhance research, improving work-life balance, and being innovative in the classroom. Judging from the mean, the categories where the participants expressed least confidence were: commercializing research, using their knowledge of the NSF budget process and work-life balance. In most cases, the categories showing least gain in confidence (<0.5) were positively correlated with those where the initial level of confidence was already high, like pivoting to new research areas, being competitive in future proposals, and achieving tenure.

Full pre- and post-workshop survey results are available in the Appendix.
6. Recommendations for Future Workshops

Participant Feedback and Recommendations

Following the workshop, participants were asked to provide anonymous feedback as to the most and least useful topics, recommendations for future workshops, the timing of the workshop relative to career stage, and how NSF might improve CAREER. They were also asked to rate the workshop, on a scale of 1 to 6 (“not at all valuable” to “extremely valuable”), as to how valuable it was overall. The feedback was as follows:

<table>
<thead>
<tr>
<th>Workshop Value</th>
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<tbody>
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<td>(% of respondents giving that rating vs. 1 to 6 rating, n = 35)</td>
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Most Useful Topics
- Most frequently mentioned: Innovations in teaching, NSF initiatives, Entrepreneurship
- Somewhat frequently mentioned: Defining yourself and your work, Pivoting to new research areas, Increasing visibility panel, Science storytelling
- Less frequently mentioned: Budget, Work-life balance breakout, Promotion and tenure breakout
- Also mentioned: Meeting with program directors

Least Useful Topics
- Most frequently mentioned: Budget
- Somewhat frequently mentioned: Defining yourself and your work, Innovations in teaching, Science storytelling
• Less frequently mentioned: Increasing visibility panel, Promotion and tenure breakout, Entrepreneurship, Being competitive in your next proposal, Work-life balance breakout, NSF initiatives
• Also mentioned: The program director meet-and-greet was not as effective as it could have been. It would be better for program directors to be introduced at the beginning of the session to put faces with names.

Topics and Recommendations for Future Workshops
• Many participants would like to see a research component to future workshops. This could take the form of a short slide blitz or poster session.
• Many participants would like increased interaction with program directors and other NSF personnel. Recommendations included breakouts led by PDs or other time to meet personally or in small groups.
• What to do when things go wrong
• How to recruit and mentor graduate students
• How to best integrate research and outreach
• Strategies for submitting competitive proposals to different agencies
• How to manage your research group
• Writing effective letters for awards
• Specific strategies for changing research directions
• What does success look like, and what happens if you fail?
• Best practices to encourage diversity
• How to prepare and lead large-scale proposals
• How to collaborate efficiently and effectively
• How to deal with difficult students, colleagues, and administrators

Workshop Timing
• Participants were evenly split between feeling this was the most appropriate time for the workshop vs. feeling the workshop would be better one year earlier.

Feedback to NSF
• Many participants mentioned they would like better outreach from NSF to notify them of CAREER supplements. Specific recommendations included a single webpage devoted to supplements and an annual email reminding CAREER awardees of available supplements.
• Several participants mentioned they would like to see this workshop run again in the future. They also recommended follow-up workshops, or the idea of doing a workshop after the first year and one after the third year. They also recommended having one workshop focused on professional development (similar to this workshop) and one focused on research.
• Additional comments included helping awardees make connections to program directors and helping individual PIs connect with centers and other major efforts that would allow the awardee to get more out of the award. Some participants also would like to see the award size increased, or perhaps the total duration of the award shortened to four years so that the annual amount would increase.
Organizing Committee and Mentor Recommendations

Overall, the workshop was a great success. We would recommend keeping this as part of the NSF programming.

Pre-workshop

- Start organizing/publicizing the workshop earlier – 2 months was not enough time for all of the awardees and mentors to get this on their schedule. The planning for this workshop started 6 months out. At least 9 months are needed. (So start in September for a June workshop.)
- Co-chair structure of one junior faculty and one senior faculty was a good combination
  - Diversity of connections and experiences
  - If possible, at least one co-chair should have good admin staff support to help in planning
- In future years, consider having past workshop participants serve on the organizing committee
- Define a small number of learning goals and participant skill outcomes. Define them specifically enough that they can be used to design the workshop activities and pre- and post-surveys. Define a small enough number that they can be reasonably achieved.
- Aim for diversity of mentors and publicize mentors as soon as possible
- Have CAREER awardees and mentors submit photos and short research descriptions to include in a bio book before the workshop.
  - This will help attendees know which other attendees they should make sure to reach out to at the workshop
  - Include in the workshop material which program each awardee is funded through
- Bio book could also be expanded to a larger handout to include worksheets (perhaps specific ones for each breakout group), notes, compressed copies of talks, survey questions, and pre-survey results.
- Emphasize to mentors that it is their role to keep their groups engaged, even if they discuss another relevant topic
  - Ask leading questions
  - Call on people to get their opinions and share experiences
  - Facilitate discussion among all attendees in the group, not just mentor’s experiences
- If possible, consider 2 mentors per group, one junior and one senior faculty or one faculty and one NSF person

During the workshop

- The workshop did a great job of connecting people personally though common experiences in getting tenure, working on career-family balance, etc., but didn’t make scientific connections clear. Find a way for attendees to present their research quickly at the beginning to foster connections on a personal and scientific level.
  - Poster session during ice-breaker Sunday night or after first day of workshop? This would have to be planned carefully to allow participants the opportunity to both present their work and see other participants’ work.
Quick 1-minute, 1-slide description of the participant’s work?

Consider designing and building the activities with more personal interactions, both before and during the workshop – something more interactive than informational seminars to build lasting skills. Activities could include self-reporting, identifying weaknesses and characteristics that need improving, role plays, reflective planning, sharing, and evolving plans as both individuals and in small groups. Have participants go away with achievable goals in mind.

Assigning different mentor groups each day was great – allowed/forced attendees to meet and interact with different group of attendees and also get advice from a different mentor each day

During NSF meet-and-greet:
- Have everyone arrive at the same time and make introductions of NSF people
- As it was, people showed up when their breakout group was finished and NSF people weren’t introduced
- Couldn’t tell who was an NSF employee vs. other attendees

Increase contact with NSF program directors
- Have lunch one day with NSF directors?
- Invite NSF people to coffee breaks/breakfast?
- Invite NSF people to ice breaker?
- Optional meetings with NSF program directors on Wednesday morning
  - May be easier to schedule 1-on-1 or small group meetings with NSF program directors vs. having them show up at events
  - People who want to have that experience can delay flight home to Wednesday afternoon
- Attendees wanted more contact with NSF leadership on a personal level

May want to have some discussions in more homogeneous groups – areas like visibility, group management, motivating and managing people, how to balance invite talks, etc vary widely between disciplines (ex. chemistry vs. physics, theoretical vs. experimental)

For senior professor talks – encourage professors to make talks accessible
- “I had 3 Science publications pre-tenure and none since then.”
- “I know some of you make be thinking this is way far off from what your goals are now, but I encourage you to dream big.”

Increase panel discussion time
- Shorten formal talks and give more dedicated time for questions and discussion

Post-workshop
- Continue to include a report writing day after the full workshop programming so that the report can be prepared as quickly as possible. Share the report with NSF and the workshop participants at a minimum.
- Measure outcomes based on the original goals set for the workshop. Consider doing follow-ups 6 months or 12 months after the workshop to see how far participants have come towards achieving goals they set for themselves in the workshop.

General
- It was imperative to have someone at the NSF like a AAAS fellow to help organize
  - Connecting co-chairs to NSF people
Having someone on-site to help with local organization

• 45-50 was a good number of participants. Keeping the workshop at 1 year’s CAREER awardees should keep the number of potential attendees in this range
  • More attendees may hinder thoughtful small-group discussions

• Try to reach out to mentors from more diverse fields – this may be easier with more planning time so people can get this on their schedule before it gets filled up
  • Even if CAREER PIs aren’t in a mentor group/table with a PI from their field, they can still reach out to PIs at lunch, coffee breaks, etc.
  • More experienced PIs could be an invaluable connection for these young faculty in mentorship and making introductions in the future – mentoring beyond the workshop

• Have a mix of young mentors (PIs who recently finished their CAREER grant) and more experienced/distinguished mentors (ex. Joe, Paul, Bennett, etc)
  • The distinguished PIs will attract the younger mentors and both views will be helpful to career awardees
  • Not so big of a jump from early career to height of career PIs with mid-career PIs there as well

• NSF should continue to fully fund workshop attendees’ expenses to attend the workshop.

• May consider holding this or a second workshop in year 1 of CAREER award
  • This would change the focus of the workshop to getting tenure because more PIs would be pre-tenure
  • May be more helpful to learn these lessons early on
  • In year 3 of CAREER award, more focus was on work/life balance, teaching, and research directions for the future
  • May be best addressed by having two separate workshops – one for year 1 CAREER awardees and one for year 3 awardees

Feedback to NSF

• Please increase visibility of “hidden” supplements. Many participants did not know these existed and were very interested to hear about them.
  • Minority student support
  • European collaboration support
  • Conference support
  • Family leave support
  • Workshops

• An open and honest discussion about the possibility (or lack thereof) of further NSF funding when holding the CAREER would be helpful. There was a large amount of interest in this topic at the workshop, and is an important and unclear issue to the community.
Appendix
# Workshop Agenda

**Sunday, June 16**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00PM</td>
<td>Ice Breaker at the Westin hotel bar</td>
</tr>
</tbody>
</table>

**Day 1 – Monday, June 17 – Location: Stafford I, Room 375**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00AM-8.30AM</td>
<td>Registration (refreshments available)</td>
</tr>
<tr>
<td>8.30AM-8.40AM</td>
<td>Welcome remarks</td>
</tr>
<tr>
<td>8.40AM-8.50AM</td>
<td>Welcome remarks</td>
</tr>
</tbody>
</table>

**Session 1: NSF Initiatives and Operations**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>8.50AM-9.50AM</td>
<td>Introduction and NSF initiatives related to materials science</td>
</tr>
<tr>
<td>9.50AM-10.20AM</td>
<td>The Federal Budget Outlook and NSF</td>
</tr>
<tr>
<td>10.20AM-10.40AM</td>
<td>Coffee Break</td>
</tr>
</tbody>
</table>

**Session 2: Implementing Innovation**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.40AM-11.30AM</td>
<td>Entrepreneurship</td>
</tr>
<tr>
<td>11.30AM-12.30PM</td>
<td>Panel Discussion #1: How to be competitive in future proposals</td>
</tr>
<tr>
<td>12.30PM-2.00PM</td>
<td>Lunch in small groups</td>
</tr>
</tbody>
</table>

**Session 3: Publicizing your research and yourself**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.00PM-2.30PM</td>
<td>Science Storytelling</td>
</tr>
<tr>
<td>2.30PM-3.20PM</td>
<td>Defining Yourself &amp; Your Work</td>
</tr>
<tr>
<td>3.20PM-4.30PM</td>
<td>Meet and greet session with NSF program directors over coffee break (Stafford I, Atrium)</td>
</tr>
<tr>
<td>4.30PM-5.30PM</td>
<td>Breakout session #1 How to be strategic about planning for the promotion process</td>
</tr>
<tr>
<td>5.30PM-6.30PM</td>
<td>Wine Reception (Stafford I, Room 110)</td>
</tr>
<tr>
<td>6.40PM</td>
<td>Dinner and Keynote talk at Westin</td>
</tr>
</tbody>
</table>

**Keynote speaker:** Marc Kastner
“A career at MIT—the things I did wrong and still survived”
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30AM-8.40AM</td>
<td>Welcome (refreshments available)</td>
<td>Ashley White and Vidya Madhavan, Workshop Co-Chair</td>
</tr>
<tr>
<td>8.40AM-9.30AM</td>
<td>Pivoting to new areas of scholarship</td>
<td>Bennett Goldberg, Boston University</td>
</tr>
<tr>
<td>9.30AM-10.30AM</td>
<td>Breakout session # 2 Your pathway to change: Critical junctures and appropriate balance</td>
<td>Mentor meetings (part 2) (see list of mentors)</td>
</tr>
<tr>
<td>10.30AM-10.50AM</td>
<td>Coffee Break (Mentors synthesize outcomes from breakout session)</td>
<td></td>
</tr>
<tr>
<td>10.50AM-11.20AM</td>
<td>Collective Reports on Breakout session #2</td>
<td></td>
</tr>
<tr>
<td>11.20AM-11.50AM</td>
<td>Innovations in classroom teaching and effecting change</td>
<td>Eric Hudson, Pennsylvania State University</td>
</tr>
<tr>
<td>11.50AM-12.30PM</td>
<td>Panel discussion #2 Effecting change in the classroom, and outreach</td>
<td>Panelists: Eric Hudson, Bennett Goldberg, Sarah Heilshorn, Stanford University, and Arun Bansil</td>
</tr>
<tr>
<td>12.30PM-2.00PM</td>
<td>Lunch in small groups</td>
<td></td>
</tr>
<tr>
<td>2.00PM-3.00PM</td>
<td>Panel Discussion #3: How to increase visibility in the community. How to select journals and conferences.</td>
<td>Panelists: Bennett Goldberg, Joe DeSimone, and Arun Bansil</td>
</tr>
<tr>
<td>3.00PM-3.20PM</td>
<td>Coffee Break</td>
<td></td>
</tr>
<tr>
<td>3.20PM-4.20PM</td>
<td>Breakout session #3: Strategies to balance work and life. Optimizing the mix of research, teaching, and service to achieve your career goals. Skills and techniques to mentor and achieve success with your research team.</td>
<td>Mentor meetings (part 3) (see list of mentors)</td>
</tr>
<tr>
<td>4.20PM-4.40PM</td>
<td>Social Time, Fill out Survey, (Mentors synthesize outcomes from breakout session)</td>
<td></td>
</tr>
<tr>
<td>4.40PM-5.00PM</td>
<td>Collective Reports on Breakout session #3 &amp; Wrap Up</td>
<td></td>
</tr>
</tbody>
</table>
Participant List

Steering Committee

Joseph DeSimone, University of North Carolina at Chapel Hill (UNC)
Vidya Madhavan, Boston College
Sarah Heilshorn, Stanford University
Eric Hudson, Pennsylvania State University

Keynote Speaker

Marc Kastner, MIT

Mentors, Panelists and Speakers

Arun Bansil, Northeastern University
Dan Dahlberg, University of Minnesota
Bennett Goldberg, Boston University
Frank Snowden, University of Minnesota
Paul Weiss, UCLA
Fleming Crim, NSF
Mary Galvin, NSF
Beth Blue, NSF
Andy Lovinger, NSF
Maria Zacharias, NSF

Organization

Ashley White, NSF
Matt Destruel, Boston College
Jane Carter, Boston College

Participants

Katherine Aidala, Mount Holyoke College
Aleksei Aksimentiev, University of Illinois at Urbana-Champaign
Raymundo Arroyave, Texas A&M
E. Silvana Andreescu, Clarkson University
Stanko Brankovic, University of Houston
Jasna Brujic, New York University
Michael Dickey, North Carolina State University
Tequila Harris, Georgia Tech Research Corporation
Jiaxing Huang, Northwestern University
Masahiro Ishigami, University of Central Florida
LaShanda Korley, Case Western Reserve University
Chih-Wei Lai, Michigan State University
Brian LeRoy, University of Arizona
Stephan Link, Rice University
Jason Locklin, University of Georgia
Tim Mewes, University of Alabama Tuscaloosa
Casey Miller, University of South Florida
Vadim Oganesyan, CUNY College of Staten Island
Zhengwei Pan, University of Georgia
Amy Prieto, Colorado State University
Padma Rajagopalan, Virginia Polytechnic Institute and State University
Nathaniel Rosi, University of Pittsburgh
Sachin Shanbhag, Florida State University
Michael Shatruk, Florida State University
Sara Skrabalak, Indiana University
Douglas Spearot, University of Arkansas
Daniel Spirn, University of Minnesota
Alexander Star, University of Pittsburgh
Mihaela Stefan, University of Texas at Dallas
Junghae Suh, Rice University
Klaus van Benthem, University of California-Davis
Oskar Vafek, Florida State University
Maxim Vavilov, University of Wisconsin-Madison
Anton Vorontsov, Montana State University
Shiren Wang, Texas Tech University
Yong Wang, Penn State
Jon Wilkening, University of California-Berkeley
Yiying Wu, Ohio State University
Jian Yang, Penn State
Yadong Yin, University of California-Riverside
Wei You, University of North Carolina at Chapel Hill
Michael Zach, University of Wisconsin-Stevens Point
Peihong Zhang, SUNY at Buffalo
Hui Zhao, University of Kansas

Graduate Students/Postdocs

Kyle Lampe, Stanford University
Sarah Mueller, University of North Carolina at Chapel Hill
Workshop Survey Data

= Before workshop (n = 44)
= After workshop (n = 35)
= Change in confidence level (n = 35)

Horizontal axis = confidence rating
Vertical axis = proportion of respondents giving that response

Horizontal axis = number of points of change in confidence rating

1. Take my research in a new direction.

2. Commercialize my research.

3. Publicize my research and interact with the media.
4. Make effective use of social media.

5. Increase my visibility in the research community.

6. Select the best journals in which to publish.
7. Select the best conferences to attend.

8. Develop a good strategy for achieving promotion from assistant to associate professor.

9. Develop a good strategy for achieving promotion from associate to full professor.
10. Be competitive in future grant proposals.

11. Use my knowledge of the NSF budget process to enhance my research plans.

12. Employ good strategies to balance my work life and my home life.

Further information, including presentation slides, can be found on the workshop website:
http://www.bc.edu/sites/nsfworkshop