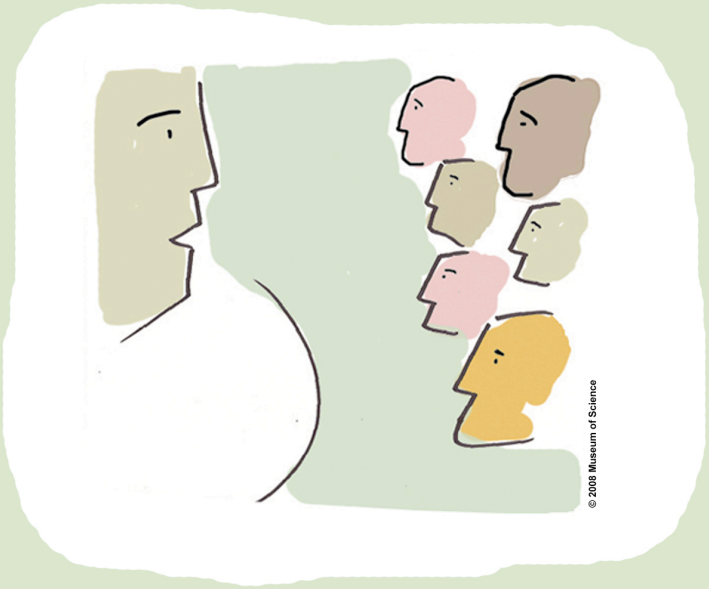
RESEARCH EXPERIENCE FOR UNDERGRADUATES

Science Communication Workshop



A NISE NETWORK PROFESSIONAL DEVELOPMENT GUIDE

Written by Carol Lynn Alpert, Museum of Science, Boston

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NISE network
NANOSCALE INFORMAL SCIENCE EDUCATION

Museum of Science™

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About this Guide

The *REU Science Communication Workshop* was developed by Carol Lynn Alpert and the Strategic Projects Group at the Museum of Science, Boston, in collaboration with the Center for High-rate Nanomanufacturing (a National Science Foundation Nanoscale Science and Engineering Center based at Northeastern University, the University of Massachusetts-Lowell, and the University of New Hampshire), and the "Nanoscale Systems and Their Device Applications" NSF NSEC based at Harvard University. The University of Massachusetts Donahue Institute provided professional research and evaluation services. Funding was provided by the National Science Foundation and the Massachusetts Technology Collaborative through sub-awards from the two NSECs. This guide was prepared with the assistance of Karine Thate and Jeanne Antill at the Museum of Science.

Contributors to the development of the *REU Science Communication Workshop* include Carol Barry, Jacqueline Isaacs, Karine Thate, Alex Fiorentino, Timothy Miller, Lisa Regalla, Kathryn Hollar, and Glen Miller.

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Research Experience for Undergraduates
SCIENCE COMMUNICATION WORKSHOP

Executive Summary

This guide provides information and resources for planning and hosting a two-session *Science Communication Workshop* for students involved in undergraduate research programs. The *Research Experience for Undergraduates Science Communication Workshop (REU-SCW)* is designed to:

- Encourage students to explore the broader context of their research;
- Guide them in developing professional science communication skills;
- Enhance their confidence in pursuing careers in science and in speaking about science in a variety of settings.

The *REU Science Communication Workshop* can be implemented by science museum staff and other informal science educators, either separately or in collaboration with university faculty, and is highly adaptable to a variety of situations. While initially developed for implementation within the context of National Science Foundation's "Research Experience for Undergraduates" (REU) program structure, the *REU Science Communication Workshop* has also been successfully integrated into other university-based undergraduate research programs.

The REU-SCW brackets an undergraduate research program with two half-day sessions, with Session One occurring close to the start of the program and Session Two occurring close to the end of the program. It is structured to support the undergraduate faculty and mentors along the typical trajectory of the research program, guiding the students in their development and delivery of a final professional style research presentation at the conclusion of their research project. The REU-SCW is designed to accommodate up to 24 students as a time, with the participation of one workshop leader and 4-6 faculty or staff mentors involved in small group facilitation. A variation of the REU-SCW format, developed in collaboration with the University of Wisconsin-Madison, condenses the workshop sessions and integrates them into the REU timeline to include both slide and poster presentations. This version will be added in the next edition of this guide.

Funding for workshop materials and staff time can often be provided through the university's undergraduate research program budget or NSF REU program funds. If partnering with a science museum for implementation, the sponsoring university can provide a sub-award or small contract to cover program expenses. The REU-SCW can also be organized within the context of a multi-faceted research center – science museum education outreach partnership.

The REU-SCW is a product of over five years of collaboration, evaluation, and iterative development by the Museum of Science in partnership with faculty and students from five universities* hosting undergraduate research programs. Students typically rate the REU-SCW among the most useful and enjoyable activities of their research program experience and program faculty report seeing considerable improvement in the quality of student oral and graphic presentations of their research.

*Harvard University, Northeastern University, University of Massachusetts-Lowell, University of New Hampshire, Harvard University, University of Wisconsin-Madison.

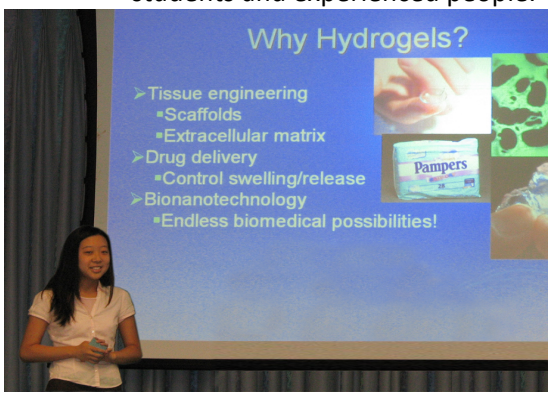
Comments from Science Communication Workshop *participants:*

"Communication of research is highly important and seldom discussed in undergraduate programs."

"More than anything, it is important that scientists understand how to communicate their work."

"It helped me find the best way to communicate scientific concepts to non-scientists."

”The most useful thing was to be able to practice our presentation skills and to have the opportunity to receive feedback from other students and experienced people."



"I had fun, which is rare for me at workshops."

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Appendices Available for download from Resources tab at
http://www.nisenet.org/catalog/tools_guides/reu_science_communication_workshop
Or, by request from nano@mos.org

- Document Appendix Folder: Editable and printable document versions of all hand-outs, guides, and surveys included in this Guide.
- Digital Appendix Folder: Workshop slide sets:
  - REU SCW Session One PPT.pptx [This pptx file contains still images in place of the sample video clips used in Session One, because the video files are too big to upload to nisenet.org. If you wish to use the clips portion of the PPT in your Workshop, contact nano@mos.org to obtain this file through a file-sharing service or via DVD.]
  - Materials for *(Really Bad)* Sample Presentation Activity
    - Bad Presentation Desktop.pdf
    - CMOS-FET 1.ppt
    - Beyond CMOSFET v2 for REU Workshop.ppt

Research Experience for Undergraduates
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Overview

Undergraduate students participating in science and engineering research programs are typically exploring their options for continuing on to graduate programs and careers in scientific and technical fields. They may be uncertain whether or not to continue in this direction or to commit to graduate training, and they may be using the research program as an opportunity to get a taste of graduate level work. Or, they may have already made a commitment to a scientific or technical career, and they are shopping for graduate schools and racking up experience. Most undergraduate research programs are funded to provide stipends to participating students, so they can devote themselves to the research full-time, and students are motivated to do well. Some have never had the experience of getting out of the classroom and getting into the lab for a research project of their own; others are REU veterans, returning year after year to further their research experience portfolio.

This guide provides materials and guidance for university faculty wishing to incorporate a professional science communication education component into an undergraduate research experience program. The REU Science Communication Workshop is designed to assist the faculty in preparing students for successful graduate school level work and for later careers in science and engineering. The Workshop supports students in developing the communication skills and confidence they will need to persevere and perhaps to provide peer leadership. Besides science communication skills development, the Workshop concentrates on introducing students to habits of inquiry and exploration into the broader societal, ethical, and economic aspects of their research.

Background

The REU-SCW was initially developed by science museum educators in collaboration with university research center faculty, and can be adapted for implementation by university faculty alone as well as in partnership with science museums or other science communication organizations. The Workshop format and content was developed over five years of iterative design, practice, research and evaluation by the Strategic Projects Group of the Museum of Science, Boston, in collaboration with REU program directors and faculty from the Center for High-rate Nanomanufacturing NSF NSEC at Northeastern University, the University of Massachusetts-Lowell, and the University of New Hampshire; the "Science of Nanoscale Systems and their Device Applications" NSF NSEC headquartered at Harvard University; and the Institute of Chemical Education associated with the Nanoscale Science and Engineering Center at the University of Wisconsin – Madison. The REU-SCW has also been implemented as part of an independent undergraduate research program run by the Department of Engineering at the University of Massachusetts-Lowell. Evaluation results show that students value the SCW experience highly, rating it as one of the most valuable components of their REU program. Faculty and graduate student mentors also credit the SCW for bringing about demonstrable improvement in students' oral, slide, and poster research presentations.

The NSF-funded Nanoscale Informal Science Education Network (NISE Net) supported the development of this professional development program dissemination package. Part of the mission of the NISE Net is to advance the communication, education, and outreach skills of scientists and engineers in interdisciplinary fields and to expanding opportunities for young people from all backgrounds to gain the confidence and training to develop careers in science and engineering. Science museums and university-based research centers are natural partners in advancing science and engineering education and public engagement in science.

Context

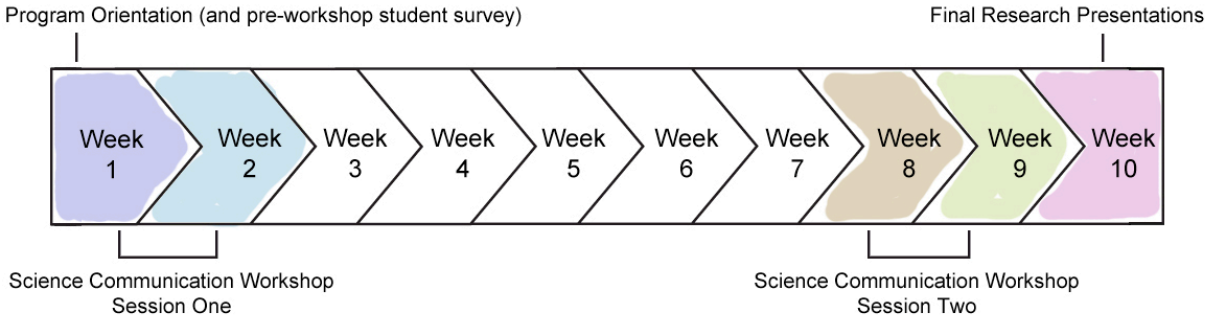
Typical research experience for undergraduate (REU) programs last 8-12 weeks, during which time students develop, carry out, and analyze the results of scientific experiments or engineering design challenges, under the guidance of faculty or graduate student mentors. Most REU students are required to make either an oral presentation with slides or a poster presentation during their final week in the program. The presentation of research is an integral aspect of science and engineering professional practice. A successful research presentation can help students to draw meaning and context from their weeks of immersion in laboratory activities and can provide them with a sense of reward and accomplishment through sharing with mentors and peers. The two-session REU Science Communication Workshop program is designed to integrate seamlessly into the arc of a 2-3 month research experience, to provide structural and pedagogical support for faculty teaching objectives, and to build student confidence in navigating the uncertainties of experimental research. It is important that students completely grasp the notion that even experiments or engineering efforts that turn out unexpectedly or fail can advance knowledge and practice, and that scientists and engineers regularly make valuable contributions when they practice clear communication of results and insights. The REU Science Communication Workshop is also designed to help students bridge the gap between their 8-12 week immersion in research with like-minded peers and professionals on the one hand, and their regular home and social environments on the other – places where it may be difficult - without practice - to engage in conversation about their science and engineering interests and efforts.

Basics

Many REU programs take place during the summer months. A typical schedule has the students arriving and getting oriented during the first week in June and delivering their final presentations during the last week in July or the first week in August. Generally we like to schedule the first workshop session within the first two weeks of their arrival on campus and the second workshop within two weeks of their departure.

Session One provides an introduction to the importance of communication skills in science and to achieving understanding of the larger context and meaning surrounding individual research projects. Students practice basic communication skills and techniques for introducing their research and describing its context and meaning in simple terms that can be understood by non-scientists. They are given guidance for developing the oral slide presentations they will later be delivering on their research. They also learn techniques of providing supportive and constructive feedback to each other.

Workshop Scheduling within a Ten-Week REU Program



Students come to Session Two prepared to deliver the first 5-10 minutes of their final research presentation in small groups, and to receive support, feedback, and further guidance. Session Two is scheduled to occur a week to ten days before the students are to deliver their final research presentation in a higher stakes setting.

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Program Goals and Learning Objectives

The *REU Science Communication Workshop* was designed to:

- Help students gain greater appreciation for the importance of science communication skills to successful careers in science and engineering.
- Assist faculty in preparing students for successful graduate level work and for careers in scientific and technical fields.
- Guide students in developing effective science communication skills for use with both science professional and general audiences.
- Guide students in developing habits of inquiry and exploration into the broader social, ethical, and economic aspects of their research.
- Provide students with communication tools to help integrate their life in science with other aspects of their lives.

Specific learning objectives include:

- Tailoring science communication and presentation of one's own research for specific audiences, settings, and timeframes.
- Presenting research within the larger context of human societal and scientific goals so that audiences can better connect to its relevance, meaning, and motivation.
- Developing brief introductions to one's own research that can be used with both science professional and general audiences.
- Mastering basic oral presentation skills that allow one to successfully connect with an audience of one or many.
- Mastering basic slide and/or poster graphic design skills and appropriate choreography in the context of oral presentations.
- Becoming adept at giving and receiving constructive feedback to one's peers in a collaborative learning community.

Planning your *REU Science Communication Workshop* Sessions

We recommend that the decision to include the SCW into an undergraduate research program be made at least two months prior to the start of the program, giving stakeholders – including REU program directors, faculty mentors, and workshop leaders - ample time to get on the same page about goals, curriculum sequence, pedagogy, student requirements, and logistics, including securing rooms for the sessions. Students need to know from the day they arrive – if not earlier – the expected trajectory of their research experience and what they will be required to accomplish by its final week. Instructions for preparing for the first SCW session are typically delivered during the overall program Orientation. It is best to coordinate with the program faculty so that students can fill out the pre-workshop survey at the Orientation or at least a few days prior to Session One, so that the Workshop leader can report back to the group about their survey responses at the beginning of Session One. This strategy engages their interest; they are curious to hear how their responses compared to those of their peers and in hearing what the Workshop leaders concluded from analyzing the responses.

Scheduling

Each of the two SCW sessions can range from 120 minutes to four and one-half hours. The longer timeframe is preferable for several reasons. It allows ample time for small group work, which is the most highly rated aspect of the SCW program. Too many professional development experiences consist of students watching a presentation and taking notes; the SCW sessions are based on the idea that practice, and only practice - in a secure environment with helpful feedback - will produce measurable improvement in communication skills and confidence. We also like to ensure that the students get a lunch as part of the deal. We want them happy, alert, and well-nourished as they take on the social and intellectual challenges of communicating science.

Participants

Participants can include rising freshman, sophomores, juniors, seniors, and even students undertaking a fifth year of undergraduate study. We recommend keeping the number of participants to 24 or less, because of the importance of ensuring an adequate amount of individual practice and feedback for each of them in small break-out groups. Each small group also requires a mentor/facilitator or faculty advisor, and these can be difficult to round up. If there are four groups of six students, and each student is allotted five minutes to speak and five minutes for receiving feedback, that's an hour for that part of the workshop. If there are six groups of four students, the hour turns into forty minutes. We generally prefer groups of five to seven students, which tends to provide enough examples and variety for peer learning to occur and enough practice at providing constructive feedback to begin to understand what it means to listen critically and offer sound advice. If more than 24 students need to be accommodated, workshop leaders can consider having breaking the group in two and holding the session on consecutive days.

Workshop Leaders and Facilitators

With a reasonably sized group, a single, well-organized Workshop leader can do a solo facilitation, but we recommend including at least one additional staff member, faculty mentor or experienced graduate student per four to six Workshop participants, to facilitate the small group work, which is key to the success of the Workshop. You will brief and prepare these mentors in advance of the Workshop sessions. It's best if the mentors have been through the Workshop before, and can offer students guidance through their own experience and knowledge of professional practices. It is particularly important to have the mentor spots all filled for Session Two, when the small groups take off to different rooms.

Room Requirements

Session One requires just one room large enough to hold 24 restless adolescent bodies and several adult mentors, as well as a projector and screen, a demo table, space to break out into small groups, and space for lunch buffets and trash. For Session Two, focusing on oral presentations with slides, it is ideal to have separate break-out rooms for the small groups to meet separately, since sound and sight insulation between groups is very helpful. When four to six break-out rooms have not been available, we have used divider to split the main gathering room into smaller group meeting places while sending two to three groups to smaller rooms in the building.

Digital Assets

Session One requires a single laptop, projector and screen. For Session Two's small group work, each break-out area or room needs to have a projector and screen as well as a laptop or computer. It is preferable for students to be able to operate their own sequences of slides directly from a laptop or computer at the front of the room near the screen. Laser pointers are optional; we tend to discourage their use in these settings. In order to avoid the hassle of changing computers and struggling to open various slide presentation programs with various versions of software, we require the students to email, post to an ftp server, or use a large file sending service to deliver the slides for their presentations at least twelve hours in advance of Sesson Two, with their last name in the file name. We pre-assign each student (and their set of slides) to a break-out group in advance and load their presentations onto the computer that will be in the room their group will be assigned to. It's then helpful to check that each presentation will open and play correctly on the computer to which it has been assigned.

Materials and Amenities

Each student receives a nametag upon arrival, and usually, the nametag is pre-marked with a color dot, number and/or letter code that discretely notes the small group assignments for each individual. We try to mix the small groups so that students are likely to meet others from different labs, schools, or disciplines, both to broaden their experience and to prevent familiarity from interfering with the role-playing aspects of the Workshop. Well-fed students are more likely to be

happy, focused and productive, so, if the resources are available, we typically begin a Workshop session with a buffet or boxed lunch or provide a voucher so students can stop off at the cafeteria on their way in. It helps to have friendly, tone-setting walk-in music playing when participants arrive. Each participant is also provided with a packet containing the assignment and resources for the day. Finally, we like to make sure there is fresh water – usually in bottles – available for students. As speech and drama coaches will tell you, good hydration is a key component of good public speaking.

Visual Documentation

Take a few photos of the participants engaged in activities at your Workshop sessions. They'll be quite useful for you and your university partners when you are reporting on your work. We always take a group shot of the students and faculty and share it with all of them. Remember to have the appropriate institutional photo releases handy, although often, students have already signed releases covering the whole program.

Budgeting

The most expensive resource for running the SCW is the time of the Workshop leaders and planners. This may be included within the scope of work for the REU program directors; and in cases where the university has a partnership with a science museum, may be covered by a sub-award or contractual arrangement. Beyond the human resources, the chief expense is food and refreshments if these are to be provided. We are assuming that room space, computers, projectors, and screens can be cobbled together or borrowed. Photocopies of some workshop materials are also required.

Evaluation

Evaluation of your REU-SCW is not essential, but highly recommended. We know the Workshop works well for its target audience. However, through simple surveying efforts, you may gain invaluable insight into the particular experiences *your* student participants are having, and you may discover some low-cost, high-benefit modifications you can make to better serve your students the next time you offer the Workshop. This package includes sample evaluation forms we have used successfully. There is a pre-Workshop survey, a post-survey for Session One, a pre- and post-survey for Session Two, and a final post-Workshop survey. If the REU program already administers a pre- or post-program survey, we try to integrate our questions into those instruments. See the evaluation section for guidance on evaluation and a summary of past findings. We also recommend debriefing with the faculty and/or mentor/facilitators immediately following each Session.

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Sample Planning Timeline

This sample timeline is based on the assumption that the two SCW sessions will be implemented during the course of a 10-week summer Research Experience for Undergraduates program. It can be adapted and modified for implementation in other programs and for other spans of time.

DATE	EVENT / PURPOSE	DESCRIPTION	OUTCOMES
March - April	**Strategic Planning**: Integrating SCW into the summer undergraduate research schedule.	- Confirm decision to implement SCW. - Agree on learning goals and research/poster presentation requirements. - Schedule workshop sessions. - Book rooms. - Determine evaluation strategy and timing. - Set remainder of planning schedule.	Partners have agreed on how to integrate the Science Communication Workshop sessions into the summer undergraduate research program.
May	**Preparations for Session One**	- Finalize logistics (room, equipment, hand-outs, timing, refreshments). - Finalize pre-Workshop survey and load into computer survey software. - Finalize post-Session One survey and make copies. - Recruit Session One mentors and facilitators and brief them. - Pre-Assign students into small groups. Make nametags for students, coded with group assignments. - Make photocopies/packets. - Adapt presentation/powerpoint for Session One and gather props. - Re-check that the stakeholders are in sync on learning goals, activities, student assignments and requirements. - Confirm student assignments & due dates.	Everything is prepared ahead of the students' arrival.
Early June	**REU Orientation**	- Give students summer schedule including the two SCW sessions. Note due dates for assignments. - Have students fill out pre-Workshop survey either on the web or at the Orientation, on computers or on paper. - Give students the assignments due at the first SCW session.	Students know what is expected; organizers know what prior experience students have had in science communication and where they feel they need the most help.

Early June (within first ten days of program)	**Session One Science Communication Workshop**	See Session One Agenda and Notes.	Students meet learning goals for Session One.
Early June	**Assess Session One**	- Compile survey data. - Debrief mentors. - Debrief faculty, mentors and students on outcomes if students were required to deliver an introductory presentation the following week.	Gather information helpful for planning Session Two and helpful for improving Session One the next time it is given.
Late June – Early July	**Preparations for Session Two**	- Finalize logistics (rooms, equipment, hand-outs, timing, refreshments). - Finalize pre- and post- Session Two survey and load into computer survey software and make photocopies. - Recruit Session Two mentors and brief them. - Pre-Assign students into small groups. Make nametags for students, coded with group assignments. - Make photocopies/packets. - Adapt presentation/powerpoint for Session Two and gather props. - Re-check that the stakeholders are in sync on learning goals, activities, student assignments and requirements. - Confirm student assignments and due dates. - Optional research abstract writing assignment for students.	Everything is prepared ahead of the students' arrival.
Week prior to Session Two	**Last Preparations for Session Two**	- If appropriate, remind students of what is due for Session Two in an email or by other means. - Brief mentors and facilitators on Session Two roles.	Encourage students to prepare in advance and practice their slide or poster presentation aloud.
24 hours prior to Session Two	**Receiving and Loading Student Slide Presentations**	Have students send a file with the first 5-10 minutes of their slide presentation via email or ftp or large file sending service. Pre-load presentations on computers for each pre-designated small group.	There will be no delay in getting to the small group work.

July – late	**Session Two Science Communication Workshop**	See Session Two Agenda and Notes.	Students meet learning objectives for Session Two.
Late July	**Assess Session Two**	- Compile pre- and post-Session Two survey data. - Debrief mentors/facilitators.	Gather information helpful for improving Session Two the next time it is given.
Early August	**Students deliver final research presentations with slides or posters**	- Science Communication Workshop leaders attend with faculty and mentors. - Informally debrief with students if appropriate about impact of SCW.	All the hard work comes to fruition! Students feel sense of accomplishment.
August – before students depart	**Post Program Assessment**	- Students complete surveys on entire research experience, including SCW. - Debrief faculty and mentors and students on outcomes.	While the experience is fresh, participants and faculty offer their insights.
August - September	**Post Program Analysis**	- Analyze data and assemble report including recommendations for next time. Note what worked well and what should be improved. - Decide on planning agenda for the following year or next iteration of the program.	A learning community has been established.

SESSION ONE – SAMPLE AGENDA – *REU Science Communication Workshop*

NOTE: Session One has been delivered in a format condensed to as little as 120 minutes and as long as four and one-half hours (including lunch and two rounds of small group oral presentation exercises). It may be customized to any length. However, it should be noted that when it is run in a condensed fashion, student feedback invariably indicates they wanted more time practicing in small groups; and while the extended version earns more kudos; even then, students hunger for more practice time in small groups. The variety of Session One's activities seems to make the extended time go by quickly for students, even if they came in with low expectations. The chance to respond to feedback and to deliver the oral introduction a second time is a validating experience for most students. We also recommend finding a way to get all the students to take the pre-survey a few days before Session One begins, either in person at their program orientation or online. They are appreciative that we've taken the time to learn something about them when we open Session One by sharing with them what we learned about their group from the survey. The survey results also help us fine-tune our emphasis during the Workshop sessions. [**ALSO NOTE:** Details and guides for most of the activities listed in this agenda are included in a later section of the Guide. Hand-outs and signage are included in the Document Appendix and slide files are included in the Digital Appendix.]

11:30 Arrival Time and Informal Welcome

Preparation Notes: Walk in music; lunch buffet; nametags coded with small group assignments; pre-assigned clearly numbered tables with student packets and pre-survey forms if students have not already completed them. Lunch table small group discussion assignments placed in stand-up clear plastic sign stands at each table. Greet students as they arrive and direct to buffet and to assigned lunch table groups. Ask them to turn off cell phones and to begin the Lunch Table Activity when most students have arrived. During the Activity, brief mentor/facilitators on their roles.

11:45 Lunch Table Activity

Students take turns introducing themselves and their summer research assignments as they understand them thus far. Instructions for this activity are posted in a vertical plastic sign stand on each table.

12:15 Welcome and Introduction to Science Communication

- Overview of SCW two-session sequence.
- Goals for Session One.
- What we know about this group and your prior experience in science communication: report on pre-survey results.
- Importance of good communication skills in science, especially in an era of increasing specialization yet increasing need for interdisciplinary effort.
- Debrief of lunch table discussion assignment**:** The challenges of speaking to a group.
- *The secret is practice.*

12:30 (*Really Bad)* Sample Research Presentation

Workshop leader or "invited speaker" gives a straight-faced research presentation with slides embodying many of the worst research presentation and slide design practices, while students gradually catch on that this is a spoof. [Details on this activity are provided later on in this guide, and materials are included.]

12:35 Debrief of *(Really Bad)* Sample Research Presentation

Workshop leader admits to spoof and guides discussion of specific negative attributes of the sample research presentation and accompanying slides, teasing out what practices make a presentation successful or successful. [Option to alert students to hand-out in packet: "Presentation Pointers" back-to-back with "PowerPoint Pointers."

12:45 Connecting to Your Audience

Discussion of key aspects of successful face-to-face communication strategies. Making contact: eyes, gestures, movement, *being there.*

- Landing points; using pauses [hands-on sports analogy].
- Gauging your audience [mis-matched sports equipment analogy].
- Telling a story; having a beginning, middle and end.
- Balancing the *what* and the *why.*
- Balancing audience attention between you and your slides.

12:55 Sample video clips of researchers connecting to their audiences

With guiding commentary and discussion with students.

[Please Note: Because of limitations on the size of files allowed for upload to nisenet.org, the PowerPoint slides for this segment posted on that site contain only still images and labels representing the video clips at this time. Please contact nano@mos.org to arrange for the video files to be sent via DVD or a large file sending service, if you are using materials downloaded from the NISE Net Catalog.]

1:05 Break

1:15 Exploring Context and Meaning

- Leader asks students to pull from their packet the back-to-back "Science Communication" and "5-Minute Intro Talk" assignment sheet, and discusses the concept of discovering and addressing the broader context of their science and engineering research projects.
- Leader may use the physical Box-within-a-Box analogy (prop).
- Optional add-on: engage in exploratory sample dialog with one or two students, in a Socratic demonstration of the process of discovering the broader context of a short-term research project.

1:25 Brief Writing Exercise: Context and Meaning

All students take five minutes to write an introductory statement about their research project that addresses its larger context and meaning.

1:30 Debrief of Writing Exercise

Workshop leader inquires about the challenge presented by this assignment. Students volunteer to share their statements with the group and leader provides gentle guidance to clarify goals of this exercise.

1:45 Research Introductions Activity: Instructions and Preparation

Students are given 3-5 minutes to prepare a brief oral introduction to themselves and to their research projects, which they will shortly deliver. They are reminded of the oral presentation practices reviewed previously. They may sit and write, or wander

around the room, practicing on their own.

1:55 Research Introductions Activity: In Small Groups

Students split into pre-assigned groups based on the second code on their nametags, with one mentor/facilitator assigned to each group. The whole group can stand during this exercise or just the presenting student can stand. The workshop leader gives guidance on constructive feedback. Mentor/facilitators serve as timers. Each student has three minutes maximum to speak; and receives a total of five minutes of feedback from the listeners. Each listener is required to offer at least at least one specific piece of praise and at least one specific suggestion for improvement. The mentors should take their turn last so as to encourage the students to practice making their own reflections and analysis of the talks. The length of time this exercise takes depends on the number of students in each group, according to the formula: Time = (3 minutes speaking time per student + 5 minutes feedback time per student) x (# of students per group). Ensuring every student gets their full quota of attention is a key job for the facilitator, as well as gently coaching them in providing constructive feedback - paying attention to oral presentation skills as well as content. We counsel groups that finish their task ahead of others to start going around their circle or table once again, making improvements based on feedback they've received.

2:30 Debrief: Research Introductions Activity

The workshop leader orchestrates a group debriefing session, drawing out commentary on the challenges this exercise can present, and advises the group on importance of advance preparation and practice. The leader may also invite one or several students to deliver their introduction to the group as a whole and to provide gentle commentary.

We highly recommend giving the students an opportunity to repeat this exercise, as it allows them to begin the process of iterative improvement of their presentations immediately following the first round of feedback; however, if time is limited, there is a quick wrap-up.

2:45 Abbreviated Session Wrap-up

- Review of key points, assignments, and hand-outs.
- Preview of what will happen at next session.
- Acknowledgements.
- Completion of Post-Survey.
- Optional: Group photograph and good cheer.

3:00 Adjourn

OR…

2:50 Preparation for Second Round of Research Introductions

Students take a brief break and are given about 10 minutes to rework their research introduction presentation based on the feedback they've received. They reassemble into

pre-assigned groups that include some fresh ears as well as at least one member of their prior group who can comment on how well the student responded to the feedback given.

3:00 Second Round of Research Introduction Presentations in Small Groups
This round can be shortened by asking students to keep their introductions to two minutes each and by reducing total feedback time to four minutes per person.

3:30 Brief Debrief of Second Round

3:40 Optional: PowerPoint Slides: A Few Design Tips
This is a pretty quick PowerPoint presentation [in digital appendix], with time for questions. We've found that most students these days have had experience designing and delivering slides in high school and during their freshman year. Our focus is on avoiding the most egregious errors.

3:50 (Extended) Session Wrap-up

- Review of key points, assignments, and hand-outs.
- Preview what will happen at next session.
- Acknowledgements.
- Completion of post-survey.
- Optional: Group photograph and good cheer.

4:00 Adjourn

<u>Ideas for Streamlining Session One – if limited to two hours</u>

- *Leave out one or more of the following:*
  - *Lunch and Lunch Table Activity*
  - *Sample Research Presentation and Debrief*
  - *Sample Video Clips of Researchers Connecting to their Audiences*
  - *PowerPoint Slides: A Few Design Tips*
  - *Second Round of Research Introductions and Debrief*
- *Condense Workshop Leader content*
- *Use Abbreviated Session Wrap-Up*

SESSION TWO – SAMPLE AGENDA – *REU Science Communication Workshop*

Note: The bulk of Session Two takes place in small groups, as students deliver the first 5-10 minutes of their final research presentations or posters and provide constructive feedback to each other. The major burden here for organizers is to arrange enough nearby break-out rooms or spaces (usually 4 to 6 for 24 students) for presentations to occur simultaneously without obvious distractions. This also requires being able to provide or borrow up to six laptops, computer projectors, and screens for each small group. Sometimes two or more groups can occupy different sections of a single large workshop room, but try to ensure some sound and visual barriers, for instance, by using folding room panels. Small group facilitators and the workshop leader should be able to coordinate timing through advance planning, but mobile phone communication between groups is also beneficial to coordinate the moment of reassembly of the full group. It is recommended that students deliver their slide presentations by a strict deadline on the day prior to the session (by email or file server), so that the presentations can be sorted into laptops or flash drives by pre-assigned groups.

11:30 Arrival Time and Informal Welcome

Preparation Notes: Walk in music; lunch buffet or cafeteria vouchers; nametags coded with small group assignments; pre-assigned clearly numbered tables with student packets and pre-survey forms if students have not already completed them. Greet students as they arrive and direct to buffet and to assigned lunch table groups. Ask them to turn off cell phones. The Lunch Table Activity prompts students to share "aha moments" and "bloopers" from their research experience, in an effort to warm them up to story-telling. Remind them to make eye contact, engage their listeners, and land their points. Pick up completed surveys before beginning the Session. During Lunch Meet with faculty and facilitators to go over logistics of the day and to distribute laptops (or files on flash drives) pre-loaded with the presentations of the students in their groups.

12:15 Welcome and Introduction to Session Two

- Timeline and logistics for the day.
- If appropriate, brief students on findings from post-Session One surveys.
- Debrief students their observations, experiences, and assignments, since Session One.

12:30 Warm-up with Brief Oral Research Introductions

- Remind students of some of the oral presentation skills they practiced in Session One: being present, connecting with the audience, making eye contact, landing points, using gestures, choosing non-technical language.
- Students gather in pre-assigned groups of 3-6, with facilitators.
- One quick round with 1-2 minutes for each student to speak, followed by a three-minute round of constructive feedback. Instructions are to introduce themselves and their research to students majoring in economics or history. Encourage them to do this standing up in a group.
- Students may have a chance to go around again.
- Leader may invite one or two students to try their talk in front of the whole group.

1:00 Guidelines for Small Group Research Presentations

- Logistical instructions – pre-assigned groups, group leaders, rooms, when to return.
- Activity instructions – 5-10 minutes presentation time (group leader should decide on time limit in advance), followed by 5 minutes of individual reflection time using Research Presentation Reflection Sheets, followed by 5 of verbal feedback time from

group members, then proceeding to the next student. Facilitator will collect Reflection Sheets in separate piles for each student to give them after everyone has had a turn.
- Small groups move off to small meeting spaces.

1:15 Small Group Research Presentations
Pre-assigned groups and rooms.

3:00 Debrief and Discussion *(All groups return to the main meeting room.)*
- Workshop leader draws students into discussion about the challenges they faced giving their talks, the value gained by practicing in advance (polling the room to see how many did, how many practiced aloud, or in front of others), how today's experience will impact their preparations for finalizing their presentation and delivering it in front of an audience at the university.
- Q & A, and further advice.
- Logistical information from faculty on next steps.

3:30 Closing Remarks and Post-Survey
[Note: It's nice to make a celebratory ending. Buy a sheet cake with a congratulatory message; take a group photo; etc. Invite students to tour museum, if you are in a museum. Wish them luck and remind them to practice.

4:00 Adjourn

Note: We suggest workshop leaders try to attend the students' final presentations. The students and faculty appreciate it; and it is wonderful to see the results of your work together.

Materials List for *REU Science Communication Workshop* Session <u>One</u>

- Nametags (marked with pre-assigned small groups)
- Large workshop room with tables and chairs, water and trash cans
- MP3 or CD player and walk-in music (optional)
- Laptop, projector, and screen for slides
- Instructions/Guidelines for facilitators
- 4-6 vertical clear plastic holders with Lunch Table Activity instructions and table group number
- Pre- and Post-Survey Instruments (we recommend having students take pre-survey during a prior orientation event, so that results are available for this session)
- Student packets including the following handouts:
    - "Intro to Science Communication" back-to-back with "Five-Minute Introduction to Your Research Assignment"
    - "Presentation Pointers" back-to-back with "Slide Pointers"
    - "Research Presentation Reflection Sheet"
    - "A Field Guide for Poster Sessions"
    - "Additional Science Communication Resources" list
    - Museum Map and Schedule (optional)
- Mentor/Facilitator Guidance Document
- Pens, pads
- Optional timing devices with gentle alarms
- "Bad Presentation" PowerPoint and presenter
- Soft volleyball or soccer ball.
- Baseball mitt, basketball, and ping pong ball (or other mis-matched sporting equipment)
- Lunch vouchers, boxed lunches or lunch buffet, and/or snacks.
- Bottles of water
- Camera for documenting the Workshop
- "Box within a Box" demo prop (optional)

    The "Box within a Box" is a hand-assembled aggregate prop used to illustrate the way one small undergraduate research project is usually part of a set of research investigations which are themselves explorations of a greater research or design challenge which is aimed at securing important knowledge or providing a possible solution to a major social, economic, or technical challenge we face. We like to use a see-through plastic storage box, about 24"x 15" x 15." Inside we put smaller boxes, with other smaller boxes or items inside them. We also scatter toy scientific equipment, and things like calculators, telephones (for collaborative efforts), joke items, etc.

Materials List for *REU Science Communication Workshop* Session Two

- Nametags (marked with pre-assigned small groups)
- Large workshop room with tables and chairs, water and trash cans
- MP3 or CD player and walk-in music (optional)
- 4-6 break-out rooms or spaces, each suitable for a presenter with PowerPoint slides and 4-6 audience members
- A laptop, projector and screen for each break-out room, preferably allowing speaker to control the slides from the laptop itself
- Optional timing devices with gentle alarms for each break-out group
- Six empty file folders or 9x12 envelopes for each break-out group
- Pre- and post Session surveys
- Packets for each student including the following handouts:
    - "Presentation Pointers" back-to-back with "Slide Pointers"
    - 6 Research Presentation Reflection Sheets
    - Museum Map and Schedule (optional)
- Mentor/Facilitator Guidance Document
- Pens, pads
- Soft volleyball or soccer ball
- Lunch vouchers, boxed lunches or lunch buffet, and/or snacks
- Bottles of water
- Camera for documenting the Workshop
- Celebratory "graduation" cake and/or fun workshop completion certificates

SESSION ONE - Sample Workshop Leader Commentary, Notes & Activity Guides

NOTE: This is a detailed walk-through for the full-length version of Session One, including sample commentary, notes, activity guides and instructions. It is provided as a rough guide to help new workshop leaders prepare their own approaches. Please refer back to the Session One Sample Agenda to see where these sections fit in. An optional set of PowerPoint files is included in the digital appendix to this package. The beginning of this talk relies on having been able to get almost 100% participation in the pre-survey, with results analyzed before the session begins. (It is for this reason that we recommend working with the REU program organizers to have the students complete the survey at their first orientation meeting, or online during the prior week. The survey results used in the talk below reflect the results from one of our groups; you can substitute your own findings.)

[The session will have begin with the Lunch Table Activity – refer to the Session One Agenda for details.]

Welcome and Introduction to Science Communication

Hello, my name is _____ and we're delighted to be hosting you here today at [this institution]. How many of you have come [to the Museum] previously? Welcome back. How many of you have never been here before? Welcome! Please feel free to stay and explore the museum after the Workshop has ended. We've included a Museum map and schedule in your packets.

[Optional: Introduce other workshop facilitators. Give brief background – this can a briefing on the university-museum partnership, its aspirations and joint activities.]

Today, we're going to take you through a number of experiences that will help you begin to sharpen your science communication skills, and when you return, on [date], you'll have a chance to practice your final research presentation here, in small groups, before you deliver it to the intended audience.

Our first goal for this session was to convince you that a successful career in science requires very good communication skills.

But, we looked at your Surveys and found out that already [76%] of you rated good science communication skills of high importance to a career in science. And the remaining [24%] of you said rated them as "moderately high" in importance." So, we figured we have already aced that workshop goal. [These figures are from a pre-survey we did with one cohort of students; substitute your own findings.]

As you know, science communication includes not just papers and presentations, but also job interviews, reports to funders and reviewers, and teaching.

Our next goal was to help you develop those skills.

And from the survey we learned that there is still work for us to do together:

- While [76%] of you know that science communication skills are of high importance to a career in science, [71%] have not participated in a science communication workshop as of the first week of this program.

- [32%] of you have never had any kind of presentation workshop experience, whether about science communication or any other topic.
- About a third of you have never given an oral presentation on science or engineering
- And, while almost all of you have experience using a digital slide presentation program like PowerPoint or Keynote; [37%] of you have not yet used one for a science presentation

So, clearly there is work we can do here to help you develop your oral research communication skills and your integration of slides into those presentations. By the way, has anyone noticed that I'm not using slides in this presentation to you? Why do you think that is? [relevant answers include: no need for slides to convey the information that was being conveyed; preference to stay in direct face-to-face, eye-to-eye communication, rather than audience eyes on a screen; freeing up the presenter to move around among the audience, etc.]

Now, I think it's going to be pretty easy for all of you to improve your science presentation skills. In fact most of you already rate yourselves at moderate or better proficiency in delivering oral presentations;

But there's one big caveat:

- Only [31%] of you actually feel comfortable giving them. Many of you talked about stage fright. Being nervous in front of a group. Worrying that you would get asked a question you couldn't answer.

<u>Debrief introduction exercise</u>

- So let me ask you – what was it like doing your lunch table exercise, how hard was it to introduce yourself and try to describe your research project?

- Our goal today is to try to make standing up in front of a group and introducing yourself and your work as easy and non-threatening as having a casual lunch conversation about what you're doing in the lab this summer.

- The best cure for nervousness? Advance preparation, practice, even rehearsal. *The secret is practice.*

- Questions? Some of you are nervous about handling them. Here's what you do: it's not an oral quiz. You don't have to guess at the answer. If it's a good or interesting question, let the questioner know you think so. Take a deep breath. If you know the answer, give it. If you don't know the answer, be frank about it. Ask if anyone else knows. Suggest what might be done to find out the answer.

[The Workshop leader transitions to the *(Really Bad)* Sample Research Presentation Activity]

(see details for this activity on the next page..)

(Really Bad) Sample Research Presentation Activity

Note: This workshop element is a great ice-breaker and critical thinking stimulator delivered fairly early in the first session. We present a guest researcher speaker (another staff member or acting talent) who is going to model current research presentation practices. In fact, their presentation and slides incorporate many of the common mistakes and annoying mannerisms that plague lecture halls and conference sessions. Participants experience some incredulity and discomfort on the way to gradually "discovering" the hoax, even though the workshop leader and mentors play it "straight-faced." We then ask the participants to help us identify all the "less than best practice" elements of the presentation, as a step toward clarifying what good practices actually are. This debrief can be a Socratic give and take, with the workshop leader prompting areas the participants may be missing. The leader can use pads and easels or white boards to jot down participant input; we find it just as effective to reiterate and clarify what is being brought up verbally with the group. Below is a sample script for the "Really Bad Presentation" and the two sets of PowerPoint slides that accompany it are included in the Digital File Appendix of this Workshop Package, along with an image of the presenter's laptop "desktop." The presentation script and slides were developed by Karine Thate, and further "seasoned" over a few brainstorming sessions with Jeanne Antill, Lorraine Grosslight, and Carol Lynn Alpert. Users of this guide are welcome to create their own "Really Bad Presentations," or to modify this one. For our presentation, we worked with Lorraine Grosslight, a Museum of Science staff member and actress, to create a persona for the "guest researcher," Dr. Lorraine Fisher-Katz from M.I.T. It's best if the person who "plays" Dr. Katz has some acting skills and practices the skit in advance. We always have technical difficulties in the beginning; for instance, Dr. Katz first opens the wrong presentation and has to go back to her desktop to find the right folder. In the meantime, we see a silly kitty screensaver and some folders with fairly frank and humorous names. Throughout the presentation, Dr. Katz avoids eye contact, rushes through her material, often reads her slides with her back to the audience; at times seems bored, distracted, rude and/or dismissive; and she makes faulty assumptions about the technical background of the audience. She rejects questions and uses her squiggly bright green laser pointer constantly and somewhat randomly. Her slides are atrocious, a gallery of mismatched fonts and colors and inscrutable graphics. The slides have goofy transition sound effects.

Props: Podium, microphone, if necessary, slide projector, screen, bright green laser pointer, cell phone; laptop loaded with the desktop image file ("Bad Presentation Desktop.pdf") and the two PowerPoint files for this presentation [located in the Digital Appendix]. The one called "CMOS-FET 1" is the "false start" presentation; the other, called "Beyond CMOS-FET v2 for REU Workshop" is the main presentation. The script notes for the talk also appear in the Presentation Tools or Presenter View version of the "Beyond CMOSFET v2" PowerPoint.

(Really Bad) Sample Research Presentation

[The workshop leader introduces the next agenda item, "Sample Research Presentation," saying something like, "Today we are delighted to have in the museum a nanoelectronics researcher and very experienced science communicator from MIT who has generously offered to treat us to a ten-minute research talk on her work in the very exciting field of "next generation computing." This talk models many of the sorts of practices we've seen recently in research presentations. Please join me in welcoming Dr. Lorraine Fisher-Katz (applause, "Dr. Fisher-Katz" takes the podium.]

Dr. Katz's Talk

[False Start PPT slide 1 – a black/blank slide] –
Dr. Katz: Thanks. Well, I'm here to talk to you about a really important topic that affects all of us… [click to slide 2]

[Slide 2 – Nanoelectronics Research Initiatives…] –
Dr. Katz: Oh wait, that's not the right presentation. I'm so sorry… *[flustered]…* this never happens to me… let me find the right presentation… *[fumbles around on computer desktop with cute kitty cat photo and cluttered with inappropriate file names-the "Bad Presentation Desktop"]* I think this is it… let's see… Yup, okay. Let's start over… *[closes false start presentation and opens second presentation, "Beyond CMOSFET.."].*

[Slide 1 – new presentation – cluttered with logos]
Dr. Katz: I'm going to be telling you about Nanoelectronics Research Initiatives in the Beyond CMOS FET arena. We've been very lucky to work with a number of organizations who are supporting our work and I want to recognize them.

[Slide 2]
Dr. Katz: So let's jump right in.

[Dr. Katz begins to read directly from the slide with her back to the audience - squiggling the laser pointer around - reading fast with monotone voice.]

We all know that CMOS FET is an optimal electronic switch as shown the following equations for minimum energy per bit based on optimal switching time and gate density (and of course assuming the switch is at thermal equilibrium) -This equation basically describes Landauer's principle - any logically irreversible manipulation of information such as the erasure of a bit or merging of 2 computational paths, must be accompanied by a corresponding entropy increase in non-information bearing degrees of freedom.

[Turns to the audience.] You guys with me? Great. *[turns back without giving anyone a chance to answer)*.

[Planted staff member interrupts:] Actually, Dr. Katz, I do have a question… could you explain…

[Dr. Katz cuts off the questioner:] Actually, lets save questions for the end, or we won't have enough time to get through all this.

[Slide 3]
Dr. Katz: - OK - so now let's get into the nitty gritty. MOS FETs suffer from very fundamental and unavoidable limitations.
[Pulls out cell phone] Limitations - which if we don't figure out how to overcome, we're never going to be able to make next generation electronics like a smaller better cell phone … Oh look, I have a text… excuse me, this is important…*[texts a moment]..* Date tonight! *[puts phone away without apology]*

[Reads first 2 bullets from slide verbatim, back turned on audience, squiggling laser pointer around and mumbling - sometimes loud and sometimes quiet.]
Actually, you get the gist of this so let's move on….

[Slide 4]
Dr. Katz: - Actually, this slide is a bit over your heads, so let's just skip it… *[clicks past the next THREE slides, mumbling to herself.]*

[Slide 5 – Skip]

[Slide 6 – Skip]

[Slide 7]
Dr. Katz: So, now that we've identified the problem with existing technologies and understand how emerging technologies and nano devices need to fill that void - let's look at some of the solutions - devices in the pipeline…. I'm really pleased how this graph came out - it was so hard to fit everything on a single graphic - but you can see the cost on one axis, compared to the switching time and size on other axes - keep in mind they're all represented with log scales. *[She leaves the podium to step in front of screen and point directly to parts of the slide, casting a shadow and blocking part of the slide – she turns to audience and keeps talking with part of the slide projected over her face - squinting because of the glare].*
And the colors represent energy density - and you can see we have everything from Quantum technologies to biologically inspired devices in dark blue. The NEMS in light blue and even plastic solutions too. So that pretty much summarizes where we are with emerging technologies that will solve the problems and limitations we've faced with current nanoscale CMOS FET technologies.

[Slide 8]
Dr. Katz: And that's pretty much it…. I'm done…. Good luck with whatever you're trying to do here. *[we strive for as awkward an ending as possible].*

[By the end of the presentation, the joke is obvious and participants may be laughing. The workshop leader makes a show of shutting the talk down, sometimes using a film slate snapping shut and yelling "Cut!" - but then clapping and thanking Dr. Katz and reintroducing her with her real name as a museum staff member or actress, playing Dr. Katz. Then the workshop leader turns to the participants and invites them to share their experiences of the presentation…]

Debrief of *(Really Bad)* Sample Research Presentation

[Note: this is a Socratic type questioning session, drawing out discussion, underlining salient points to remember. This can also begin as a "Think-Pair-Share," where students pair off and first compare notes about what was so bad, and when they realized it was a farce.]

Sample Workshop Leader Questions:

- When did you start to wonder whether this presentation was a spoof, or that something wasn't quite right here?
- Did any of you think that the presentation was targeted at the wrong audience?
- Have any of you ever seen real research presentations or lectures that embodied some of the bad practices dramatized here?
- [for a shy audience, try some prompts like, "Anyone ever seen a speaker use a laser pointer in the annoying way? How about speakers who turn their back on the audience and read their slides aloud?" etc. Here are some other issues to bring up: Technical fumbling at beginning – not having slide presentation cued up and ready to go. (Anyone ever seen that happen at a conference?); use of inexplicable jargon and acronyms; checking smart phone during the talk; squiggly constant use of laser pointer; packed slides, logos all over the place; making bad assumptions about what audience knew and didn't know; not having an ending; little contextualization with the broader context of her work; skipping slides; awkward handling of questions; throwing shadow over screen; etc.]

[Continue in this manner until almost all the bad practices built into the script, the slides, and the speaker's delivery have been noticed. Then, ask…]

- What lessons might we take from this experience, about what makes a truly good research presentation? What are your thoughts?

Connecting to Your Audience

Note: This part of Session One picks up on the lessons learned from the "*really bad* research presentation," focusing on key aspects of successful face-to-face communication strategies.

The workshop leader addresses the following topics:

[It is good to move around the room, making eye contact.]

- **Live presentations** are about being authentic, genuine, and truly in the room with your audience. Not to be an automaton reading your notes off the screen, but a live intelligence. sharing your thoughts with a group. Otherwise, why are you there? Why not just a book, or an article, or a video recording? So, give it life, personality, authenticity; interact, tell a story.

- **Communication:** It's not just you talking, and putting your information out there; the loop has to be closed; there is the audience listening, and actually receiving your communication.

- **What signals that live intelligence is at work?**

- Eye contact.
- Using your voice, gestures, dynamic movement.
- Being interested in what you yourself have to say.
- Telling it as a story. Having a 'hook' or an interesting question. Having a conclusion.
- Getting the audience involved.
- Landing your points.

Landing points; using pauses

Note: It can be very effective to demonstrate the following ideas with a soft volleyball throughout the discussion, making eye contact with an individual, landing a point while tossing it to them and cueing them to toss it back, and so forth, around the room.

Sample commentary for this:

Here, I make eye contact with you. I toss my thought to you. I watch it land with you. I anticipate your return. It's a connection – and a return. That's an effective exchange of information. You share a piece of yourself with another – you want to pay attention to what happens to that message, where it goes, and if it lands. And you get something back – the other person's attention, their acknowledgement that they received the message, a glint of understanding – hopefully – or perhaps confusion – a message to try a new way to connect to them. That's why eye contact is key to help make that connection and to make sure your message lands with the intended recipient. That is "being there." You have a roomful of people? That's fine. Treat them as a collection of individuals and still make eye contact and land individual points with individual members of the group. Make sure to spread the "love" around widely. Don't ignore one side of your audience. Be inclusive. Engage them all.

What does this do? Besides making you truly present in the room and with your audience it also slows you down. You might find yourself pausing between ideas, waiting for the toss back from an audience member. Now people often make the mistake of thinking that pausing and slowing down is going to increase the boredom and restlessness of their audience. Nothing could be further from the truth. Slowing down, delivering each point deliberately, makes each point more meaningful and drives it home. You will have time to formulate each though into a sentence. Your listeners will have time to digest it and stay with you wherever you are taking them. Instead of reading from your notes or slides, you will find yourself speaking from your own live intelligence, thoughtfully, in person, *being there.* Your audience will likely respond by being there too. Putting down their smartphones. Focusing their attention. Looking YOU in the eye.

Gauging your audience

Note: It's fun to demonstrate this by giving a baseball glove to a student volunteer and tossing the volleyball or Frisbee to him/her, and other sports examples like pitching a ping pong ball to someone with a plastic bat – lots of room for innovation here.

Sample commentary for this:

Science communication skills aren't just about you doing a good job describing your research; they're about how well your audience *understands* your research. So you need to think about who your audience is. Once you know your audience it makes it easier to craft your presentation. Do they need it in spoonfuls? Do they need your acronyms and units of measurement defined? Are they in your field or in another field of science? Are they people without much knowledge of current research. You wouldn't toss a basketball to a someone wearing a baseball mit. You don't want to pitch a ping pong ball to a batter if your team needs a home run. You get the idea. You want to shape your message and your delivery vehicle so that they match the needs and capacities of your audience.

Can you think of some things you might do for different audiences?
What should you do if audience is mixed? (Show the experienced scientists in the room that you know the jargon, but explain it for the rest of the folks.)

Don't forget the power of story: Telling a story about how you came up with the idea for your research project, or something that happened during it the course of it that became a key turning point. Stories are engaging and can also carry a lot of information. Just make sure that every story you tell has a beginning, a middle, and a satisfying or intriguing end.

Once you figure out who your audience is, you can adjust your language and the kinds of explanations you provide. More importantly, you can figure out what it might take them to care about what you're saying. Whether we like it or not, there is always a little lingering question in the mind of every listener: "why should I care?" Or, more bluntly, "what's in it for me?" And that takes us to our next subject…

Balancing The *What* and The *Why.*
[Slide 2 in the Session One PowerPoint has a fun graphic about this concept, put together by Tim Miller. Put it up after you have introduced the following idea.]

Sample commentary for this:
You see, your lab partners and your Ph.D. advisor already understand why you're spending two months trying to figure out how to get this molecule to bind to that specific receptor on that molecule, or tuning gold nanoshells to that one special wavelength of light. So, you can get right down to the nitty gritty with them –giving them "The What" - or how are you conducting your investigation. But other audiences may not understand why you're taking all the trouble to do this. They'll be too impatient with learning "The What," or how you did your research. You'll have to work harder to make them care. The best way to do that is to tell them about "The Why." Why on earth are you spending so many hours on this? What good could come of it? These audiences might include your funders, your soccer pals, or members of your family.

Connecting to Your Audience - Sample Video Clips
[Note: These are embedded in the PowerPoint file, after the What/Why slide.]

Sample commentary for this:
Now, I'm going to show you several 30-60 second video clips we're collected of some very good scientists connecting to their audiences about their research and their motivation for their research, in clear and compelling terms. I'd like you to notice not only how *well* they present the motivation for their research, but also how *relaxed* they are. Also, how well they make eye contact and land their points with their audience; and how they pause sometimes for dramatic effect. Other things you might notice are: how they use their slides as illustrations to their talks, rather than as the crib notes to their talk; and how well they orchestrate the timing of their slide changes; how they cue the audience when to look at the slide and when to look at them. [Before each clip, introduce the scientist briefly:]

- **Ainissa Ramirez**– She is a Yale researcher describing how she invented a special material to be used for solder. Pretty dull topic that she manages to introduce in such a way as to make it seem relevant. But notice her relaxed style, her eye contact. She shows you when to look at the screen and when to look her in the eye.

- This is a TED talk by **Bonnie Bassler.** She is a molecular biologist at Princeton who studies how bacteria communicate. Please notice how she uses a single provocative slide as a segue to a story that communicates just how fascinating her research question is, and why it motivates her to want to explore it.

- Another one that illustrates the fascination that can motivate research: Here is MIT nano researcher **Jeff Grossman** using an analogy and a careful sequence of slides to help his audience understand just how remarkable it is that the mere size of something could determine the color of the light it emits. Notice how he keeps his eyes on the audience, except when he directs them to look at a sequence of images on his slide.

- Now about process. We said "the what" can be boring. But it can also be told as an interesting story. Here is **Eric Mazur** of Harvard describing a sequence of events in the invention of a new room-temperature technique for pulling nanowires. He hadn't done an exhaustive literature review, as you will see, and he freely admits to the role of serendipity in science – how the spirit of just being willing to try something sometimes leads to interesting results. Notice his engagement with his audience and his sincerity.

- And here's **Professor Mazur** using the timing of his slides to make a very luminescent point. Again, no words on the slides, but superb timing showing his results.

- Here is **Don Ingber** of Harvard Medical School showing how a simple children's toy used as a prop, can be even more effective than a slide in helping people understand his discovery that cells are not just bags of cytoplasm; indeed they are highly engineered systems.

- In engineering, it can be easier to explain one's larger motivation. Here is **Pamela Silver** effectively communicating the motivation behind her research in synthetic biology. Notice how she makes eye contact and her use of a simple pictorial slide.

- And one more, because I'm about to ask you to spend 5 minutes writing about the motivation of the research in your lab group, watch how Harvard chemist **George Whitesides** tells you what motivates him to get up and go into the lab every morning.

Exploring Context and Meaning

[Leader asks students to pull from their packet the back-to-back "Science Communication" and "5-Minute Intro Talk" assignment sheet, and discusses the concept of discovering and addressing the broader context of their science and engineering research projects.]

The Box Analogy

[Note: The Box is a prop filled with props. We use a clear plastic storage box about 24 x 18 x18 with a clear plastic lid. We fill it with lots of boxes nested within boxes, dice, toy science equipment, an old corded telephone, some spring-loaded joke store streamers, etc.]

Sample commentary for this:

We are going to do a brief writing exercise in just a minute, but I want to make a stronger point to you about context and meaning. I have a box here. And I'm going to say that this box represents a collection of efforts to address a big challenge that human beings face. It could be that the box is about slowing global climate change. Or, it could be about finding a cure for cancer. Or it could be about developing the next computing paradigm beyond CMOS. If I open up this box, I find a lot of research projects that teams of researchers are pursuing, working toward solutions to this challenge. [Here you riff on whatever you have collected in the box: I use the toy scientific equipment to talk about different approaches different labs are using; I answer the corded phone to talk with international collaborators; I note a few surprises in the research and set off some spring-loaded streamers; then I take out a box, and say…] Let's say your lab is working on this approach to the challenge, and (open box to find smaller boxes and set of dice) and one graduate student is working on this part of the problem, and this post-doc is working on this approach with a few undergrads, and a collaborator is trying a really chancy approach (use the dice), and your mentor is doing this experiment (open another small container, find a matchbox); and this is YOUR summer research project, which is contributing to this approach, which is part of the bigger overall investigation your lab is taking on, and all of it is to try this (larger box) particular approach to this gigantic challenge we all face (the big box). So, if I'm not familiar with your lab's investigations, and you start talking to me about this (matchbox) problem you're trying to address – I'm not likely to know what the heck you're talking about, nor will I care. But if you begin by introducing me to this overall (big box) challenge – and it's something I can identify with, or understand why people care about it, then, I might be interested in the approach your lab is taking, and what you have been doing to move that research along.

Unless you brief your audience on what this larger overall goal is about – unless you find a way to connect your day-to-day work with a larger human goal or purpose, very few people will have the stamina to listen to the details of your progress. So, when you're trying to share your

science with people outside your lab or your area – say, with your gang from the neighborhood, or, your soccer buddies, or your little brother or sister, you have to think about a way to capture their attention, hook their interest, understand why you care and why they should care about what you do. Our jargon for this is "context and meaning." You supply context for your efforts and help make them meaningful.

[Optional Socratic exercise: engage in exploratory sample dialog with one or two students, in a Socratic demonstration of the process of discovering the broader context of a short-term research project.]

Context and Meaning Brief Writing Exercise

Sample commentary for this:
Now, I'd like everyone to take out a pen and paper, or use the ones we've left on the tables. You're going to take 3-5 minutes to write a few sentences describing your research project to a 16-year old. Try to start with the overall challenge you are addressing that tells me why I should care about your work. Then tell me how your research project fits in; why it matters. Now, I recognize that some of you may not know the answer to this question yet. You've only just arrived a week or two ago. That's OK. When you go back to your lab tomorrow, you're going to schedule some time to sit down and talk to your mentor or lab director and find out the answer. In the meantime, you can make up a context and meaning. Sometimes its just pure science – we want to know what happens, when X. Yes, but WHY do you want to know? OK, we're not collected these and you don't have to share them, but you do need to spend the next few minutes writing them. Go ahead.

Debrief of Writing Exercise
Cue them when there's just a minute left. When the time is up have them partner and read their statements to each other. Then ask for volunteers to read their statement to the group. Have them stand up and make eye contact before they read aloud. Be very encouraging and point out what worked and didn't work, or ask them a few questions to try to get clarification. Applaud each volunteer.

Research Introductions Activity

Instructions and Preparation for Small Group Work

Sample commentary for this:
In a minute we're going to take a stretch break, and then each of you is going to prepare a 3-5 minute oral presentation introduction to your research project. You're going to begin by making eye contact with everyone in your group, introducing yourself, and saying where you are from, and what lab you are working in. Then you are going to tell the others what larger societal challenge or research problem your lab group is trying to address. In the future, how might people benefit from these research efforts? (If you don't know, make it

up!). Then, tell how your research project is designed to contribute to the work of the group, and if you have time, how you are going to approach it.

So you have ten minutes. You can go the restroom, get some water, sit down and write out what you want to say, or walk around the room rehearsing it to yourself. Then I'll call you back and you will share what you have come up with, with your group.

Small Group Work

[Note: A mentor/facilitator is assigned to each group. Their instructions are included in the resource and hand-out section of this guide. Their role is to set a tone for encouragement, courtesy, and constructive feedback, to keep each student to a pre-established time (usually 3 minutes), to ensure each group member offers feedback – at least one positive comment and at least one suggestion for improvement. It is very important that each student contributes each time. The mentor/facilitator should give comments last. Comments should address oral delivery and audience connection as well as content. If a group finishes before the other groups, it can start going around a second time, with improvements.]

Timing Considerations:

- (3 minute intro from each student) + (total of 5 minutes of feedback from group) = 8 minutes per student.
- (8 minutes) x (number of students in largest group) = total time allotted for this exercise.

Debrief: Research Introductions Activity

The workshop leader asks for comments from the group about their experience. It's good to make the point that it makes sense to prepare and practice a three-minute talk like this that they can pull out of their pocket when they are asked what they are doing this summer (or other time of year). Encourage them to try it out. If there is time, it is good to ask for volunteers to deliver their introductory talk in front of the whole group. Reinforce what they are doing well, and provide some pointers for how to improve.

Second Round of Research Introductions (Optional)

If there is time, you may want to split the group up again and do another round. (It sounds tiresome to contemplate this, but all of our evaluation studies show that students want to have at least another go at this, after they've received the initial round of feedback. And our main message is that THE SECRET IS PRACTICE.) The second round can be shortened, by reducing feedback to a minute or two. We like to mix up the groups for the second round (and we do this by coding the nametags in advance). This way, each student is addressing some fresh ears as well as some others who have heard the prior version. They can get feedback on both how they do on a first impression and how their performance improves from the last round.

Optional: PowerPoint Slides: A Few Design Tips

We've found that most college students these days feel pretty confident about making digital slide presentations, so we cover this terrain pretty quickly. We spend more time earlier in the day discussing how to interact with one's slides, and how to ensure that attention to slides is directed in purposeful ways, and how, at other times, one would rather have the audience watching and listening to the presenter rather than reading or staring at the slides. This brief segment goes over briefly some of the major do's (and mostly don'ts) of slide graphic design, and introduces ways of using slides as illustrations and for impact. The sequence also introduces the Presenter Tools feature on PowerPoint, which can aid speakers by having their notes present on their laptop screen – but not on the projection screen. This segment is included in the Digital File Appendix, and the notes for the talk are in the Notes section of the PPT file.

Session Wrap-Up: Concluding Thoughts and Assignments

Note: Session One ends with a wrap-up discussion of assignments, advice about practice, and instructions about how to prepare for Session Two. We go through each of the hand-outs in the packet:

- "Intro to Science Communication" back-to-back with "Five-Minute Introduction to Your Research Assignment." The Science Communication sheet summarizes some of the themes of the day. The "Five-Minute Introduction" contains the assignment – what students will come back prepared to do in Session Two.

- "Presentation Pointers" back-to-back with "Slide Pointers." These two sheets summarize the presentation and slide advice covered in Session One.

- "Research Presentation Reflection Sheet." We go over this sheet together, letting the students know that this is the rubric that we will all use to help us give feedback during Session Two.

- "A Field Guide for Poster Sessions." Some REU students are required to do posters, and we provide this sheet as a tool to help them observe a poster session in a spirit of inquiry, to see for themselves what style of posters and poster presentations seem most effective.

- "Additional Science Communication Resources." This is a list compiled by Karine Thate with useful websites, books and articles about science communication.

- If the workshop is taking place in a Science Museum, we often provide a map and guide to the Museum's offerings. We often try to schedule the workshop on a day the Museum is open late, so students can take advantage of its offerings.

It is good to emphasize to students the importance of observation and practice. Advise them to pay attention to the different ways they see science presented in the classroom, the media, and elsewhere. Advise them to notice when they attend a good presentation, what characteristics made it good. And finally, advise them to practice. Stress to them that there is no substitute for

actually practicing their presentation aloud, either alone or with friends, before they give their presentation at the next session. It will make a world of difference.

Post-Survey Forms

If you are using a post-survey, ask the students to fill it out and hand it to you before they leave the room.

Adjourn

Wish them luck!

SESSION TWO - Sample Workshop Leader Commentary & Notes

NOTE: This section includes some expanded notes and sample leader commentary for two of the activity/discussion sections that take place in Session Two. Please refer back to the Session Two Sample Agenda to see where these sections fit in and for logistical instructions on the small group activities. The survey results used in the talk below reflect the results from one of our groups; you can substitute your own findings if you used the Session One post-survey.

[The session will have begun with the Lunch Table Activity and completion of pre-surveys– refer to the Session One Agenda for these details.]

Welcome and Introduction to Session Two

- Welcome back for our second Science Communication Workshop. We hope you've had a very interesting, challenging and fulfilling research experience so far, and we are looking forward to seeing the first parts of your final research presentations today. [Option to introduce any new people present; provide timeline and logistics details…]

- Debrief students their observations, experiences, and assignments, since Session One, with inquiries such as:
    - Did you find yourselves observing science talks and lectures with a more critical eye? Did any of you see presenters making some of the same mistakes as Dr. Katz? What did you notice; what advice did you want to give the presenters?
    - Did you attend any poster sessions? If so, what did you notice; what kinds of poster presentations seemed most effective? Did you use the Field Guide?
    - Did you find yourself asking graduate students, post-docs, or faculty about the context and meaning of their research? How have these conversations influenced your perceptions, understanding, and sense of connection with the researcher(s)?
    - Did you practice your brief research introductions with various individuals? What did you notice? Did you find yourself making creative adjustments to them based on the listener's prior experience?

- Based on your lunch conversations, does anyone have any really good bloopers or 'aha' moments they want to share? Research doesn't always go exactly as planned and the 'ahas' and bloopers are all normal parts of the research process - and they can really spice up your presentation. [Try to get a few stories….]

- Now I'd like to report out to you some of what we learned from your post-Session One surveys last time you were here. Based on those surveys, the elements of that workshop that you found most useful were the small group practice, and the oral presentation advice. You also really valued the feedback you got from peers and faculty. [Substitute your own findings here].

- Many of you even noted that if we'd had more time, you would've liked to do practice even more - perhaps have another chance to present and improve your talk, based on the

feedback you received. That's great that you felt that way - because we believe that practice is the best way to get good at and become comfortable communicating your work.

- In fact, based on the last survey, [74%] of you said you definitely would practice giving your research talk aloud before presenting it to the group. The rest of you said you maybe or probably would practice aloud. How many of you had a chance to do that? How many of you actually practiced your presentation aloud, with slides? How many people intended to, but had trouble finding the time at the last minute? Did anyone practice aloud with friends? Well the beauty of today's workshop is that it'll give you another chance - to practice presenting aloud - before you give your final presentations in another week or two. You'll see that it will make a huge difference.

- What did you find the hardest about preparing your presentation for today? [Discuss what comes up.]

Warm-Up Activity

- We're going to do a little warm-up while we're together in this room to get ourselves ready for the presentations. We're going to do what's often called an "Elevator Speech," or I like to think of it as a "Cocktail Party Spiel." Imagine you've met someone - a non-scientist - who's interested in hearing about your research. You have only a few minutes before they get to their floor or wander off and talk to someone else. So, keep it brief - about 2 minutes - and give them the basic introduction: who you are, what you've been doing in the lab, and what you've found out.
  [Ask them to recall the advice from last time about speaking to people. They should mention things like eye contact, landing a point, pausing for emphasis, staying relaxed, avoiding jargon, etc. Remind them about constructive feedback, saying at least one positive thing about the introduction and one suggestion for improvement.]

- [Break each table into 2 groups of 3 people. Take turns making a 2- minute introduction, followed by a minute of feedback from the other two. Encourage them to do this exercise standing up if there is room. Refer to Session Two Agenda.]

- Optional debriefing with student volunteers in front of group.

Activity Guides and Handouts for the *REU Science Communication Workshop*

The next few pages contain specific activity guides and handouts that are used in Sessions One and Two of the Workshop. All have been referred to previously. They are also included as documents in a separate file, to make it easier for you to make copies for your participants.

Included:

- **Lunch Table Activity Sign** - **Session One** (Print back-to-back for each table, changing the group number for each table and place in vertical plastic sign stand holders at each table).

- **Lunch Table Activity Sign** - **Session Two** (Print back-to-back for each table, changing the group number for each table and place in vertical plastic sign stand holders at each table).

- **Mentor/Facilitator Guidance Sheet** (Print on front side of the following two Guidance sheets.)

- **SCW Session One - Break-out Group Guidance for Mentors/Facilitators**
  These can be handed out to the mentors/facilitators at the beginning of Session One and/or emailed to them in advance. (Print back-to-back with Mentor/Facilitator Guidance sheet.)

- **SCW Session Two - Break-out Group Guidance for Mentors/Facilitators**
  These can be handed out to the mentors/facilitators at the beginning of Session One and/or emailed to them in advance. (Print back-to-back with Mentor/Facilitator Guidance sheet.)

- **Participant Hand-Outs:** (these may be assembled into packets for each student)

  - "Intro to Science Communication" back-to-back with "Five-Minute Introduction to Your Research Assignment"

  - "Presentation Pointers" back-to-back with "Slide Pointers"

  - "Research Presentation Reflection Sheet" (This sheet is used in both session 1 and session 2. For session 2, multiple copies – equal to the number of students in the small groups – will be needed for each student in session 2)

  - "A Field Guide for Poster Sessions"

  - "Additional Science Communication Resources" list

Note: Sample Evaluation Survey forms are included in the Evaluation section.

GROUP 1

Welcome! This Workshop begins with introductions and a conversation about your research, over lunch at your tables.

Instructions:

- Take turns introducing yourselves, including:
  - Name, college, and major.
  - The focus of your lab group's research and how it might advance knowledge and benefit society in the long run.
  - The purpose of your research project and how it is designed to help advance the work of your lab group.
- Each person speaks no longer than 5 minutes, to ensure that everyone gets a turn. (Appoint someone to be the timer.)
- When it's your turn, practice making eye contact with each person at your table as you speak.
- Listeners: Be attentive; do not interrupt.
- Use any extra time for questions and answers.

GROUP 1

This workshop begins with a conversation about your research experience over lunch.

Instructions:

- Take turns introducing yourselves, including:
  - Name, undergrad school and major
  - The general topic of your research
  - An "aha!" moment you had this summer
  - A "blooper" or funny mistake you made this summer
- When it's your turn, practice making eye contact with each person at your table as you speak. Keep in mind what you learned in the first workshop.
- Use extra time to complete the Pre-Survey on the table.

REU Science Communication Workshop

MENTOR – FACILITATOR GUIDANCE

Roles: timer, facilitator, and tone-setter

- Make sure everyone knows what to call you.
- Be practice-oriented, rather than performance-oriented.
- Make sure everyone gets full turn.
- Make sure everyone participates in feedback.
- Make the judgment on whether to cut people off if they go on too long.
- Gently guide student feedback efforts. Help students coach each other in suggesting ways to improve.
- Counsel group if necessary to have a little extra patience with non-native English speakers.
- Offer students a chance to try a second time, if the first round finishes early.
- Leave each participant feeling respected and supported
- Send us helpful feedback on the process within a day or two, if you can! [insert your email address(es) here]

Brief group on the roles of listeners

- Be kind and attentive.
- Try to hear what the message is, even if the delivery is not yet polished.
- Make eye contact with the speaker.
- After each speaker, each member of the group will have about 30 seconds to provide some constructive feedback to the speaker. There is a total of 5 minutes of feedback allowed for each presentation.
- Participants can address "presence," eye contact, vocabulary, or content. Did the speaker make you want to learn more about the project than he or she had time to deliver?

Brief group on constructive feedback

- It is specific, collegial, and intended to be helpful.
- First mention one or two specific things that were effective about the talk;
- Then, if you have them, offer one or two suggestions for developing it further. This isn't quite criticism, like "you didn't do a very good job making eye contact," but more of an inquiry, like "Hmm, I wonder if more practice would help you make eye contact with listeners," or "I wonder if some people may have trouble understanding the term "quantum coherence?" or, "What do you think about the idea of giving an example of the kind of application this would be used for?"

REU SCW Session One: Break-out Group Guidance for Mentors/Facilitators

Students will have taken 5 minutes to prepare a 2 - 3 minute introduction to their research.

Their instructions were to:

- Introduce yourself, say what lab group you are working with this summer.
- Describe a challenge your research group is trying to address, and how your research project relates to that effort.
- If you would like to and have time, add what you know about how you are approaching your research, perhaps referencing results from your preliminary literature review.

Advice given:

- Think about the most concise way you can interest your group in your research project. Feel free to use very plain language, and to provide examples or analogies that could help your listeners understand."
- It doesn't have to be perfect, or even very good. This is just a chance to warm yourself up for the task ahead, and to practice giving and receiving constructive feedback.
- If you aren't yet sure yet about the broader context of your research project, just do the best you can.
- One of the hardest things to do is to end your brief talk. Often people trail off…they kind of peter out, like "and so, that's about it," or "And, so, like I said, that's what I'm up to." So try to plan in advance how you will end your soliloquy. You could end with what you hope or expect to find and what you might do if it doesn't work. Or there's always the old standby – "Thank you for asking, now what about you?"

Getting into groups and group activity:

- After the 5-minute preparation time, students will reassemble at their assigned tables for this activity. The workshop leader will give a few more instructions. Then the group mentor will take over timing and facilitation.
- **There will be 48 minutes for this activity:** Each of the six students at each table will have up to 3 minutes to talk; and the feedback from other students for each talk should take no more than 5 minutes. So, 8 minutes total for each of six introductions.
- **The mentor will be the timer.**

REU SCW Session Two: Break-out Group Guidance for Mentors/Facilitators

You will have 6-7 people in your group. They will each give the first 5 minutes of their presentation, with slides. We are allotting a total of 15 minutes per presentation (5 min presentation, 5 min silent reflection, 5 min discussion).

- Some groups have to travel far to presentation rooms. Some groups get to stay here – but may find having other groups in the room distracting, so remind speakers to keep volume at a reasonable level – so as not to disrupt other groups.

- Your role is to:
    - Keep the time- 5/5/5. (You can also designate a timekeeper).
        - Use your judgment about where to stretch. Remind them not to rush through their slides – they don't have to get through all of them – just present whatever they reasonably can within 5 minutes.
    - Get everyone back to this main meeting room within two hours.
    - Create a positive, supportive learning environment.
        - Applause after each presentation.
        - Encourage each participant to contribute feedback
        - Focus on positive attributes as well as suggestions for improvement.

- Criteria
    - Presentation (verbal, physical, use of slides and props)
    - Slides (design, clarity)
    - Content (success in communicating larger context, background, motivation, and reason for the approach being taken.)

- Presentation Reflection sheets
    - Each participant fills one out for each presenter.
    - Let them know there is a front and back.
    - Remind them to put name of presenter on it.
    - You may want to ask participants to specialize their observations, deliberately focusing on different sections of the reflection sheet.
    - Don't give stack of completed reflection sheets to presenters until the end of the session.

- If there is time left at the end… options:
    - Does anyone want to try again, or to give more slides from presentation?
    - Questions? Further discussion on issues that came up for you?
    - Bio Break

Science Communication

Every science or engineering research project is designed to make a contribution of some kind.

Examples:

- A deeper understanding of ourselves and/or our world.
- A solution to a challenge people face.
- A better way of doing something.
- A savings of cost, resources, energy, time.
- An opening to new possibilities….

A single research project is often one small step in the context of a larger challenge; and that larger challenge is often itself one small step in the context of an even larger challenge...

A research project is best designed with an awareness of relevant prior work, including the techniques and approaches tried and the results produced. **In science, process is as important as results.**

Whether or not the results of your research project turn out as you expected or hoped, if you follow the scientific process rigorously, document your process and results, and share them with others, you will have made a meaningful contribution to the overall challenge.

Nevertheless, your results will have little impact unless you can successfully communicate them to others.

YOUR ASSIGNMENT FOR SESSION TWO

Five-Minute Introduction to Your Research Project

Motivation/Application:

What larger societal challenge or problem is your research group trying to address? *(In the future, how might people benefit from these research efforts?)*

Research Objective:

How is YOUR summer research project designed to contribute to the work of your adopted research group? *(What do you hope to find out?)*

Literature Review:

What is the current state-of-the-art in your area of research, informing your approach? *(What previous work has been done in this area? What is known?)*

Approach/Procedure:

How are you approaching your research project and designing your experiment(s) so that you will be able to produce *at least one* meaningful result? (*Broadly outline the steps you will take.)*

Try to tell this story in such a way that even your friends who are not in scientific fields could understand it. So, for example, if you need to use a technical term or acronym, explain it. If you need to describe a technical process, describe it with everyday terms or use an analogy. If a picture will save a thousand words, show it. If gestures will help, use them. You can use as many slides as you would like, as long as your presentation takes no longer than 5 minutes. For best results, practice making the presentation aloud, with slides, in advance.

Presentation Pointers

Prepare your presentation in advance

- Know your audience and adapt to their needs
- Be clear on what you want to say to them
- Focus on the message you want to get across
- Practice aloud ahead of time with your slides
- Make adjustments as necessary

Prepare the space

- Have water handy
- Have ppt set up and use "presenter view."
- Reduce light shining on projection screen
- Breathe deeply
- RELAX – get loose
- Greet people

Connect with the audience

- Make eye contact with audience, be inclusive
- Take your time; Land your points
- Face the audience; make it clear when to look at you and when to look at the slides
- End cleanly
- Offer to take questions; repeat each question; it's okay not to know every answer

Slide Pointers

Make it easy for the audience to see what's on your slides

- Use a simple font and color scheme, preferably light on dark background
- Don't cram too much onto a single slide; instead, use more slides and/or cut some unnecessary detail
- Use a simple font and color scheme, preferably light on dark background
- Limit yourself to one clear idea per slide
- Keep it simple – few words, one large picture or graph
- Make sure the critical information be seen from the back of the room
- Dim the lights shining directly on the screen.
- Consider one version for projection and one for printing.

Make it easy for the audience to know when to look at the slides and when to look at you.

- Use slides as illustrations, not as notes for your talk. (Put notes in "notes" section in Presenter View)
- Face the audience, not the slides; make eye contact
- Tell a story
- Use laser pointers sparingly; feel free to gesture with your hands and use props.

REU Science Communication Workshop

RESEARCH PRESENTATION REFLECTION SHEET

Presenter:

Title:

CONTENT	**Very Clear**	**Clear**	**Not so clear**	**Comments, Advice**
Title / Subtitle				
Motivation/Challenge/ Larger Context				
Research Objective				
Literature Review (Background)				
Approach/Methodology				
PRESENTATION	**Very good**	**OK**	**Work on**	**Comments, Advice**
Greeting / Introduction				
Attitude/enthusiasm				
Apparent comfort level Poise, pace, confidence				
Eye contact				
Movement - Hands, body				
Voice - Volume, enunciation				
Filler word management				
Jargon management				
Integration of slides, props & devices				
SLIDES & GRAPHICS				
Visual appeal (harmony/balance)				
Ideas per slide ratio (kept low?)				
Minimal text				
Use of Images/Figures				
Visibility to audience				

Other Comments: (see back side)

How do you think the presenter felt about his/her research project?

Did he or she make the research project seem interesting? Why or why not?

What was the coolest part of the presentation for you?

What questions do you still have about the motivation for doing the research?

What questions do you still have about the methodology or approach?

Anything else you want to share with the presenter?

SCIENCE AND ENGINEERING POSTER SESSIONS
A Field Guide for Observers

You can gain valuable insights about making and presenting posters, by carefully observing posters, presenters, and browsers at science and engineering meetings.

Try noticing:

1. Which posters seem to be attracting a lot of *attention* and why?
   - Are they near the food?
   - Are they graphically appealing?
   - Do they have an unusual or provocative title?
   - How does the poster presenter greet each visitor?
   - Where do they stand?
   - How do they handle conversations with friends and acquaintances who visit?
   - Does a group of people around a poster tend to attract more people, or send people off to look at less crowded posters?

2. Which posters do you find *yourself* attracted to?
   - Are you attracted more by the subject, the title, the graphic design, the personality of the presenter, their aura of approachability?
   - What kind of graphics seem to work really well? Use of color? Photos? Density of information? Charts? Graphs?
   - What makes a presenter seem more approachable?
   - Do you sometimes avoid posters because the presenter is right there?
   - Would you rather approach a poster and read it yourself, without having to engage in conversation, unless you have further questions?
   - What kind of information do you want from the presenter?

3. Which posters do you find the most *satisfying?*
   - Which posters seem to have just the right amount of information – not too much; not too little?
   - Which posters seemed aimed at someone other than you?
   - Which posters tell you a story: what the challenge was, it's significance; how it was approached; what conclusions can be drawn?
   - Which posters give you new insight into a field or methodology or problem that you hadn't been aware of previously?
   - Which give you an "ah ha" moment?
   - Which make you want to speak more with the presenter?

REU Science Communication Workshops
Additional Resources

- **Presentation Zen** - http://www.presentationzen.blogs.com/
  Communications expert, Garr Reynolds', blog on professional presentation design & delivery (both public speaking and slide creation) – including examples, videos, and discussion of effective communicators and well-designed presentations. Other resources by Garr Reynolds include:
  - **Presentation Tips** - http://www.garrreynolds.com/Presentation/index.html
    Top 10 Tips on: Organization/Preparation; Delivery; Slides
  - **Presentation Zen: Simple Ideas on Presentation Design and Delivery**
    Reynolds' book summarizing his ideas on presentation design.

- **slide:ology: The Art and Science of Creating Great Presentations**
  Designer Nancy Duarte's book teaches you how to effectively express your ideas through visuals and gives a practical approach to visual story development, You can find more on her blog: http://blog.duarte.com/

- **Pimp Your PowerPoint** – http://www.the-scientist.com/2010/03/1/76/1/#video
  An article in *The Scientist* about how presentation software is misused in science; provides tips on creating engaging presentations.

- **TED talks: Ideas Worth Spreading** - http://www.ted.com/
  A series of online videos showing interesting talks by people in a variety of fields. These feature different presentation styles so you can compare/contrast what you find most effective. In the left column, you can filter those related to science. One nanotech-related example – engineer, Michael Pritchard, demos his water filter: http://www.ted.com/talks/michael_pritchard_invents_a_water_filter.html.

- **Talking Nano** - This 6-DVD set features talks by cutting-edge researchers we've hosted at the Museum of Science who have a knack for communicating complex concepts with clarity and style. The set can be purchased at www.talkingnano.net, or clips can be viewed on You Tube (in multiple parts due to size constraints):
  - **A Brief Intro to Nanotechnology -**
    http://www.youtube.com/watch?v=zURjQS3y7KY
    - Ch 1 & 2, Ch 3, Ch 4, Ch 5, Ch 6, Ch 7, Ch 8, Ch 9 & 10
  - **Guiding Light with Nanowires -**
    http://www.youtube.com/user/NanoNerds#p/u/76/oKyfH3Bxj0E
    - Part 1, Part 2, Part 3

Evaluation Studies of the *REU Science Communication Workshops*

The University of Massachusetts Donahue Institute for Research and Evaluation has conducted evaluation studies of the REU SCW workshop over more than six iterations. These include workshops conducted by the Museum of Science Strategic Projects Group in collaboration with faculty at Harvard University, Northeastern University, the University of Massachusetts-Lowell, and the University of New Hampshire. In 2010 Donahue also conducted an evaluation of a dissemination version of the workshop implemented at the University of Wisconsin-Madison (not yet published). The findings from the evaluations show that the Science Communication Workshops are rated highly by students and faculty alike; they typically rate the highest among professional development sessions attended by the students. Faculty note a marked improvement in poster and slide presentations.

The 2009 evaluation study is posted at:
http://www.nisenet.org/catalog/evaluation/research_experience_undergraduates_reu_science_communication_workshops.

The following papers have been published:

Alpert, C.L., Levine, E., Barry, C., Isaacs, J., Fiorentino, A., Hollar, K., Thate, K., "Tackling Science Communication with REU Students: A Formative Evaluation of a Collaborative Approach," *Mater. Education,* eds. M. Marinho Patterson, D. Dunham, E. Marshall, J. Nucci (*Mater. Res. Soc. Symp. Proc.* **1234**), PP04-12. 2009. **DOI:** 10.1557/PROC-1233-PP04-12.

Alpert, C.L., Isaacs, J., Barry, C. Miller, G., Busnaina, A., "Nano's Big Bang: Transforming Engineering Education and Outreach," *Proc. ASEE Annual Conf. & Expo*, June 2005.

Evaluation Instruments and Protocols

We use formative evaluation instruments – surveys and informal interviews – to monitor and improve the participant and stakeholder experience of the REU Science Communication Workshop. The program described in this packet has been thoroughly evaluated through more than four iterations, and we know that it is effective and enjoyable for participants. However, we recommend that formative evaluation protocols be applied in each new location and with each new partner in order to continue shaping and optimizing the program for local needs and conditions.

In this packet, we are providing generic sample copies of survey instruments we have used. You may use these with appropriate modifications, or simply consider them as guidance for making a set of inquiries that are better adapted to your situation and needs. The demographic data these collect are in alignment with NISE Net evaluation protocol. Please keep in mind that in many situations, particularly those that involve minors, you may be required to have your protocol and instruments reviewed by an Institutional Review Board, which is charged with protecting research and evaluation subjects. We do not collect names, and we aggregate data so that individuals are not identifiable; however, we still submit our surveys and protocols for review. We also conduct informal interviews and discussions with stakeholders and university faculty to try to learn from their perspectives and experiences.

The following sample surveys are included:
(They are also included as separate, editable docs in a file accompanying this guide.)

- Pre-Workshop Survey (REU Science Communication Experience Survey)
- Post-Session One Survey
- Pre-Session Two Survey
- Post-Session Two Survey
- Sample Post-REU Program Survey
  (This sample shows how the REU program based at the Center for High-rate Nanomanufacturing integrated into its REU program post-survey questions designed to gather additional information about the impact of the Science Communication Workshops.)

REU Science Communication Experience Survey

This survey is aimed at helping the REU faculty and workshop providers understand how best to meet student science communication skill development needs. All responses are confidential and not individually identifiable; results will be aggregated for analysis. Please be as accurate as possible with your responses.

Date: Month Day Year

Sex: O Male O Female

Race/Ethnicity (Check all that apply):
O African American O American/Indian/Alaskan Native O Asian-American
O Hispanic/Latino O White, not of Hispanic origin O Other _____

Education (Choose year of college you will enter in the Fall):
O Freshman O Sophomore O Junior O Senior
O 5th year senior O Graduate School O Other _____

Undergraduate Major _____

REU Program Host University
O University 1 O University 2 O University 3

1. Have you previously participated in undergraduate research?
O No O Once O Twice O Three or more times

2. Have you previously participated in an REU program?
O No O Once O Twice O Three or more times

3. Have you previously participated in this particular REU program?
O No O Once O Twice O Three or more times

If so, did you participate in last year's REU Science Communication Workshop sessions?
O No O Yes

4. Please rate the importance of science communication skills to a career in science:
Low Importance Moderate High Importance
O O O O O

5. Have you ever participated in a science communication workshop?
O No O Once O Twice O Three or more times

6. If so, check the topics that were included:

O Oral Presentations O Written Reports O Slide Design and Use O Poster Design

7. Have you ever participated in *any* kind of speaking or presentation workshop?

O No O Once O Twice O Three or more times

8. Have you ever given an oral presentation on a science research project?

O No O Once O Twice O Three or more times

9. Have you ever prepared and delivered a slide presentation, using a program such as PowerPoint or Keynote?

O No O Once O Twice O Three or more times

10. Have you ever given an oral presentation on a science research project with accompanying slides?

O No O Once O Twice O Three or more times

11. Have you ever made and presented a poster on a science research project?

O No O Once O Twice O Three or more times

12. Rate your proficiency in giving oral presentations:

Beginner		Intermediate		Experienced
O	O	O	O	O

13. Rate your comfort level in giving oral presentations:

Uncomfortable		Comfortable		Very comfortable
O	O	O	O	O

14. When you have to give an oral presentation, do you practice giving it aloud before hand?

Never		Sometimes		Always
O	O	O	O	O

15. Rate your proficiency in designing slides for presentations in programs such as PowerPoint or Keynote:

No Experience		Moderate		Highly Proficient
O	O	O	O	O

16. Rate your proficiency at incorporating slides into an oral presentation:

No Experience		Moderate		Highly Proficient
O	O	O	O	O

17. Rate your proficiency at explaining scientific research to non-scientists:

No Experience		Moderate		Highly Proficient
O	O	O	O	O

18. Rate your proficiency at explaining scientific research to scientists and engineers:

No Experience O O O O Highly Proficient O

19. What aspects of presenting science to an audience do you like the most?

20. What aspects of presenting science to an audience do you like the least?

21. Which of the following aspects of science communication do you think you need the most help and practice with?

Oral presentations No Help O O O O A lot of help O

Slide presentations No Help O O O O A lot of help O

Slide design No Help O O O O A lot of help O

Poster design No Help O O O O A lot of help O

Poster presentations No Help O O O O A lot of help O

Explaining the broader context of a research project

No Help O O O O A lot of help O

Explaining scientific research to non-scientists

No Help O O O O A lot of help O

Explaining scientific research to experienced scientists

No Help A lot of help

O O O O O

Handling questions from an audience

No Help A lot of help

O O O O O

Giving effective feedback to others on their presentations and slides

No Help A lot of help

O O O O O

Receiving feedback from others on your presentations and slides

No Help A lot of help

O O O O O

Writing research reports

No Help A lot of help

O O O O O

Writing scientific papers

No Help A lot of help

O O O O O

Visual representation of data

No Help A lot of help

O O O O O

Translating science "jargon" into language most people can understand

No Help A lot of help

O O O O O

22. Please add below any other science communication skills you would like help developing. You may also provide further detail on the skills mentioned above.

Thank you for your participation in this survey.

REU SCIENCE COMMUNICATION WORKSHOP - SESSION ONE POST-SURVEY

Please help improve future workshops by providing feedback. Your responses will remain confidential; and will be aggregated with others for analysis. Thank you.

Date: Month ☐☐ Day ☐☐ Year ☐☐☐☐

Sex: ☐ Male ☐ Female

Race/Ethnicity (Check all that apply):

☐ African American ☐ American/Indian/Alaskan Native ☐ Asian-American

☐ Hispanic/Latino ☐ White, not of Hispanic origin ☐ Other

Education (Choose year of college you will enter in the Fall):

☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior

☐ 5th year senior ☐ Graduate School ☐ Other _____

Undergraduate Major _____

REU Program Host University

☐[University One] ☐[University Two] ☐[University Three]

First Small Group Facilitator for today's session: _____

Second Small Group Facilitator for today's session: _____
(if applicable)

How useful to you were each of the following elements of today's session?

1. Presentations from the workshop leader

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

2. Practice speaking to others in small groups

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

3. Practice giving constructive feedback to others

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

4. Receiving feedback from faculty and mentors

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

5. Receiving feedback from other students

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

6a. Powerpoint and graphics advice

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

6b. Oral presentation advice

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

7. Thinking about the broader context of my research

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

8. Thinking about how to explain my research to non-scientists

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

9. Interacting with other REU students

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

10. Interacting with other REU faculty and mentors

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

11. Learning more about other students' research projects

Not useful Moderately useful Very useful

☐ ☐ ☐ ☐ ☐

12. What did you find most useful about today's session and why?

13. If we had had more time today, what would you have liked to use it for?

14. What questions did today's session leave you with, if any?

15. Do you intend to practice giving your research slide presentation aloud, before you present it to the group?

No Maybe Definitely Will

☐ ☐ ☐ ☐ ☐

16. Please feel free to make any additional comments or recommendations regarding today's session.

REU SCIENCE COMMUNICATION WORKSHOP - SESSION TWO PRE-SURVEY

Please help improve future workshops by providing feedback. Your responses will remain confidential; and will be aggregated with others for analysis. Thank you.

Date: Month ☐☐ Day ☐☐ Year ☐☐☐☐

REU Program Host University:

☐[University One] ☐[University Two] ☐[University Three]

Please rate your level of agreement with the following statements concerning the last Science Communication Workshop (SCW - Session One).

1. The last SCW session helped me think carefully about the best ways to communicate scientific and technical concepts to others.

Strongly Disagree ☐ Disagree ☐ Somewhat Disagree ☐ Somewhat Agree ☐ Agree ☐ Strongly Agree ☐

2. The last SCW session increased my interest in seeking out and understanding the larger context of my research.

Strongly Disagree ☐ Disagree ☐ Somewhat Disagree ☐ Somewhat Agree ☐ Agree ☐ Strongly Agree ☐

3. As a result of the last SCW session, I have noticed improvement in my ability to describe scientific and technical concepts to others.

Strongly Disagree ☐ Disagree ☐ Somewhat Disagree ☐ Somewhat Agree ☐ Agree ☐ Strongly Agree ☐

4. As a result of the last SCW session, I have made a point of practicing my science communication skills with non-scientists.

Strongly Disagree ☐ Disagree ☐ Somewhat Disagree ☐ Somewhat Agree ☐ Agree ☐ Strongly Agree ☐

5. As a result of the last SCW session, I have found myself thinking more critically about how other people present their scientific and technical work.

Strongly Disagree ☐ Disagree ☐ Somewhat Disagree ☐ Somewhat Agree ☐ Agree ☐ Strongly Agree ☐

6. As a result of the last SCW session, I feel more confident in giving and receiving constructive feedback.

Strongly Disagree ☐ Disagree ☐ Somewhat Disagree ☐ Somewhat Agree ☐ Agree ☐ Strongly Agree ☐

7. The last SCW session helped me prepare and delivery my 5-minute research introduction talk and slides.

Strongly Disagree ☐ Disagree ☐ Somewhat Disagree ☐ Somewhat Agree ☐ Agree ☐ Strongly Agree ☐

8. Did you practice giving your 5-minute research introductions and slide presentation in advance, ALOUD?

Yes ☐ No ☐

9. Did you practice giving your 5-minute research introductions and slide presentation in advance, TO OTHERS?

Yes ☐ No ☐

10. In retrospect, what concept(s) from the last SCW session have you found most helpful?

11. Please note any other comments or questions here.

REU SCIENCE COMMUNICATION WORKSHOP - SESSION TWO POST-SURVEY

Please help improve future workshops by providing feedback. Your responses will remain confidential; and will be aggregated with others for analysis. Thank you.

REU Program Host University

☐[University One] ☐[University Two] ☐[University Three]

Which presentation group where you in? (circle one) A B C D E F

How useful to you were the following aspects of today's workshop session?

	Not Useful	Somewhat Useful	Very Useful
Being required to prepare part of my presentation in advance	❑	❑	❑
Lunchtime activity	❑	❑	❑
Opening discussion and debrief	❑	❑	❑
Elevator speech activity	❑	❑	❑
Small group work on presentations	❑	❑	❑
Practice giving my presentation to peers	❑	❑	❑
Feedback from my peers	❑	❑	❑
Feedback from workshop leaders and mentors	❑	❑	❑
Learning about other people's research	❑	❑	❑
The workshop session overall	❑	❑	❑

If there had been more time today, what would you have liked to use it for?

How did the pair of Science Communication Workshops compare to other professional development seminars in which you took part this summer? (circle one on each row)

Least helpful Most helpful

1 2 3 4 5 6 7

Least enjoyable Most enjoyable

1 2 3 4 5 6 7

What comments or suggestions do you have about the REU science communication workshops overall?

CHN REU Post-Survey 2010

1. Institution and Respondent Description

Please answer the following demographic questions. NSF grant funding requires CHN to collect demographic information related to program participants. Thank you.

1. Please create your own identification number so we can match this survey with your previously completed survey.

The second letter of your middle name (If your middle name is Jane, write the letter A) ☐

The second letter of your last name (If your last name is Doe, write the letter O) ☐

Your 2-digit birth month (If your birthday is in May, write the number 05) ☐

2. What university / college do you attend?

☐

3. Where are you completing your REU?

- ◯ UNH
- ◯ UMass Lowell
- ◯ Northeastern University

4. Which of the following best describes your academic status?

- ◯ Completed Freshman Year
- ◯ Completed Sophomore Year
- ◯ Completed Junior Year
- ◯ Completed Senior Year

5. Please list your academic major(s).

☐

6. What is your sex?

- ◯ Female
- ◯ Male

7. What is your race / ethnicity? (Please select all that apply.)

- [ ] African American / Black
- [ ] Asian
- [ ] Caucasian / White
- [ ] Hispanic / Latino(a)
- [ ] Native American / Alaska Native
- [ ] Pacific Islander
- [ ] Other (please specify)

8. What is your citizenship status?

- ◯ U.S. citizen
- ◯ Permanent resident
- ◯ Other non-U.S. (e.g., temporary visa; student visa)

9. Do you have one or more disabilities? (A disability refers to having an impairment that substantially affects one or more activities of daily living and is not correctable with assistive devices.)

- ◯ Yes
- ◯ No

CHN REU Post-Survey 2010

2. Participant Impressions

Please select the responses that most accurately reflect your opinion and answer open-ended questions as completely as possible. Thank you.

10. How has your ability level in each of the following areas changed as a result of your participation in the CHN summer research experience?

	Increased a Lot	Increased a Little	No Change	Decreased a Little	Decreased a Lot	N/A
(1) Find information using library database resources	◯	◯	◯	◯	◯	◯
(2) Condense literature search into a coherent written introduction	◯	◯	◯	◯	◯	◯
(3) Understand how a particular science or engineering challenge relates to a larger goal or application	◯	◯	◯	◯	◯	◯
(4) Construct a professional PowerPoint presentation	◯	◯	◯	◯	◯	◯
(5) Communicate a research project and results verbally as a 15-minute professional presentation	◯	◯	◯	◯	◯	◯
(6) Summarize the purpose and results of a research project in a brief 1-3 minute "elevator speech" to other researchers in the same field	◯	◯	◯	◯	◯	◯
(7) Summarize the purpose and results of a research project in a brief 1-3 minute "elevator speech" to people who don't have much scientific or technical training in your field	◯	◯	◯	◯	◯	◯
(8) Demonstrate new technical skills	◯	◯	◯	◯	◯	◯

11. How has your level of awareness, interest or preparation in each of the following changed due to your participation in the CHN summer research experience?

	Increased a Lot	Increased a Little	No Change	Decreased a Little	Decreased a Lot
(1) Awareness of the broader societal implications of new technologies related to nanotechnology	◯	◯	◯	◯	◯
(2) Interest in pursuing a graduate level degree related to nanotechnology	◯	◯	◯	◯	◯
(3) Interest in careers in research and manufacturing related to nanotechnology	◯	◯	◯	◯	◯
(4) Interest in careers in science education and/or engineering education	◯	◯	◯	◯	◯
(5) Preparation for careers in research and manufacturing related to nanotechnology	◯	◯	◯	◯	◯

CHN REU Post-Survey 2010

12. How did you learn about CHN's Research Experience for Undergraduates program? (Please select all that apply.)

- [ ] Advisor recommended
- [ ] Faculty member (not advisor)
- [ ] Friend
- [ ] CHN Web site
- [ ] Received information via email
- [ ] Attended a workshop
- [ ] Was invited to attend (please specify by whom in the 'other' space below)
- [ ] Other (please specify)

13. Within the first week, my advisor and I developed a clear set of research goals related to my summer research experience.

- ◯ Strongly Agree
- ◯ Somewhat Agree
- ◯ Neither Agree nor Disagree
- ◯ Somewhat Disagree
- ◯ Strongly Disagree

14. I was given access to appropriate information, equipment, and facilities so that I could achieve my research goals.

- ◯ Strongly Agree
- ◯ Somewhat Agree
- ◯ Neither Agree nor Disagree
- ◯ Somewhat Disagree
- ◯ Strongly Disagree

15. Whom would you identify as the primary advisor for your research project?

- ◯ The professor with whom you worked
- ◯ The post-doctoral fellow with whom you worked
- ◯ The graduate student with whom you worked

CHN REU Post-Survey 2010

16. My research advisor provided helpful guidance as my research project advanced.

- ◯ Strongly Agree
- ◯ Somewhat Agree
- ◯ Neither Agree nor Disagree
- ◯ Somewhat Disagree
- ◯ Strongly Disagree

17. What were the most significant strengths of this summer's REU program?

18. What were the most significant weaknesses of this summer's REU program?

19. What recommendations (if any) do you have for program improvement?

20. How would you rate each of the following aspects of your summer research experience?

	Excellent	Good	Fair	Poor	N/A
(1) Interaction with your advisor	◯	◯	◯	◯	◯
(2) Interactions with other students	◯	◯	◯	◯	◯
(3) Interactions with other professors	◯	◯	◯	◯	◯
(4) Opportunities to use research facilities and learn new techniques	◯	◯	◯	◯	◯
(5) Opportunities to share and discuss your research results with others	◯	◯	◯	◯	◯
(6) Housing	◯	◯	◯	◯	◯
(7) The two Museum of Science workshop sessions on science communication.	◯	◯	◯	◯	◯
(7) Overall summer research experience	◯	◯	◯	◯	◯

CHN REU Post-Survey 2010

21. What are you plans after graduation?

- [ ] Pursue a Masters Degree
- [ ] Pursue a Doctoral Degree
- [ ] Find full-time employment related to STEM (Science, Technology, Engineering, Math)
- [ ] Find full-time employment in STEM teaching or education
- [ ] Find full-time employment NOT related to STEM
- [ ] Don't know
- [ ] Other (please specify)

22. What impact, if any, did this summer research experience have on you (e.g., academically, career plans, new collaborations, future research ideas)?

23. What comments or suggestions (if any) do you have about the Museum of Science Communication Workshop sessions?

24. Any other comments.

Thank you for completing this survey!!

Conclusion

Questions, comments, and suggestions for improvement to this Guide and to the Workshop and materials are encouraged and welcome. Please send them to nano@mos.org.
For more information, or to inquire about consulting, also write to nano@mos.org

A future edition of this guide will contain additional content focusing on preparing students to design and present science research posters.

The Museum of Science has developed another professional development program for the NISE Network that may be useful for research center - science museum education outreach partners. ***The Sharing Science Workshop & Practicum*** focuses on providing science communication, education and outreach skills for early-career researchers such as graduate students and post-docs. Graduates of the Sharing Science Program often become particularly enthusiastic and effective volunteers at education outreach events, like NanoDays. Find the ***Sharing Science Guide*** in the NISE Net catalog under Tools and Guides.
http://www.nisenet.org/catalog/tools_guides/sharing_science_workshop_practicum

Small Steps, Big Impact: A Guide for Science Museums Developing Partnerships with University-Based Research Centers is another guide written by Carol Lynn Alpert with NISE Net support, posted on the web at http://www.risepartnerguide.org. This online resource provides information and step-by-step guidance in developing effective, productive, and funded education outreach partnerships with university-based research centers.