RESEARCH EXPERIENCE FOR UNDERGRADUATES

Science Communication Workshop

Planning & Implementation Guide, v. 5.0

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Written by Carol Lynn Alpert

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Background & Acknowledgements   Version 5.0

Since its beginnings as a professional development program designed and hosted at the Museum of Science for undergraduate research program participants from two Boston-area NSF Nanoscale Science and Engineering Research Centers, the *REU Science Communication Workshop* has been adopted at more than ten university campuses across the U.S. The network of campus providers shares implementation data and insights, and these have greatly benefitted this new edition of the REU SCW Planning & Implementation Guide. **This Guide and its associated materials and digital resources are designed to assist new providers in implementing REU SCW sessions on their own campuses, even if they have not had the opportunity to participate in an implementation workshop. We welcome new or prospective REU SCW workshop providers to contact us at nano@mos.org and join this providers network. We offer free updates to Guide materials, back-up support and guidance, and a set of IRB-approved online survey instruments that providers can use to gather timely participant and program data - before, during, and after workshop implementation.**

We thank the National Science Foundation, the NISE Network, and our original collaborators at the NSF Center for High-rate Nanomanufacturing (CHN) and the Harvard-MIT-UCSB-MOS NSF Nanoscale Science and Engineering Center. Many thanks also to the REU SCW early adopters who contributed valuable perspectives on adapting the workshop content and structure to a broad range of undergraduate research experience programs: Sharnnia Artis (UC Berkeley), Mack Carter (U of Washington), Samantha Cruz (UC Santa Barbara), Meltem Erol (UC Berkeley), Brandon Lucas (U of Michigan), Leda Lunardi (North Carolina State U), Leslie O'Neill (Georgia Tech), Jacques Richard (Texas A&M), and also Andrew Greenberg (U of Wisconsin-Madison), who was our first dissemination collaborator and worked with us develop workshop material on research poster design. CHN Professors Carol Barry at UMass-Lowell and Jacqueline Isaacs at Northeastern worked with us through nine years of implementation and evaluation, some of it additionally supported by the Mass Tech Collaborative. Early Museum of Science (MOS) contributors to the development of the *REU Science Communication Workshop* include Alex Fiorentino, Timothy Miller, Lisa Regalla, and Amy Swint.

Since 2009, MOS Program Manager Karine Thate has enriched all aspects of the REU SCW program, including data collection and analysis, network coordination, development of new workshop materials, and production of this Guide. We also thank our art and design colleague Jeanne Antill and Lorraine Grosslight, who portrays Dr. Fisher-Katz in the YouTube video "Graduate Students Unwittingly Subjected to World's Worst Research Presentation," part of the course materials. We also appreciate the support of Larry Bell, Senior VP at MOS and NISE Net PI.

Finally, here's to all the students, who have shared with us their joy, good will, and earnest appreciation of the hard work that goes into practicing good science and communicating well about it.

- C. L. Alpert, Boston, May 2015

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Digital Appendix is available on accompanying DVD, or by download from:
http://www.nisenet.org/catalog/tools_guides/reu_science_communication_workshop
Or, by request from nano@mos.org
- PDF of this entire Guide and Appendix.
- e-Document Folder: Customizable Word Doc versions of handouts, tools, and surveys.
  (Note: Workshop providers may contact nano@mos.org to access the online evaluation system)
- Multimedia Folder: Session One PowerPoint slide set and videos.
  (Note: The Digital Appendix download from nisenet.org does NOT include the video files – only placeholder slates for the videos. Request the videos from nano@mos.org

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Introduction

The presentation of research is an integral aspect of professional science and engineering practice, essential to scientific progress and critical to career advancement. Practice in formulating effective techniques of communicating research helps undergraduate students draw meaning and context from their weeks of intense investigation and provides them with a means of sharing their journey and reaping a sense of accomplishment.

The *Research Experience for Undergraduates Science Communication Workshop (REU SCW)*

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

While initially developed for integration within the National Science Foundation's "Research Experience for Undergraduates" (REU) program structure, the *REU SCW* has proven to work just as well when integrated into other types of undergraduate research programs and formats.

The REU SCW adapts to the typical trajectory of the undergraduate research experience. It begins with an emphasis on understanding and articulating the motivation and broader context of a research project, and follows with guidance and practice in the development and delivery of research project presentations and/or posters. The original two-session format brackets the 8-12 weeks of an undergraduate research experience with two half-day sessions; Session One occurring close to the start of the program and Session Two close to the end. These two half-day sessions can also be broken up into multiple shorter sessions.

Materials, staff time, and refreshments are usually provided through an NSF REU site award, or a university's undergraduate research program, and meetings are conducted on campus, although our REU SCW workshop often take place at the Museum of Science, within the context of a multi-faceted research center – science museum education collaboration.

The REU-SCW is a product of 10 years of collaboration, evaluation, and iterative development by the Museum of Science team in partnership with faculty and students from 12 universities that host undergraduate research programs. Students typically rate the REU SCW among the most useful and enjoyable activities of their research program experience, and faculty report considerable improvement in the quality of student research presentations and posters.

From REU Science Communication Workshop Faculty & Students...

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

"I wish all the professors and research people would take part in such a workshop. It makes you aware that no matter how great your results are, they don't mean anything if you can't communicate them to others."

"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."

"The program is very effective and helps the students a great deal. Students are much more confident in their presentation skills and comfortable with presenting the subject matter."

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

More comments from students about the REU SCW workshops...

"I was very pleased with the feedback I received. I was glad I was able to connect with the audience and get my message delivered effectively."

"I am most pleased about being able to effectively communicate complex ideas to any type of audience; and the increased level of confidence I have when presenting."

"I was most pleased at how I connected with the audience, I presented my information in a way that was very easy to understand."

"This experience changed my life completely. Today I am confident I can be a researcher and I can present my data for different audiences effectively. This REU made me believe in myself and gave me the motivation to work even harder to be successful."

"Great Workshop. Gained knowledge and necessary skills required for the engineering field."

"This program is absolutely incredible and I definitely recommend it to any student interested in graduate school."

"The workshop was fantastic! Definitely one of the most productive workshops that I have ever attended. Ms. Alpert's presentation was fantastic, and the feedback sessions were very useful."

"The facilitators were extremely knowledgeable and had really keen ears for helping to perfect our presentation skills. I really applaud their ability to be so enthusiastic and excited to help us to become better at presenting our research."

"It is very interesting to see what other students and professors work on day to day. I am excited and privileged to be a part of this group."

"They helped me to better understand how to relate scientific material to a wider audience and to realize the importance of being able to effectively communicate among a variety of scientific disciplines."

"Most useful was being forced to actually think about the reasons behind what we're doing. Having to explain the motivation behind your project to someone else helps you to understand it greatly."

"I really enjoy the opportunity to present our project in small groups. I liked how we also did it more than once and received good constructive feedback."

"Gaining confidence and comfort in speaking to peers and professors ... was hugely important. I also found that in doing so I learned a lot about organizing my thoughts."

"It made me approach my project and the questions I ask, as well as the background reading I do, in such a way that I understand it well enough to explain it simply."

"I have never had practice giving an 'elevator pitch,' and it was very useful to get some experience with that yesterday. It's important to be able to quickly and concisely convey the meaning of your research."

"I really love the opportunity to know that I'm not the only one struggling with my project - there are others with my same problems, and that made me feel part of something, made me understand that we are growing in science together."

"It made me think about the 'big picture' and how my research will help."

"It was amazing! Well organized and useful."

"This was really good. Her tips on the most important considerations when preparing a research presentation were spot on. I thought this was a great seminar, probably the most I've gotten out of one yet, so that's awesome."

"This session was effective and enlightening. I will apply these ideas to my presentations and to life."

More comments from faculty and mentors about the REU SCW...

"The program is very effective and helps the students a great deal."

"Students are much more confident in their presentation skills and comfortable with presenting the subject matter."

"There was a huge difference from the beginning of the program to the end - vast improvements on presentation skills and poster presentation."

"It became clear just how much work the students were able to accomplish in their time here."

"I observed there was a remarkable improvement in both the presented material, as well as the presentation methodology."

"Especially noticeable were improvements made by returning students… confidence, presentation quality, and quality of work were all improved."

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Using this Guide

Welcome! This Guide provides materials and step-by-step guidance for university faculty and staff wishing to incorporate a science communication skills professional development component into an undergraduate research program. The sessions integrate seamlessly into the typical trajectory of an 8-12 week research immersion experience, guiding students in developing and delivering their final research reports and presentations and readying them for successful graduate level work. They also introduce students to habits of inquiry and exploration into the broader societal context of research.

This 5th edition has benefited from reports and feedback from the national network of providers, who have adapted the sessions for use across a broader swath of undergraduate research programs. All prospective providers are welcome to consult the REU SCW coordination team at nano@mos.org for additional advice on customizing the program and to access updates and supplements. You are welcome to join the providers' network and make use of our free, IRB-approved confidential online survey instruments to reinforce student learning and to obtain timely feedback and reports.

IF YOU HAVE DOWNLOADED THE DIGITAL VERSION OF THIS GUIDE, WE RECOMMEND PRINTING OUT THE PDF, PUNCHING HOLES, AND INSERTING IT INTO A 3-RING BINDER WITH TABS for the four numbered chapters and for the main Appendix sections. This will make it easier to navigate around some of the more detailed material. This pdf of the Guide and Appendix contains all the REU SCW instructional materials, including planning agendas, timelines, and activity guides, sample workshop leader scripts, handouts, signage, and evaluation tools. **A separate *e-Document Folder* contains customizable versions of most of the handouts, surveys, and table signage.   A *Multimedia Folder* contains the digital PowerPoint slides. The videos to insert in the slides are available by request at nano@mos.org. [Note: if you have received the DVD, it includes the pdf plus all the e-documents, slides, *and* videos.]** Please attribute all materials appropriately*.*

We suggest that prospective REU SCW providers read the first chapter (Overview) and browse through the session materials before choosing an implementation strategy, then focus on the sections relevant to that strategy.


Updates, supplements, and video files are available from nano@mos.org and at
http://www.nisenet.org/catalog/tools_guides/reu_science_communication_workshop
The program videos are available by request from nano@mos.org.
We welcome feedback, corrections, and errata at this address as well.

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Chapter One: Overview
Workshop Structure, Brief Agendas, Learning Goals & Approach

This Guide presents the REU SCW as two half-day workshops: the first scheduled to occur within the first two weeks of the start of the research experience program and the second within two weeks of its conclusion.
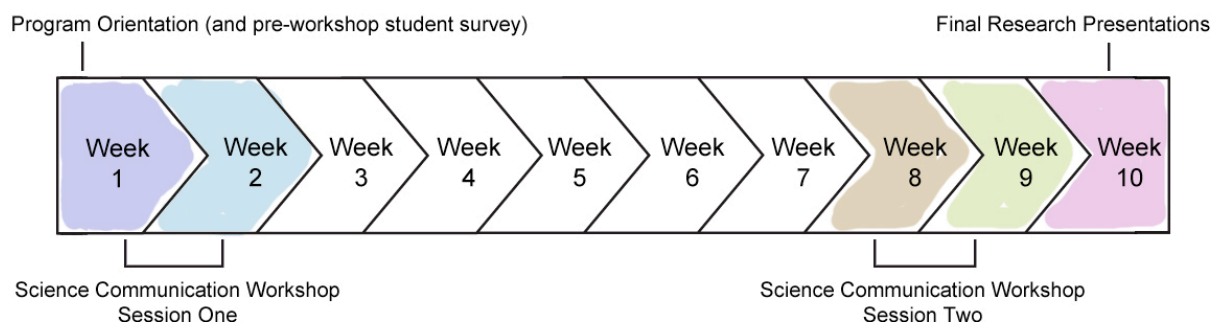
Session One provides an introduction to the important role of communication skills in science and engineering. It coaches students to seek out and consider the larger scientific and societal context motivating their individual or group research projects. Workshop exercises provide students the opportunity to learn and practice basic oral communication skills and techniques. They begin to find ways to introduce themselves and their research projects within a broader framework, and to express scientific and technical concepts in ways that can be understood by scientists outside their field, or even by non-scientists. They are also given directions and guidance for developing the slide or poster presentations they will deliver when they complete their projects. They learn techniques of providing constructive feedback to each other and experience the benefit of participating in a supportive learning community.

Session Two serves as a reinforcement and "dress rehearsal" of the principles explored in Session One. Students come to Session Two prepared to deliver the first 5-10 minutes of their final research presentation or poster, addressing the motivation, approach, and preliminary results of their research project. They give and receive support, feedback, and further guidance alongside their peers, workshop leaders, and facilitating faculty and graduate student mentors. Session Two typically occurs a week to ten days before the students are to deliver their final research presentations in a higher stakes setting.

The Session One and Session Two Brief Agendas on the following two pages provide a high-altitude view of the two-session format and scope. Each of these sessions can be broken into shorter sessions, as detailed in the Advanced Planning section of this Guide.

Session One Brief Agenda

…As implemented for a group of 18 to 24 students in a single afternoon session with two rounds of break-out group practice. Alternative formats are detailed in the Advance Planning and Session One Sections of this Guide.

12:00   Students Arrive | Informal welcome   Pick up lunches and nametags

12:15   Student Lunch Table Activity
Instructions for this activity are posted on each table

12:30   Welcome & Introduction to Science Communication

12:45   Sample Research Presentation

12:55   Debrief of Sample Research Presentation

1:05   Connecting with Your Audience

1:15   Exploring Context & Motivation

1:25   Sample Video Clips: Communicating the Broader Context

1:40   Brief Writing Exercise: Context & Motivation

1:45   Pair Sharing and Group Debriefing Writing Exercise

2:00   5-minute Stretch Break   (Optional refreshments)

2:05   Oral Research Introductions Activity: Instructions and Preparation

2:10   Oral Research Introductions: Break-out Groups

2:55   Debrief of Oral Research Introductions Activity

3:10   Preparations for Second Round of Research Introductions

3:15   Second Round of Research Introductions: Break-out Groups

3:50   Debrief of Second Round of Research Introductions

4:00   Presentation/Poster Assignment, Instructions, Resources, and Advice.
Optional 5-minute "Brief Slide Presentation about Slide Presentations"

4:15   ADJOURN

Session Two Brief Agenda

…As implemented for a group of 18 to 24 students in a single afternoon session. Alternative formats are detailed in the Advanced Planning and Session Two Sections of this Guide.

12:00   Students Arrive | Informal welcome   Pick up lunches and nametags

12:10   Students Begin Optional Lunch Table Activity
Instructions for this activity are posted on each table

12:30   Welcome & Introduction to Science Two

12:45   Warm-Up Activity

1:15   Guidelines for Small Group Research Presentations

1:30   Small Group Research Presentations (in separate break-out spaces or rooms)

3:30   Reconvene for Debrief, Discussion, and Closing Remarks

4:00   Adjourn with Instructions for Final Presentations

Structural Variations and Scheduling Adaptations

Undergraduate research program coordinators working along different timelines, or finding difficulty scheduling two half-day sessions for students assigned to various labs across campus, may break one or both workshop sessions into multiple shorter sessions, or eliminate parts of sessions. Or they may hold a portion of each session convened as a large group and schedule break-out group work on different days for subsets of students. Advice for these options is included in the **Advance Planning** Chapter and in the detailed **Session One** and **Session Two** Chapters. A poster supplement can be found in the **Appendix**

REU SCW Pedagogical Approach

Key to the demonstrated success of the REU SCW is the inclusion of **facilitated small group practice** in both workshop sessions. Time is always scarce, but we recommend not skimping on this key component of the REU SCW workshop sessions.   Invariably, it is the **highest-rated aspect** of the REU SCW design. Rather than simply receiving instructions and advice, students *practice* the communication strategies aloud with each other and are also coached in the art and craft of **providing constructive feedback** to each other*.* The group facilitator (typically the workshop leader or a faculty mentor) encourages each member to contribute his or her thoughts, offering their own comments *last,* so as not to unduly influence students or distract them from the practice of listening carefully, formulating, and articulating their own assessments. With practice, students become adept at distinguishing particular characteristics that either contribute to or distract from effective interpersonal research communication. Working as a group, they discover the value of developing a community culture of reflection, sharing, and mutual aid.

Sometimes students are reluctant to voice any critical feedback to their peers. We tell them that in a learning community members share constructive feedback - or suggestions they think might improve performance - so that in higher stakes settings, their colleagues will be able to perform to the best of their abilities. However, students may also need to hear from *each other* that such comments are welcome. One REU SCW provider, Sharnnia Artis at the University of California-Berkeley, recommends asking students – at the beginning of each small-group exercise - to decide whether to give the others permission to provide feedback. We've adopted this practice as well. Although no one in our groups has opted out of receiving helpful feedback, the process adds an extra dimension of trust and assurance among participants.

Cultivate a friendly and supportive atmosphere in the workshop sessions. 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 to continue in this direction, and they may be using the research program partly as an opportunity to get a taste of graduate level work. Gaining competence in *communicating* about their research work can give undergraduates confidence that they can succeed in graduate school. It can also help them share their scientific interests when communicating with friends, family, or associates not as familiar with the scientific enterprise, and that can be crucial to gaining respect and support for their efforts. Besides valuing the professional practice they gain in the SCW sessions, students also value the opportunity to get to know other students in the program and to learn about each other's research experiences. This also results in a considerable amount of peer learning and teaching results.

Evaluation studies with students and faculty show that students who participate in the REU SCW workshop sessions gain confidence and proficiency in speaking, writing, and organizing their thoughts about research. They also gain a deeper understanding of the overall context of their research and its societal implications. A set of publications and reports related to about the REU SCW can be found on p. 71.

REU SCW Program Goals & Learning Objectives

The *REU Science Communication Workshop* is designed to:

- Help students understand the critical importance of science communication skills to successful graduate work and careers in science and engineering.

- Guide students in developing effective professional science communication skills.

- Guide students in developing habits of inquiry and exploration into the broader context and societal implications of their research.

- Help students gain confidence in their ability to share their research with others.

- Encourage students to engage with their peers in a cooperative learning community.

Specific learning objectives include preparing students to:

- Adjust communication content and style to the needs of particular audiences.

- Compose and deliver clear and well-organized oral and written introductions to themselves and their work.

- Explore and articulate the broader context, significance, and distinctive approach of a research project, to better communicate its motivation and relevance.

- Master basic oral presentation skills for connecting to an audience.

- Design and produce effective presentation aids, such as illustrations, graphics, slides, posters, and props. Master the choreography of presenting with slides and other aids.

- Become adept at giving and receiving constructive feedback with peers in a collaborative learning environment.

Chapter Two
Advance Planning, Alternative Formats & Timeline

The decision to integrate the REU Science Communication Workshop into an undergraduate research program is best made during the initial program planning stages, in the months before the program launch. This gives stakeholders – including undergraduate research program directors, faculty mentors, and workshop facilitators – greater flexibility in customizing workshop session design and timing in support of local program goals and student assignments. Ideally, the REU SCW workshop sessions will be scheduled into the program agenda provided to students on orientation day.   The sessions help enrich students' experiences as they pursue their research project and guide them as they prepare to report their results at the end of the program.   A handy and customizable advance-planning timeline is included in the Appendix.

Scheduling & Coordination with Faculty

Many REU program directors schedule a coordination meeting with all faculty mentors prior to the start of the undergraduate research program. A briefing on the goals and design of the REU SCW program is best included in this meeting. The REU SCW learning objectives, communication guidance, and handouts can be reviewed, as well as the optional pre-Session One assignment. (This assignment requires each student to seek a discussion with their research advisor regarding the broader context, aims and goals of their research project.)

Scheduling the exact number, dates, and times of the REU SCW sessions is also a matter of faculty coordination, and is sometimes dependent on the availability of suitable meeting rooms. The pertinent dates and times should be on everyone's calendar and potential conflicts checked in advance. Depending on the number of students in the program, the REU SCW workshop leader may also want to recruit faculty mentors to facilitate workshop session break-out groups.

Standards for student posters and oral and slide presentations should be discussed. The guidance provided to students in the REU SCW can sometimes conflicts with traditional approaches that may be embodied, for instance, in rigid design templates provided for slides and posters, or by rules that attempt to limit the length of a presentation by limiting the number of slides, thus inducing overly-dense and difficult-to-view figures. Likewise, slide and poster templates are sometimes pre-loaded with prescribed logos and headings that favor conformity over functional communication. REU SCW materials counsel students to customize oral, slide and poster presentations to maximize communication and impact *for the live audiences, events, and meeting spaces for which they are being principally designed*, rather than for secondary purposes like printed pdfs or laptop viewing. (Increasingly, scientists are

learning to break out of old habits like cramming slides with text and multiple images, and reading from bullet-pointed outlines of their talk projected on a screen. It is not that the old ways are *wrong,* but scientists everywhere are beginning to adopt newer presentation techniques designed to optimize real-time communication in real-time meeting settings, showing greater respect for the time and attention of attendees, and appropriately re-adapting the materials for other purposes, such as publication and distribution.)

REU SCW workshop providers should discuss these matters ahead of time with faculty mentors and advisors, and develop a consensus on standards for final oral, slide, and poster presentations, including time allowances and review and due dates. The workshop provider can provide REU SCW handouts and guidance on these matters to faculty stakeholders ahead of time to facilitate discussion.

Finally, research funding sources may dictate particular acknowledgements, logos, and credits that must appear in presentations of research, and students as well as workshop providers should be made aware of these.   Likewise with confidentiality issues related to pre-published work and industry-funded work.

Participant Numbers

We recommend keeping the number of participants per session to 24 or less, because of the importance of ensuring an adequate amount of individual practice and feedback for each student in their break-out groups, and because of the larger number of break-out group facilitators and rooms required for larger cohorts. The break-out groups, working in parallel, save time, but they also *take* time.   For example, if there are four break-out groups of six students each, and each student is allotted just five minutes to speak and a total of five minutes for receiving feedback from the other students and the faculty member, that's still an hour for this part of the workshop, not including set-up time. In Session Two, it's best to let students deliver at least *half* their final presentation in the working groups, taking about ten minutes each and then receiving a total ten minutes feedback each, thus devoting about 20 minutes to each student. In the 24-student scenario with four break-out groups of six each, you would then plan on roughly two hours for this portion of the workshop session.   (We generally prefer groups of four to six students plus one mentor; this size provides enough variety for extensive peer learning to occur, but not so much it cause attention burn-out.) If the number of students is not precisely divisible by the number of groups, one or two of the groups may need additional time.

In summary, the amount of time and space needed for break-out group sessions depends on the total size of the groups, the availability of break-out spaces, and the allowance per student of both presentation and feedback time. Add to that 10-15 minutes for travel/set up.

Group size, presentation times, and feedback allowances can each be adjusted up or down to suit your timing and space needs, but we encourage you not to short-change this part of the workshop. Participant surveys have repeatedly shown the break-out group work to be the most valued aspect of the REU SCW sessions. Students often comment that they would have

enjoyed having *more than* two rounds of practice in groups. (We encourage them to follow up by organizing their own practice and feedback session.) To streamline the flow, ask students to submit their slide sets the day before, and pre-arrange how students will be divided in groups, so that slide sets can be pre-loaded in the projection computers in each room.

Alternative Formats: Different size groups and different numbers of sessions

The REU SCW was originally designed as two half-day sessions for 18-24 students, including lunch or breakfast. The extended length helped to accommodate the fact that the original workshop took place off campus, at a science museum. It also reinforced the workshop's core pedagogical approach, which emphasizes small group practice, for which ample time is essential. In our opinion, too many students are given professional development experiences consisting of lectures and note-taking. In contrast, the SCW sessions are based on the idea that practice, and only practice, in a relatively safe environment with helpful feedback, will produce measurable improvement in communication skills and corresponding growth in self-confidence. Taking additional time to include a meal and/or refreshments helps to sustain students and enhance informal sharing. However, alternative formats may be necessary. For instance, as the number of participants in undergraduate research programs varies widely, several programs on one campus may join together for professional development workshops and events. The structure of other REU programs may not be able to accommodate professional development sessions lasting longer than 60 or 90 minutes each. In these cases, please consider these alternative formats:

- **If more than 24 students need to be accommodated,** workshop leaders can consider breaking the entire group into two sections that meet on two consecutive days for Session One and two again for Session Two.

- **If the program has seven or fewer students,** you do not need break-out groups.

- **If you cannot organize sessions that last three or four hours** with a meal or refreshments, than
    - Break the group into two sections as above, OR
    - Break Session One and/or Session Two into two or more shorter sessions.
        - One alternative is to break the second session up into several meetings, with three - four students presenting and getting feedback at each.
        - Or, Session Two could be transformed into a weekly meeting activity during the last month of the program, with one or two students giving presentations on their work and the group providing constructive feedback at each session.
        - (Note: Both these configurations mean that the opening exercises and closing debrief and celebration will be deleted from Session Two.)

    Detailed advice on condensing or breaking up Session One and Two into shorter sessions can be found in those further chapters of this Guide.

Room Requirements & Reservations

Surveys of REU SCW providers reveal that finding and reserving appropriate rooms for workshop sessions can be one of their greatest challenges. Often these on-campus spaces need to be reserved well ahead of the start of the undergraduate research program.

<u>Session One</u> (depending on the size of the group) requires one room large enough to hold up to 24 young adults and several faculty mentors, as well as a projector and screen, a demo table, space to break out into small groups, and facilities for food and trash. An open floor plan where chairs and tables can be re-arranged works best to accommodate small-group work.

<u>Session Two</u> focuses on oral presentations with slides or posters. It begins with warm-up exercises and concludes with a group debrief in a main meeting room, where refreshments may also be provided. If the group is large and needs to split into break-out groups in the middle portion of the session, a number of break-out rooms should also be reserved for groups of 4-6 students and a mentor/facilitator can better concentrate on listening and providing feedback. Each break-out room requires a projector and screen for poster or presentation slides and something to work as a make-shift podium for slide presenters. Where an adequate number of break-out rooms has not been available, we have used room dividers or screens to split the main gathering room into smaller meeting spaces. Facilitators can agree on a time to reconvene, or coordinate through cell phones and texting. Some providers tackle this issue by scheduling break-out sessions on different days (more on this below).

Workshop Leader & Mentor/Facilitator Preparation

With a small group, a single, well-organized workshop leader can conduct a solo facilitation, but we recommend including at least one additional staff person, 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. Hold a meeting or host a phone conference to brief these contributors just before each of the workshop sessions. Brief them on the agenda for the session, the learning goals, the pedagogical philosophy, and their roles. (Sample briefing sheets to distribute to mentors are included in this Guide. After one or two years of assisting with the REU SCW, they will have plenty of experience mentoring students in these workshop exercises.) It is particularly important to have all the mentor spots filled for Session Two, when the break-out groups take off to different rooms.

Consistent with our advice to students to practice their presentations aloud in advance, we also advise workshop session leaders to rehearse their introductions, presentations, and commentary for each session in advance, also running through the activities, guidance prompts, props, and media, so as to ensure their comfort and confidence when leading the sessions live. Such preparation will augment the leader's poise and composure on the day of the session, helping the session proceed smoothly. It's not always easy giving talks about giving talks, so the practice certainly helps. One thing to keep in mind when conducting workshops for college students: treat them as adults, listen to and respect their opinions, allow debate and challenge of ideas, and encourage them to contribute to the process and to each other.

Digital and Material Assets (Detailed Materials Lists for each session are provided in the Session One and Two chapters.)

Session One requires a single laptop, projector and screen. The Multimedia Folder in the Digital Appendix includes PowerPoint slides and videos for the workshop leader's use. For the Session Two small- group work, each break-out area or room requires a projector and screen, and a laptop or computer. The set-up should allow students to operate their own sequences of slides directly from the laptop or computer at the front of the room near the screen, preferably with a podium or make-shift podium. Laser pointers are optional; we tend to discourage their use during practice and even during final presentations. In order to avoid the hassle of changing to various computers between presentations, we require the students to email or use a file transfer service to deliver their slides at least twelve hours in advance of Session Two, using a standard naming format with their last name first. We pre-assign each student to a break-out group in advance and pre-load their presentations or posters onto the computer that will be stationed in the room their group will be assigned to. It's then helpful to check in advance that each presentation will open and play correctly on the computer to which it has been assigned. Sometimes we allow students to bring updates to the session on USB drives, but this can make for a delayed start.

The Appendix contains signs, instructions, assignments, and survey instruments, as well as handouts for each session. The e-Document Folder in the Digital Appendix includes customizable electronic versions of the documents. The Multimedia Folder in the Digital Appendix contains the Session One PowerPoint slides and videos. NOTE: the Digital Appendix download from the NISE Net catalog does not include the embedded videos. Please contact nano@mos.org to arrange for the video files to be sent via DVD or a file transfer service.

Meeting Amenities

Unless it's a very small group, each student receives a nametag upon arrival. Usually, the nametag is pre-marked with a colored dot, or a number or letter code that designates small group assignments for each individual. For large groups, we encourage you to thoughtfully orchestrate the mix for the break-out groups – both to encourage communication among students from different programs, disciplines, or lab groups, and to mix older and younger students, men and women, and those from varying backgrounds. This mixing helps to broaden the experience and make it more like the real-world scientific community, where specialists in one area need to communicate with specialists in another. It also prevents over-familiarity from interfering with the role-playing aspects of the workshop, and helps the group bond overall, becoming more socially inclusive and cohesive. If time and resources are available, we like to begin a workshop session with a buffet or boxed lunch or cafeteria voucher, so that students can socialize a little. **(Food and refreshments often need to be ordered well in advance.)** Well-fed students are likely to be happier, more focused, and productive; and, since not everyone arrives on time, the food provides a bit of a buffer. We make good use of the time by giving them a communication exercise to do while they're eating at their tables. Another way to more subliminally relax students and cue them that they are walking into a

different kind of experience is to have some nice tone-setting walk-in music playing as they arrive and gather at their tables. At their tables, each participant is provided with a packet containing the resources for the day and their post session assignment. Make sure there is fresh water available for students in bottles or pitchers. As speech and drama coaches will tell you, good hydration is key to good public speaking.

Visual Documentation

Take a few photos of the participants engaged in activities at your workshop sessions and some group photos. They'll be quite useful for reporting on your work. We always take a celebratory group shot of the students and faculty at the end of the workshop and share it with all of them. Include appropriate institutional photo releases in their Session One packets and collect them, unless the students have already signed releases covering the entire research experience program.

Budgeting

The most valuable resource consumed by the REU SCW is the time of the workshop planners and facilitators. This should be acknowledged in their scope of work, and in cases where workshops sessions are being run in collaboration with a science museum, can be supported through a sub-award or contractual arrangement. Beyond the invaluable 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 local implementation of the REU-SCW is not essential, but highly recommended. Through years of independent evaluation, we know the workshop sessions work well for their target audience. By applying a few simple surveying tools, workshop providers may gain valuable insight into the particular experiences *your* student participants are having, and you may discover some low-cost, high-benefit modifications you can make to improve the program the next time you offer it. **We also use the student surveys as essential elements of the workshop pedagogy. They are designed to help students reflect on their communication experiences and skills development process, reinforcing the learning objectives of the workshop.** In addition, the Science Communication Experience survey, typically issued online before the start of the research program, provides information that the workshop leader can use very effectively to engage students in the very first workshop session (more detail on this aspect later in the Session One Sample Agenda). The results from the Session One Feedback Survey are similarly utilized during Session Two.

The Museum of Science workshop design team is currently offering free use of its IRB-approved online survey system for all REU SCW providers. To take advantage of this opportunity, contact us at nano@mos.org. Here's how it works:

- Providers send us the names and email addresses of their student participants before the program begins. They let us know <u>when</u> they would like us to email the survey out to students and the date of their first workshop session.
- We plug the names into the survey software.
- We give the providers text for a brief email they will send to the students advising them that are about to receive a link to a very brief survey from the Museum of Science, and requesting that they complete it by a particular date, before the first workshop session.
- We follow up with emails to each student with the survey link.
- Within a few days, we deliver the results to the providers, stripped of personal identifying information. The results include statistical analysis as well as verbatim responses to open-ended questions asked in the survey which are used by the workshop leader during their introduction to Session One. The survey results can also help the workshop leader adjust session content for the experience level of their group.
- Anonymous student data sets from all participating REU SCW workshop providers get aggregated into a master data set that can be used to track program trends and outcomes, and inform future editions of the program.
- The process is repeated for the Session One Feedback Survey, the Session Two Feedback Survey, and the final Post REU-SCW surveys of students and advisors. MOS sends aggregated anonymous group data and analysis from each survey back to each program provider, and that provider can use the data to report to program funders, to plan customized modifications for the following year.

The Appendix includes copies of all the evaluation forms, which providers can also administer on their own, and the Digital Appendix includes customizable versions. These forms are grouped in the Appendix according to their timing relative to workshop sessions. **If your REU program already administers a pre or post program survey, it may be possible to integrate the relevant questions into those instruments**. For information on prior evaluation findings and publications, please contact nano@mos.org.

We also recommend surveying or personally debriefing with faculty and mentors following the implementation, especially in the first year, to check whether they have observed an increase in the quality of student posters and presentations compared to preceding years, and to check if they have helpful suggestions for coordinating the next iteration. A faculty advisor survey is included in the post Session Two Document section, and, like the other surveys, can be administered to faculty online by contacting nano@mos.org.

Next is a sample advance-planning timeline that can help you organize and schedule all activities related to SCW implementation. A customizable version is available in the e-Document Folder.

Advance Planning Timeline

This sample timeline assumes that two half-day SCW sessions will be implemented a 10-week undergraduate research experience program. The version in the e-Document Folder in the Digital Appendix can be customized for variations in format and scheduling.

DATE	EVENT/ GOAL	DESCRIPTION	OUTCOMES
March - April	**Strategic Planning**: Integrating SCW into the summer undergraduate research program schedule.	- Confirm decision to implement SCW. - Confer with faculty and mentors on student research poster and/or presentation requirements and timing. - Schedule workshop sessions. - Book rooms. - Determine evaluation strategy and timing. - Set remainder of planning schedule. - Contact nano@mos.org for updates, support, and evaluation services.	Partners have agreed on how to integrate the Science Communication Workshop sessions into the summer under-graduate research program, even as student applications to are arriving.
May	**Mentor Guidance:** Coordinating with faculty mentors on expectations for student posters and presentations and conduct of workshop sessions. **Advance Preparations for Session One** Including logistics, surveys, facilitator briefings, etc.	- Brief faculty mentors on the SCW, its goals and schedule. Coordinate student communication requirements and assignments. Discuss the advice students will be given on posters and presentations. Clear up any discrepancies in expectations. - Recruit faculty mentors as small group facilitators for the workshop sessions. - Include the SCW workshop schedule in the overall program schedule. - Finalize logistics (room, equipment, handouts, timing, refreshments). - Implement the online Science Communication Experience survey. Contact nano@mos.org to get it sent to students, to receive results before the first workshop session; or, plan to use a paper survey at student orientation session. - Brief Session One facilitators/mentors on roles.	REU Directors and student mentors and supervisors are in alignment on expectations and standards for student presentations and/or posters. Workshop break-out group facilitators are recruited. Having the logistics taken care of in advance helps everything go smoothly.
Early June	**REU Orientation**	- Students receive summer schedule including the two (or more) SCW sessions and due-dates for drafts and final presentations. - Students fill out Science Communication Experience survey, either online or on paper (if they haven't completed it online prior to orientation) -After completing the Experience survey, students receive the "Science Communication" intro page and the "Session One Assignment"	Students know what is expected. Students are cued to have initial conversations with their advisors about the

		doc, a few days in advance of Session One. (Send copies to their advisors, too.)	context of their research project.
	Final Preparations for Session One	- Workshop leader checks data from Student Experience Survey and decides what to share with the group in the first Session and how to adjust content based on survey results. - Pre-assign students into small groups. Make nametags for students coded with group assignments. - Customize handouts if necessary and photocopy for student packets. Finalize assignment for Session Two. - Adapt and practice Leader talks, activities, and commentary for Session One, gather and test props. Test media. - Work with MOS to make arrangements for the brief Session One Feedback Survey; or, prepare hard copies for use at the end of Session One. - Reconfirm expectations with mentors and facilitators and presentation/poster due-dates.	Organizers know what prior experience students have had in science communication and where they feel they need the most help. Logistics are all set.
Early June (within first ten days of program)	**Workshop Session One**	- See Session One Agenda and Notes in Chapter Three.	Students develop skills during Session One.
Early June	**Assess Session One**	- Compile and analyze Feedback Survey data. - Debrief with mentors/facilitators. - Follow up on outcomes if students were required to deliver an introductory presentation in the following week.	Gather information helpful for planning Session Two and for improving Session One the next time it is given.
Late June– Early July	**Preparations for Session Two**	- Finalize logistics (rooms, presentation projection equipment or poster bulletin boards, handouts, timing, refreshments). - Finalize Session Two Feedback Surveys (or connect with nano@mos.org) and load into computer survey software or 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 for Session Two. - Adapt presentation/PowerPoint for Session Two and gather props. - Re-check that the stakeholders are in sync on student assignments, due-dates and requirements. - Optional research abstract writing assignment for students.	Everything is set to go smoothly.

Week prior to Session Two	**Final Preparations for Session Two**	- If appropriate, remind students what is due for Session Two, how their slide or poster files will be collected, and submittal deadlines. - Brief mentors and facilitators on Session Two roles if not done previously.	Encourage students to prepare in advance and practice their slide or poster presentation *aloud* alone or to others.
24 hours prior to Session Two	**Receive and load student slide or poster presentations**	- Have students send a file with the first 5-10 minutes of their slide presentation – or their research poster - via email or a large file transfer service like Dropbox or HighTail. Pre-load presentations on computers for each pre-designated break-out group.	There will be no delay in getting to the small group work.
Late July	**Session Two Workshop**	- See Session Two Agenda and Notes.	Students develop additional skills during Session Two.
Late July	**Assess Session Two**	- Analyze Session Two Feedback Survey data. - Debrief mentors/facilitators to learn more.	Reinforce student learning. Gather information helpful for the next iteration.
Early August	**Students deliver final research presentations with slides or posters**	- Science Communication Workshop leaders attend with faculty and mentors.	All the hard work comes to fruition! Students feel sense of accomplishment.
August – before students depart	**Post Program Assessment**	- Students complete final workshop surveys. Coordinate with MOS to implement these or include them the questions in the final program survey. - Debrief faculty and mentors and students on outcomes and record their feedback.	Participants and faculty offer insights while the experience is still fresh.
August - September	**Post Program Analysis**	- Analyze data and debrief with faculty to develop recommendations for the next iteration. Note both what worked well and what should be improved.	A learning community has been established.

SCIENCE COMMUNICATION WORKSHOP
Planning & Implementation Guide, v. 5.0

Chapter Three
Session One: Preparation, Materials, Leader Commentary & Activities

About Session One
Session One Annotated Agenda
Session One Alternate Formats
Preparation for Session One
Session One Materials and Props List
Session One Detailed Agenda & Facilitator's Guide

About Session One

Session One has been delivered in a condensed format in as little as one hour for a single small group of students and extended to as long as four and one-half hours for a group of 35 students, including lunch, and break-out group activities. The Session may be customized to any length, and it may be broken up into two or three shorter sessions. Please note however that **student feedback invariably indicates that practice speaking aloud in small groups is the most valuable of the REU SCW,** and they'd prefer *more* rather than fewer rounds of practice in small groups.   Please take this into account as you customize your approach. In most professional development workshops, participants sit and listen. In this one, they actively practice incorporating the guidance they are being given, and they practice giving that guidance to each other.   In the REU SCW, it's the personal and group engagement that counts most.

In Session One students not only learn and practice good oral presentation and feedback skills – they also probe the significance of their research within a broader scientific and social context. They come to understand more about the construct of research – the break up of large challenges into smaller ones; the pursuit of open-ended approaches; the expectation that many experiments will fail; and the knowledge that what doesn't work is often as important to communicate as what does.   The main message of Session One is that the cycle of practice, reflection, correction, and more practice, quickly brings results, and that for oral presentations, practice *aloud* brings greater mastery.

Next, you will see an annotated agenda for the complete Session One, followed by a discussion of various ways to customize it to different formats, such as multiple shorter sessions. Following that are notes on planning the session, a list of materials, and a very detailed workshop leader annotated agenda including leader commentary and activity instructions. The documents and handouts for Session One can be found in the Appendix.

Session One Annotated Agenda

*…As implemented for a group of 18 to 24 students in a single afternoon session with two rounds of break-out group practice. **Later in this chapter, you will have the opportunity to see a more detailed Session One agenda with sample workshop leader commentary and activity guides.***

12:00   Students Arrive | Informal Welcome

<u>Preparation Notes:</u> Walk-in music; lunch buffet, box lunches, or cafeteria vouchers; nametags coded with break-out group assignments; student packets. Podium or lectern for workshop leader, media loaded to computer; projector, slides, and audio connection tested. Session One title slide on screen. Clear sign stands on each table with table number and instructions for the lunch table exercise. (Extra table for mentor/facilitators.) Greet students as they arrive and direct them to the lunch buffet and to the pre-assigned lunch table groups coded on their nametags. Invite them to turn off cell phones and begin the Lunch Table Activity. During this time period, deliver a final briefing to mentor/facilitators on their roles in this session, referring Instructions/Guidelines for Facilitators handout. (Students can also begin by filling out Science Communication Experience surveys if they have not already completed them online.)

12:15 Lunch Table Activity

o   Students take turns introducing themselves to each other and describing their summer research projects as they understand them thus far.

o   Instructions for this activity are posted in a vertical plastic sign stand on each table. (See the Document Appendix)

12:30 Welcome and Introduction to Science Communication

o   Workshop leader welcomes students and provides an overview of the goals, agenda, and schedule of the REU SCW.

o   Leader briefs students on findings from the Science Communication Experience Survey (if it was completed online in advance)..

o   Debrief of Lunch Table Activity.   *The secret is practice.*

12:45 Sample Research Presentation: Dr. Lorraine Fisher-Katz

o   Workshop leader introduces and runs the 8-minute video, either from Session One PowerPoint slide or streaming from YouTube.

12:55 Debrief of Sample Research Presentation

o   Workshop leader facilitates critique of Sample Research Presentation, distinguishing important aspects of slide design, presenter skills, and content organization.

1:05 Connecting With Your Audience

o   Workshop leader discusses and demonstrates key components of successful face-to-face communication strategies.

 ▪   Being present. (Eyes, voice, gestures, movement.)

 ▪   Landing points. (Ball toss analogy.)

 ▪   Gauging your audience. (Mis-matched sports gear analogy.)

1:15 Exploring Context & Motivation
- Balancing the *What* and the *Why* (Session One PowerPoint slide graphic.)
- Discovering the broader context.
- Big Box Demo. (optional prop)

1:25 Communicating the Broader Context - Sample Video Clips
- Six video clips, each under 60 seconds with commentary, with examples of senior researchers connecting with their audiences. (included in Session One PowerPoint with the commentary in the Notes section.)

1:40 Context and Motivation: Brief Writing Exercise (optional handout)
- Students are given 3-5 minutes to write an introductory statement about their research project that addresses its larger context and motivation.

1:45 Pair Sharing and Group Debrief of Writing Exercise
- Students share their introductory statement with a partner.
- Workshop leader invites discussion about the challenges presented by this assignment.
- Students are invited to volunteer to share a few of their statements with the group; leader provides gentle, clarifying guidance, Socratic style.

2:00 5-minute Stretch Break

2:05 Oral Research Introductions Activity: Instructions and Preparation
- Students are given instructions for preparing brief (1-2 minute) oral introductions for rapid prototyping in break-out groups. They are reminded of the "connecting with your audience" oral presentation practices reviewed previously.
- They may sit and write, or wander around the room, practicing on their own. (This is also a stretch break.)

2:10 Oral Research Introductions: In Small Groups
- Students split into pre-assigned groups (or to stay with Lunch Table group), with one mentor/facilitator assigned to each group.
- Each student has one to two minutes to speak; and receives a total of five minutes of constructive feedback from the listeners, if they would like it.
- Each listener is encouraged to offer commentary, including at least one aspect that worked well and at least one specific suggestion for possible improvement. (Or, all the comments on what worked well can be given first, followed by suggestions for improvement.)

2:55 Debrief of Oral Research Introductions Activity
- The whole group reconvenes, and the workshop leader facilitates a group debriefing session, drawing out commentary on some of the challenges this exercise can present, and reminding the group that the process gets easier with practice.

o The leader may also invite one or several students to deliver their introduction to the group as a whole, providing gentle commentary.

3:10 Preparation for Second Round of Oral Research Introductions
o Students are given five minutes to rework their research introduction based on the feedback they've received.

3:15 Second Round of Research Introductions: In Small Groups
o Students break up into a second round of 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.
o This round can be shortened by asking students to keep their introductions anywhere from 45 to 90 seconds each and by reducing total feedback time to three or four minutes total from the group per speaker.

3:50 Debrief of Second Round of Research Introductions
o Students report on the impact of absorbing feedback, revising, and practicing a second round.

[4:00 Optional: "A Brief Slide Presentation about Slide Presentations"]
o This is a 5-minute, mostly automated PowerPoint presentation that humorously reviews some basic design tips and introduces features like "Hide Slide" and "Presenter View." [It is included in the Session One PowerPoint in the Multimedia Folder of the Digital.]

4:00 Session Wrap-up and Assignments
o Review key points, assignments, handouts.
o Preview what will happen at next session, the date and the time. Go over the Research Presentation Reflection Sheets so students understand the assessment criteria.
o Reinforce the importance of *practicing presentations aloud.*
o Have students complete the Session One Feedback Survey or tell them they will receive links to this survey via email and should complete it.
o Optional: Group photograph and good cheer.

4:15 Adjourn

Session One Alternate Formats

Multiple Shorter Sessions:

- Break Session One into two sessions of 90 – 120 minutes, including lunch or refreshments. Wrap up Part One after the debrief of the Context & Meaning writing exercise and assign preparation of the brief oral research introductions for Part Two. Begin Part Two with a brief review on connecting with your audience and then proceed with two rounds of oral introductions in break-out groups. Conclude with the Session Two assignment and resources.

- Break Session One into three or four sessions of 60 – 90 minutes, including lunch or refreshments. Wrap up Part One after the section on Connecting With Your Audience. Begin Part Two with Exploring Context & Meaning and end after the debrief of the Context & Meaning writing exercise and assign preparation of the brief oral research introductions for Part Three. Begin Part Three with a brief review on connecting to the audience and then proceed with two rounds of oral introductions in break-out groups. (Or create a Part Four with one round in break-out groups and the option for students to volunteer to deliver a second talk to the group as a whole. Or, use the extra time to workshop through improvements with students who want the extra help. Conclude with the Session Two assignment and resources.

- Hold Part One with the large group, and have students convene in small groups at different dates and times for the other Parts.

Streamlining:

- Condense workshop leader commentary, picking and choosing sections *a la carte.*
- If the group is small (4-7), no need to split into break-out groups.
- Don't use the optional slide set, "A Brief Slide Presentation about Slide Presentations."
- Omit the Big Box Analogy.
- Omit lunch and the Lunch Table Activity
- Omit the Writing Exercise
- Omit the Sample Research Presentation and Debrief
- Omit Video Clips of Researchers Communicating the Broader Context
- Limit oral research introductions to 60 seconds each, perhaps just the second time around.
- Limit group feedback time on the second round of research introductions.
- Try very hard not to omit the second round of research introductions and debriefs!

Alternate Content: Posters

- If students are giving poster presentations rather than slide presentations, substitute or add in those materials. See the Poster Supplement section in the Appendix.

Preparation for Session One

As detailed in the "Advance Planning" chapter, organizers will prepare the meeting room and materials, made student nametags (coded with break-out group assignments if it's a large group), recruited and briefed the break-out group facilitators, collected the results of the student Science Communication Experience Survey, sent students the Pre Session One assignment, tested the Session One media, made participant packets and table signs, and practiced the delivery of the workshop leader commentary.

The Survey results give the workshop leader specific details to include in the Session One introductory talk, data the students themselves contributed. This is a great ice-breaker, immediately engaging the students in hearing how their own experiences (reported anonymously) compare with the experiences of others in their group. Finding out that others have had some similar experiences and concerns can help put them at ease. Students also appreciate that their individual voices have been heard while their confidentiality has been protected. Workshop leaders should feel free to use the session to address any particular concerns raised by a particular group of students – if not already covered in the material.

The Pre Session One Student Assignment

Students will have been given this assignment, emailed, or printed double-sided with the "Science Communication" handout, after they complete the Science Communication Experience Survey, and before they arrive at Session One. (The orientation session is a good place to distribute it.) The assignment cues students to have an initial discussion with their research advisor or mentor regarding the motivation and broader context for their research project and for the work of the entire lab group. This discussion prepares them for engaging in Session One activities.

Posters or Presentations, or Both?

The default Session One plan assumes that students will be required to give slide presentations on their project near the end of the research program. The session covers planning and designing digital slide presentations, and students are given a customizable assignment sheet with instructions for drafting the slide presentation that will be due at the end of the program and that they will deliver in "dress rehearsal" mode during Session Two. However, if students are required to make research posters instead or in addition, optional materials are available. Please see the Poster Supplement section in the Appendix.

The Post Session One Assignment

Students are briefed on their final presentation assignment during the last part of Session One, In Session Two, they will deliver the first five or ten minutes of the presentation in break-out groups for practice and feedback. The assignment for posters is similar. In both cases, students will be expected to deliver their draft slide sets or their posters – on a slide or printed - a day before the start of Session Two.

Session One Materials & Props List

Items in italics are provided in the Appendix or in the Digital Appendix, which contains customizable e-versions of the documents as well as the PowerPoint and videos. If you do not have the Digital Appendix on DVD, you can download all of it <u>except the videos</u> from http://www.nisenet.org/catalog/tools_guides/reu_science_communication_workshop **Request the videos from* nano@mos.org

Pre Meeting Materials

o *Science Communication Experience Surveys*, completed on paper or online in advance.
o *Instructions/Guidelines for Facilitators,* sent to break-out group facilitators.
o *Pre Session One Student Assignment: Science Communication Introduction, usually printed back-to-back with "Brief Writing Assignment: Broader Context & Motivation"*

Meeting Materials

o Nametags (marked with numbers and/or letters of pre-assigned small groups).
o Large workshop room with tables and chairs, water and trash cans.
o Lunch buffet, boxed lunches, café vouchers, or other refreshments and snacks.
o 4-6 clear vertical plastic holders (9x12 or 8 ½ x 11), inserted with *table number & Lunch Table Activity instructions.*
o MP3 or CD player and walk-in music (optional).
o Laptop, projector, and screen for slides or posters.
o Optional timing devices with gentle alarms: smart phone apps will do the trick.
o Water pitchers and cups, or bottled water.
o Pens, pads for those who don't have them.
o *Science Communication Experience Surveys*, if not completed in advance (optional).
o *Instructions/Guidelines for Facilitators,* refresher handout for break-out group facilitators.
o *Session One Feedback Surveys*, unless they will be administered online the next day.

Media (in the Multimedia Folder in the Digital Appendix)
<u>Please test all media in advance and make sure the audio is connected to room speakers. Parts of the PowerPoint need to be customized.</u>

o *Session One PowerPoint slides, including embedded videos and speaker notes.* Contact nano@mos.org for assistance if needed. We can supply the videos if they are missing, including the Sample Research Presentation.

o Note: Sample Research Presentation can also be streamed from YouTube (not advised)
   - Straight Version: "Dr. Fisher-Katz Addresses Undergraduates on Nanoelectronics at a Science Communication Workshop" http://youtu.be/n5JKymUD2dw
   - Spoiler Version: "Undergraduate Students Unwittingly Subjected to World's Worst Research Presentation" https://youtu.be/nSGqp4-bZQY

Props

- o Soft volleyball or soccer ball for the "Connecting With Your Audience" demo.
- o Baseball mitt and basketball; plastic bat and ping pong ball; or other miss-matched sporting equipment) for the "Gauge Your Audience" demo.
- o "Big Box" demo prop (optional)

> The "Big Box" is a do-it-yourself prop used to illustrate the way in which 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. See the Detailed Session One Agenda later in Chapter Three for more guidance on this item.

Student Packets

These materials are included for photocopying in the Appendix. In addition, customizable Word Doc versions of most are included in the e-Document Folder of the Digital Appendix.

- ▪ P1 "Science Communication" introduction, often printed back-to-back with
- ▪ P2 "Brief Writing Assignment: Broader Context & Motivation"

- ▪ P3 "Research Presentation Pointers," usually printed back-to-back with
- ▪ P4 "Research Presentation Assignment."
   (This page of the handout must be customized before distribution)

- ▪ P5 "Research Presentation Reflection Rubric" (double-sided).

- ▪ P6-7 "Effective Science Posters – Quick Reference." (double-sided pamphlet).

- ▪ P8 "A Field Guide for Poster Sessions" (one-sided).

- ▪ P9 "Poster Presentation Scoresheet" (one-sided).

- ▪ P10 "Science Communication Resources" (one-sided).

- ▪ Optional: If the workshop is taking place in an unfamiliar location, we often provide a map and location guide.

How to use the *Session One Detailed Agenda & Facilitator's Guide*
following this page…

This is a detailed walk-through for the full-length version of Session One as implemented for a group of 18 to 24 students in a single afternoon session with two rounds of break-out group practice. It includes suggested workshop leader commentary scripted out for certain sections and outlined for others, activity guides, and facilitation advice. Timing notes assume the Session starts at noon and adjourns at 4:15. Workshop providers may customize all of this according to their specific needs, style, and schedule. They may also break it into multiple shorter sessions or streamline it, as described in the "Alternate Formats" section on page 31.

If you have received this Guide as a looseleaf binder, the printed Appendix includes all the necessary signage, surveys, and handouts. The DVD contains an e-Document folder with customizable electronic versions, as well as a Multimedia Folder with the Session One PowerPoint and all the embedded videos. Transfer the Multimedia Folder to your computer, and customize the slide set for your implementation.

If you have downloaded this Guide from http://www.nisenet.org/catalog/tools_guides/reu_science_communication_workshop, the e-Document Folder and Multimedia Folder will be included; however, the Session One PowerPoint will NOT contain the embedded videos, just slates for them. Please contact nano@mos.org to be sent the video files.

KEY: In the Session One Detailed Agenda & Facilitator's Guide,
    -- *Notes in italics refer to set-up instructions.*
    -- Leader's commentary is written in plain text.
    -- [Notes in brackets indicate where leaders are expected to plug in their own values or
        decide between versions.]

    -- Paragraphs in boxes provide more detailed instructions on the design of an activity.

The workshop Leader Commentary and speaking notes are numbered to correspond to slide numbers in the Session One PowerPoint file, and the Notes areas on the PowerPoint slides also include the corresponding section of Leader Commentary. Workshop leaders may thus use PowerPoint's handy "Presenter View" to help deliver the Commentary, while the audience sees only the slides. Slides and slide notes require some customization. Additional information on using PowerPoint's "Presenter View" can be found online.

The REU SCW advises students to practice their presentations aloud in advance, and we suggest workshop leaders do the same. Take the Leader Commentary, customize it to suit your needs and personality, print it double-spaced in a big font, and practice delivering it aloud with the slides, as if to a group of students. Alternatively, customize the Commentary pasted into the Notes area of the PowerPoint slides, and practice delivering it using Presenter View. Practice running the videos as well.

Session One Detailed Agenda & Facilitator's Guide
With Sample Workshop Leader Commentary, *Notes,* and Activity Guides

…As implemented for a group of 18 to 24 students in a single afternoon session with two rounds of break-out group practice.

Preparation Notes*: Walk-in music; lunch; nametags coded with break-out group assignments; student packets; clear sign stands on each table with table number and instructions for the lunch table exercise. (Extra table for mentor/facilitators.) Lectern for workshop leader, media loaded to computer; projector, slides, video, and audio connection tested. Set PowerPoint to "Presenter View" and **un**check "mirror display" to be able to use the Leader Commentary in the Notes sections of the slides on the computer display.*

(12:00) Students Arrive | Informal Welcome

Greet students as they arrive and direct them to the lunch buffet and to the pre-assigned lunch table groups coded on their nametags. Invite them to turn off cell phones and begin the Lunch Table Activity. During this time period, deliver a final briefing to mentor/facilitators on their roles in this session, referring Instructions/Guidelines for Facilitators handout. (Students can also begin by filling out Science Communication Experience surveys if they have not already completed them online.)

(12:15) Lunch Table Activity

o   Students take turns introducing themselves to each other and describing their summer research projects as they understand them thus far.
o   Instructions for this activity are posted in a vertical plastic sign stand on each table. (Customizable sign included in the Appendix and e-Document Folder.)

(12:30) Part 1: Welcome & Introduction to Science Communication

The following version of the introductory talk assumes students have responded to the pre-workshop Science Communication Experience Survey, and the workshop leader has obtained results before the session begins. Sample survey results and corresponding commentary in the introductory talk below reflect the results from one of our REU SCW groups; users of this Guide should [substitute their own findings] and adjust the narrative to focus on the most pertinent needs of their group. In the Session One PowerPoint, the Leader Commentary can be split between the Notes sections of the customized title slide and five duplicate title slides, to make it easier to see in Presenter View.

Sample Workshop Leader Commentary for Part 1 (Slide 1)

Slide 1. Hello, my name is [_____]; I [am, do] [_____,]. We're delighted to be hosting you here today [and we welcome back some folks we recognize from last year]! We would appreciate it if you would turn off cell phones while you're here.

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 delivering your final research presentation [or poster] here, in small work groups, before you finalize and deliver it to [the intended audience], during the last week of the program.

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 Science Communication Experience Survey responses and found out that 76% [substitute your own survey results] of you rated good science communication skills as of "high" or "very high" importance to a career in science. So, we figure we have already aced that workshop goal rather nicely. The rest of you, listen up…

It's true: to be most successful, professional researchers require excellent oral, written, and graphic communication skills. They write papers and publish journal articles; they present their research through slide presentations and posters at meetings and conferences. They make pitches and reports to funders and investors; they write grant proposals; they interview for jobs. They teach, mentor students, and give public talks. Occasionally they are interviewed or profiled by journalists and bloggers. Communication is a central feature of academic careers in research as well as in industry.

This set of workshops is designed to help you develop some of the skills critical to professional science communication. These include oral and graphic skills, presentation and story-telling skills, and writing skills.

We thank you from filling out the Science Communication Experience Surveys. From your responses we learned that…
[Substitute in results from your own group, and feel free to highlight more relevant findings from the Student Experience Survey that better meet the needs of this particular group, for example, poster experience]….

- While [76%] of you know that science communication skills are of high importance to a career in science, [71%] of you have not previously had any science communication training. This is fairly typical, but it is changing rapidly. Universities are offering more and more science communication training workshops.
- [32%] of you have never had <u>any kind </u>of communication training - whether focused on science or any other topic;

- [About a third] of you have never delivered an oral presentation on science or engineering;
- And, while almost all of you have used a digital slide presentation program like PowerPoint or Keynote; [37%] of you have not yet used one of these for a science research presentation.

Now, many of you have had some prior experience giving slide presentations and [there are even [some, one or two] of you feel comfortable and enjoy doing it, which is terrific:

- One of you mentioned ["that great feeling you get when you know the audience really understands what you are talking about…," and that "being able to convey the knowledge reassures you that you really are an expert in the topic."]
- Someone else said, ["When presenting science to an audience, there's a sense of pride in that I have the opportunity to show what I have done." And, "I want to try to get them to understand it as much as possible so that they can appreciate the hard work I did even more."]

So, for some of you, today is about "upping your game." For instance, you could learn how to give an even better performance, or how to use PowerPoint's excellent "Presenter View" tool. We'd definitely like to get more of you practicing your talks aloud in advance - and asking others for constructive feedback.

But for the majority in the room – while still rating yourselves at [moderate or better] proficiency in delivering presentations, *there's one big caveat:* only [31%] of you feel comfortable *giving* presentations. Many of you mentioned the symptoms of stage fright - being nervous in front of a group – forgetting what you were going to say, worrying that you might get asked a question you wouldn't be able to answer.

- One of you said…. [fill in with quote from student comments].
- Someone else said….. [fill in with another quote from student comments].

And these are not isolated experiences. Many of us have these reactions. Our pulse rate goes up, our blood pressure rises, and we feel like a deer in the headlights, up there in front of a room full of people. Today, we're going to practice some ways of dealing with these very normal aspects of speaking to an audience.

For instance, let me ask you – What was it like during the lunch table exercise - how hard was it to introduce yourself and try to describe your research project in that informal setting? *(Ask for comments, discussion…)*

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.

And, the best cure for nervousness? Advance preparation, practice, even dress rehearsal. *The secret is practice.* So, let's look at an example of a contemporary research presentation…

(12:45) Part 2: Sample Research Presentation Activity (Slide 2)

*This workshop element is a great ice-breaker, and it involves the students in critical thinking and a little bit of humor early in the first session. Beginning with an example of a very bad presentation helps to highlight common presentation pitfalls, and lightens the mood. **The eight-minute Sample Research Presentation by Dr. Fisher-Katz is a spoof, and can either be introduced that way, in "spoiler" mode, sharing the backstory of its production; or, it can be introduced to an unwitting audience, in "straight" mode as if it is an example of a typical research presentation; so that the audience can experience the full impact of the spoof themselves. The intros to both versions are in the Notes section on Slide 2. The two video versions are on slides 3 (spoiler) and 4 (straight). Choose one to show and then use the "Hide slide" feature to hide the other before the Session begins.** [If the Multimedia Folder was downloaded from nisenet.org, request the videos from nano@mos.org. They can also be streamed directly from the internet if there is a strong broadband connection – see urls below.]*

In the video, an actress, posing as an MIT professor, gives a five-minute talk on nano-electronics to a group of undergraduate students at an REU Science Communication Workshop at the Museum of Science. From the very beginning, she is disorganized, encounters technical difficulties, speaks beyond the experience level of her audience, and displays packed, busy slides. She demeans a questioner and even checks a smart phone message in the midst of it all. At the end, she turns to the session host and asks for "the check." Many of the lesser bad presentation practices exhibited – although greatly exaggerated - are recognizable and familiar to people who attend scientific meetings, lectures, and conferences. The students in the video are slow to realize that the presentation is a spoof, but their expressions begin to reveal a mixture of boredom, alarm, and disbelief as it proceeds.

The title of the spoiler version, slide 3, "Students Unwittingly Subjected to World's Worst Research Presentation" reveals to viewers that the talk is a spoof. At the end, the workshop leader in the video finally reveals to the students that it is a spoof and introduces the actress. Hide Slide 3 if you are using the 'straight' version instead.

The title of the "straight" version, slide 4, "Dr. Fisher-Katz Addresses Undergraduates on Nanoelectronics at a Science Communication Workshop," gives nothing away. The fake professor appears without introduction and delivers the same bad five-minute talk. The spoof is only revealed at the very end of the video. Hide slide 4 if using the spoiler version instead.

Both versions end with a very brief credit sequence rolling into a 90-second animated tutorial using examples of the talk to point out good and bad presentation practices.

The workshop leader can either pause the video just before the animated tutorial [at 6:25 in the spoiler version; or, in the straight version, just before the reveal at 5:12] and debrief with the students, discussing what they liked and didn't like about the presentation (see below). Follow this by running the credits and the animated tutorial on good presentation practices. It's also fine to run the videos all the way through the tutorial, and let it reinforce the discussion of what was so bad about the presentation.

> **Using Option One: "Spoiler" Version (Slide 2)**
>
> The "spoiler" version is entitled "Undergraduate Students Unwittingly Subjected to World's Worst Research Presentation," and is embedded in Slide 3. (Also available at https://youtu.be/nSGqp4-bZQY.) It is about eight minutes long, including a 30-second introduction, the five-minute talk by "Dr. Fischer-Katz, the "reveal" of the spoof, credits, and the 90-second animated tutorial. Play it full screen with good sound, tested in advance. Choose whether to pause the video before the animated tutorial rolls (at 6:25) and conduct the debrief, or roll all the way through before beginning the debrief. The following text is an example of how you could introduce this activity, directly following the Part One Intro talk:

Sample Commentary Introducing the "Spoiler" Version (Slide 2)

When this workshop was given for REU students at the Museum of Science in Boston a few years ago, the organizers had an actor come in pretending to be an MIT professor who was going to give a five-minute talk on Nanoelectronics, ostensibly so that the students could see how a typical research presentation is delivered.

The organizers had actually prepared a script and a slide show that incorporated some of the worst behaviors they had seen in research presentations, and had coached the actor how to deliver it very badly. The cameras captured not only the actor giving the presentation, but also the reactions of the students as they wrestled with the cognitive discord between this "example of a typical research presentation" and their actual gut reactions to what in reality is a very bad presentation.

So, while you're watching this video, try to make mental notes of some of the bad presentation practices exhibited here – in the slides, organization, delivery, and response to audience questions. Enjoy… and pay attention right through to the 90 second animated tutorial following the credits… [if you are going to let it roll.]

[Advance to Slide 3. Video begins automatically.]

> **Using Option Two: The "Straight" Version (Slide 2)**
>
> The "straight" version, "Dr. Fisher-Katz Addresses Undergraduates on Nanoelectronics at a Science Communication Workshop," plays from Slide 4, and is also available at http://youtu.be/n5JKymUD2dw, in a non-public area of YouTube. In this version, the fake Dr. Katz appears without introduction, and gives the same bad five-minute talk. Student reaction shots are still cut in, but there is no scene at the end showing the reveal of the spoof to the students – just an on-screen notice, followed by the credit sequence and the 90-second animated tutorial. Play it full screen with good sound, tested in advance. You may want to pause the video at about 5:12, before the spoof is revealed, and begin the debrief, discussing with students what they thought was good and bad about this presentation. Playing this version allows the students to experience some cognitive confusion as they watch, and allows you to see if and when they finally catch on that this is actually a very bad presentation. To pull this off, you have to play it very straight when you introduce the video. Here is one way to do it:

Sample Commentary Introducing the "Straight" Version (Slide 2)

Now we're going to look at an example of a scientific research presentation given to undergraduate students and see if we can pick out what we like and don't like about the presentation style. This talk is by Professor Lorraine Fisher-Katz, an MIT researcher who spoke to REU students at a Science Communication Workshop at the Museum of Science, Boston. It's about 5 minutes long. Let's take a look….
> [Advance to Slide 4. Video begins automatically.]

(12:55)   Debriefing the Sample Research Presentation (Slide 5)

> Ask the students to try to identify all the "bad" 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 notice of other "bad" elements the participants may be missing. The leader can use large easel pads 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.
>
> If there is time, it can work even better to begin this activity as a "Think-Pair-Share," where students pair off and first compare notes about what was so *bad,* and when they first realized it was a farce (if they saw the straight version). This approach allows them to relieve any tension that built up informally and to laugh, and may make them more open to sharing with the whole group next.

Sample Workshop Leader Questions

- When did you start to wonder whether this presentation was a spoof, or that something wasn't quite right here? (if straight version was used)

- Was the presentation targeted to the right 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 an annoying way? How about speakers who turn their back on the audience and read their slides aloud?" 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?); use of inexplicable jargon and acronyms; checking of phone message during the talk; dense slides, reading off slides, logos all over the place; making bad assumptions about what an audience knows and doesn't know; no conclusion or ending; awkward handling of questions; etc.]

Continue in this manner until almost most of 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?

It may help to write some of these ideas down on a white board or display pad as students come up with them. These ideas than become the basis for the guidance on making a "good" presentation, which the group will then move on to tackle.

> **Roll the video through the credits and the brief animated tutorial on good presentation practices if this was not shown earlier to prompt discussion.** This will wrap-up the lesson and reinforce the ideas about good and bad presentations that the students have just discussed.

(1:05) Part 3: Connecting With Your Audience (Slide 6)

This part of Session One picks up on the lessons learned from the Sample Research Presentation, and focuses on key aspects of successful face-to-face communication strategies, beginning with the speaker's connection with the audience in the room with them. Wherever possible, the workshop leader should demonstrate making these points – moving fluidly around the room, making eye contact with students one-by-one, and landing each point. (This is much easier to accomplish having practiced alone in advance with the speaking script.)

3. 1   Being Present - Sample Commentary

We've just critiqued a pretty bad research presentation, and we discussed good and bad aspects of presentations overall, and now we're going to address fundamentals of public speaking. We're going to start with the most basic one of all – the presenter's connection to his or her audience.

Now, you'll notice that other than having title slides [and a video running off a slide], and agenda section headings, I haven't been running slides outlining my talk or showing pictures or

clip art while I've been up here speaking to you. Why do you think I haven't been using slides? *Ask for ideas from the group; it none, use prompts such as:*

- Is there anything I've said so far that has needed to be illustrated?
- Would you have preferred to have seen bullet points outlining my talk up there on the screen? (Probably not.)

The key to using slides successfully is not use them at all unless they add something significant to your presentation. Otherwise they distract people from listening to you.

Have you ever noticed what happens to an audience when you are running a slide presentation *(gesture)* over your head or off to one side while you're talking? What do the people in the audience do? Do they keep their eyes on you?
[act these out in exaggerated fashion:]

- Do they avoid looking at you at all, and just stare zombie-like at the screen the whole time?
- Do they divide their attention back and forth between you and the slides, turning their head from side to side as if watching a tennis match?
- Or, worse, do they join you and read off your own slides, as you read off them, with your back to them….?

Having visual illustrations of ideas and concepts can be very useful to an audience – and later, we'll go over what they are particularly useful for.   But in many cases, like in a part of a talk like the part we're in now, slides would probably distract you, and in many cases would hinder the important connection you are trying to establish with the individuals in your audience.

What I mean to say here is that *the most powerful communication tool you have is <u>not</u> your slides, <u>not</u> your bullet points, and not your ability to design nifty graphics. The most powerful communication tools you have are your voice, your eyes, your personality, your gestures, your very PRESENCE in the room.* Otherwise, I might just as well send all of you an article about science communication, or a videotape of this talk, or maybe email you bullet-pointed slides. But no, I'm here, walking around *[demonstrate]*, looking you in the eye and directing your attention to the ideas and concepts. And, in return, in your faces, and in your body language, I'm getting back tiny, helpful cues from all of you – I'm finding out if you're with me, if you are engaged, if you're bored, or haven't a clue what I'm talking about.

Live presentations are about being authentic, genuine, and truly "in the room" with your audience - not about being an automaton reading notes off a screen. The advantage of attending a live talk is to be in the presence of an active intelligent, thinking human being, whose gestures, intonation, and asides add contextual insight to the information being communicated. So, don't just give the audience a dull formulaic report and slide show; instead, take the opportunity to tell a story about your research. Give it life, personality, and authenticity. Even the dullest piece of research can be made compelling if you put enough passion into the telling of it and its larger context and significance.

How does a speaker signal to an audience that he or she is entirely *present* with them, and including them in a communication loop? [Option to let audience offer responses…]

- Eye contact.
- Variation in voice, gestures, and dynamic movement.
- Showing that you yourself are interested in the ideas you are sharing.
- Giving your report in a story-telling fashion. Having a 'hook' or an interesting question up front; engaging attention.
- Letting the audience know *why* they should care about what you have to say, and why *you* care. What did you find most interesting in the topic? What larger significance does it have in people's lives?
- Getting the audience involved.
- "Landing" your points with the audience, and pausing to let them sink in. If you watch very good orators, this is something they excel at. Let's talk a little about landing points.

3.2 Landing Points (Slide 7)

It works well to make a memorable physical analogy for landing points, using a soft clean volleyball or soccer ball. Speak slowly, move a bit around the room, and make eye contact with individual audience members, including those who seem least engaged. Signal that you are about to toss them the ball, and do it lightly while you "land" the point you are making about landing points. Cue the student to toss the ball back to you; and continue on by turning to another student to land the next point while landing the ball with them, and so forth, demonstrating the power of this focusing technique.

Landing Points - Sample Commentary

Let me try a sports analogy for this idea of landing points and then pausing to let them sink in. I, the speaker, make eye contact with you, the listener, establishing a direct connection between the two of us. I see that I have your attention, and *I toss my thought gently to you.* You have been cued that my message is on its way, and you catch it. I watch you receive it, and know it has landed. You toss your acknowledgement back to me. It's a connection – a loop, a delivery, a return receipt.

My audience here is not a faceless agglomeration - you are an assembly of individual intelligences with personalities. When I share an idea you, I pay attention to how you receive that idea, and I see how you take it in – maybe a glint of understanding as the message sinks in, or, perhaps a moment of confusion, a signal that perhaps I left out a connection, or used words that are unfamiliar. This we call "being present," *in the room* with the audience. You want to treat a roomful of people as a collection of engaged individuals. Make eye contact with them and land points with different members of the group. Don't ignore the back or a 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 metaphorical toss back. Pausing is good.   Speakers often make the mistake of rushing through their talk, as if it wasn't really worth listening to. They seem to fear that if they pause… and slow down… people will get bored and restless and check their phones. Nothing could be further from the truth. Slowing down and delivering each point deliberately, while making eye contact, lends your commentary significance and drama. The slower pace will give you time to formulate each thought into a sentence, and connect the sentences into a story.   It will also give audience members more time to process the information you are delivering, and keep up with your flow of ideas – especially important in technical presentations. You will be surprised at how much better your listeners will be able to stay with you, wherever you are taking them.

Instead of reading from your notes or slides like an automaton, you will find yourself truly speaking in person, *being there.* Your audience will likely respond by being there too, putting down their phones, focusing their attention, looking back at you. If you speak like you are delivering an important story, people will listen.

3.3 Gauging Your Audience – Sample Commentary (Slide 8)

Science communication skills aren't just about you performing well in describing your research; they're also about understanding who is in your audience and crafting a presentation that will connect with their prior knowledge and training. Are they your lab-mates – so they already know why you're doing what you're doing, and what your acronyms stand for? Or, do they represent a broader range of scientific fields, so that, even though they may work on a different floor of the same building, they aren't necessarily fluent in exactly the same jargon you and your lab-mates casually toss around?   Or, are you at a conference, where specialists from many different areas are meeting to share ideas? Or they could be your friends and family, with no scientific background at all?

[Note: Demonstrate the following concept by using pairs of mismatched sports equipment for giving and receiving throws. For example, give a baseball glove to a student and ask them to try to catch the basketball you gently toss to them. Or, give a ping pong ball to a student and set up another with a plastic bat ten feet away, and tell the pitcher the ump is counting balls and strikes.   Lots of room for innovation here.]

You wouldn't toss a basketball-sized lump of heavy technical information to someone only prepared to catch a baseball.   You wouldn't want an ump calling balls and strikes as you try to pitch a ping pong ball to a major league batter. 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.*

With that in mind, what are some things you might want to do differently for different types of audiences?   [Possible responses: define technical jargon, provide some background and helpful illustrations, explain certain procedures, spell out acronyms, use analogies, etc.]

Also, don't forget the power of story: Perhaps you can deliver the motivation for your research project as a story about how you or your advisor came up with the idea; or a personal or common experience that helps convey the motivation. Describe something that happened during the course of the research that offered a key insight. Stories not only engage people, they also help us remember key points.

Once you have gauged who is in the audience you are addressing, you can adjust your approach, your language, and the level of assistance you provide in explaining conceptual and technical aspects of the work. Then try to figure out what it might take to get your listeners *to care* about what you're saying. There is always that little lingering question in the mind of every listener: "why should I care about this?" And that takes us to our next subject... exploring context and motivation.

(1:15) Part 4: Exploring Context & Motivation (Slide 9)

4.1 Balancing the *What* and the *Why* – Sample Commentary (Slide 9)

Unless your audience already understands the reason you are conducting your research, they're not going to be too interested in listening to the details. So, with most audiences, you're going to have to begin with the broader context and motivation for your research – *The Why*. **Why** you're taking all the trouble to do this painstaking work? What good could come of it? *(switch to slide 10)*

Slide 10: "Balancing *The What* and *The Why*"

Here's a somewhat tongue-in-cheek graph, suggesting how one might adjust the emphasis between elements of *The What* and *The Why* for particular audience groups, based on their experience level and interests. For your advisor and your lab colleagues, you're going to give more of the detailed information about WHAT you did and HOW you did it. You'll probably just skip *the Why,* because they will all know why you're doing it. But for your grandparents and friends and for the politicians who represent your fellow taxpayers, you're probably going to focus a lot more on WHY you are spending all this time and money on this – what is the ultimate goal of the research, besides

Balancing *The What* and *The Why*
by audience type

(graphic adapted from T. Miller)
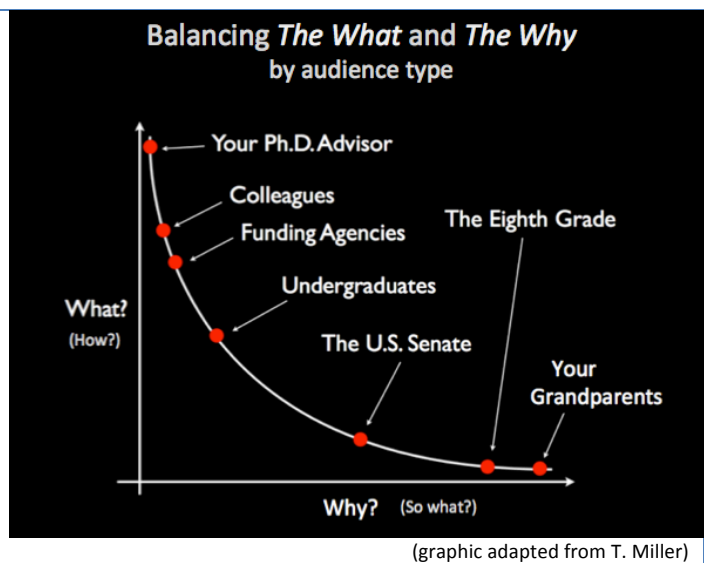
getting you a good degree and a job? What broader impact might it turn out to have?

4.2 Discovering the Broader Context – Sample Commentary (Slide 11)

So how do you go about discovering the broader context of your research project – The Why - given that you've probably only just started learning about it?

You ask questions. You query your advisor, grad students in the lab, other faculty members. [If you completed the preliminary assignment, you've already begun this process. How many of had the opportunity to speak to their research advisor about the questions in the assignment?]

Now, a two-month research project can usually tackle only one aspect of a larger research project, and I'll bet most of you are involved in solving a supplementary issue relevant to the main focus of your lab. The fact is that every research question or engineering challenge that a research team is tackling can probably be linked to an even larger research question or engineering challenge that a whole field is addressing, and that larger challenge can almost certainly be linked to some larger need, or challenge, or a societal benefit or goal that has impact for us all - and may even help make the world a better place. So, to be a super science communicator, to get your audience to understand *The Why* of your research so they'll care more about *The What* of your research, your task is to find all the links in the chain connecting your project to this larger context or motivation. **[SKIP TO p.49 * IF NOT USING THIS DEMO]** Here is a physical analogy for this concept….

Big Box Demo

The Big Box is a clear plastic storage box about 24 x 18 x18 with a clear plastic lid. We fill it with random quasi-scientific paraphernalia and toys, some inside boxes nested within boxes; within them, an egg timer, dice, microscope, beaker, large old telephone with antenna, thermometer, some spring-loaded joke streamers in a can, etc.] See further guidance on next page.

Big Box Demo – Sample Commentary

Let's say this box represents a collection of research efforts designed to address a giant challenge that human beings face. It could be that the challenge is about building a crash-proof car. Or, it could be that the challenge is about finding a cure for cancer. Or, maybe it's about making a breakthrough in the efficiency of solar energy. Now, as I open this box, I find a lot of approaches that teams of researchers are pursuing in a variety of different fields, working toward solutions to this challenge.

[Big Box Commentary guidance on next page....(skip to second page if not using this demo)]

Big Box Commentary guidance: Riff off somewhat comically on whatever items you have collected in the different boxes inside the Big Box, symbolizing the different goals and approaches different teams are using to the central challenge. I usually do something related to climate change, which can involve scientists working in many different fields. One inner box represents the work of teams exploring one set of approaches to meeting the challenge (I make up a quasi scientific approach); another box holds the work of teams coming at the challenge from a completely different angle (describe briefly). Then I open up one of those containers and find the scientific tools of a team taking one approach and communicating (pick up the phone) with a team in another box taking a somewhat complementary approach, maybe a laboratory at this very university – maybe your own laboratory -- and then inside this collection of tools is a smaller box containing items that symbolize a research question that one group in *your* lab is exploring, and (taking out and rolling a pair of dice), taking a rather risky approach, and perhaps within that effort is the supplemental research project (take out a small matchbox), that has been assigned to you. So, even though this 2-month-magnitude research project seems like a small piece of the action, and far from the grand challenge of tackling climate change, it is still an essential part – and, who knows?, may turn out the be *the* key to discovering an approach that will actually end up making a HUGE difference! (If allowed, you can strike a match from the matchbox.) I always have a few other comic surprises in the box, like a can with spring-loaded streamers, representing unexpected results.

The point is that - even though your research topic may seem small and obscure and far from the overall grand challenge it is meant to help address – it IS part of the attempt to tackle that overall challenge, and you should introduce it within that larger context – especially for any audience that is going to need a lot of The Why in addition to The What, such as your colleagues here working in other labs.

So, if I'm not familiar with your lab's investigations, and you start talking to me about the methodology of this complicated matchbox-size problem you're trying to address in the next two months, I'm not too likely to understand what the heck you're talking about, and I probably won't care enough to invest a lot of my time in trying to figure it. I'll just check out of the conversation at some point. But, if you begin by introducing me to this overall (Big Box) challenge – say, our need to cut back on greenhouse gases escaping into the atmosphere and accelerating global climate change – and how your lab's particular approach (say, trying to come up with an economical way to capture and convert fossil fuel emissions) might contribute to solving the problem – *then,* I may pay closer attention to you as you describe the ins and outs of your short-term research project, whether it be about finding a way to measure the energy consumption of a single catalytic process or about building a piece of machinery that will help your lab make that measurement. And I will likely find the rest of your story much more absorbing for me, because you will have given it Context & Motivation.

*SKIP TO THIS IF NOT USING THE BIG BOX DEMO:
So I urge all of you to find out everything you can about the larger context and motivation of your research project. Then figure out how to articulate it in a compelling manner. (It doesn't matter, by the way, whether your research ends up with the hoped-for findings, or even totally conclusive findings. ***Whether or not*** the results of your research project turn out as you expected or hoped, if you have followed the scientific process rigorously, documented your procedures and results, and **communicated them clearly,** you will have made a **meaningful contribution to tackling the overall challenge.**

To remind you of this important point, there is a two-sided handout in your packet: one side is called "Science Communication." *[This may be a duplicate of what the students received with their pre-Session One assignment, but on the reverse side this time are the instructions for the writing assignment.]* Please take this out. In a little bit, I am going to ask you to take a few minutes to try to introduce the larger context of your research project as you understand it thus far. But first I'm going to show you a few examples of some very accomplished scientists doing just that in their research talks …

(1:25) 4.3 Communicating the Broader Context: Sample Video Clips (Slide 12)
These narrative introductions for each clip are also included in the slide Notes sections. After delivering each introduction, press play on the slide video play bar and move the cursor out of the way. If the clips are missing, contact nano@mos.org.]

I'm going to show you six 30-60 second video clips of scientists connecting to their audiences and engaging them 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 - how they make eye contact and pause and land their points. Look at how they use their slides as illustrations to their talks, rather than as the crib notes to their talk; and notice how well they orchestrate the timing of their slide changes. [Before each clip, introduce the scientist briefly:]

- **[George Whitesides** - slide 13]. In this 2009 presentation at Ted Talks, the acclaimed and widely cited chemist George Whitesides begins his presentation by introducing the very broadest context and motivation for the challenge he is hoping to tackle with his research in low-cost paper diagnostics. [Press play.]

- **[Pam Silver** - slide 14]. Here you will see how Pam Silver, one of the leaders of Harvard's Wyss Institutute for Biologically-Inspired Engineering, begins her talk by introducing the very big problem she is hoping to address through synthetic biology. Notice how at each step she makes eye contact with her audience and connects her biological tools and chemical compounds. [Press play.]

- **[Ainissa Ramirez** - slide 15]. In this next clip, you will see Dr. Ainissa Ramirez, a materials scientist and inventor who was doing research at Yale when she gave this talk to a family audience describing novel molten metal materials. Notice how in the first 20 seconds, Dr. Ramirez has already connected her research to everyday things people use, and even to a popular movie at the time. [Press play.]

- **[Bonnie Bassler** - slide 16].   Next you'll see the unusual beginning of a TED talk by **Bonnie Bassler.** She's 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 how it drives her exploration. [Press play.]

- **[Jeff Grossman** - slide 17].   In this next clip, you'll see MIT scientist **Jeff Grossman** using a great analogy and a careful sequence of slides to help his audience understand just how remarkable it is that the mere size of something can 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 the screen. [Press play.]

- **[Eric Mazur** - slide 18].   We said earlier that "The What" or the *process* of research can be boring to some people. But it can also be told as an interesting story. Here is physicist **Eric Mazur** of Harvard describing a sequence of events in his 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 – and so he demonstrates how the spirit of curiosity - just being willing to try something new - sometimes leads to interesting results. Notice his engagement with his audience and his sincerity. [Press play.]

- **[Don Ingber** - slide 19].   This is **Don Ingber** of the Wyss Institute and Harvard Medical School. By using a simple children's toy as a prop, he connects far more effectively to the audience than he could by using a technical diagram. Ingber discovered that cells are not just bags of cytoplasm; instead, they are highly engineered tensegrity structures in which mechanical forces play a crucial role.   [Press play.]

(1:40) 4.4   Context & Motivation: Brief Writing Exercise (Slide 20)
The reverse side of the Science Communication Introduction sheet in the student handout packet contains the cue for this exercise and space to write. You'll need a timer to alert the students when they have one minute left. You may want to have extra pens and pads available.

Now, it's your turn. During the next [3-5] minutes, I'd like you to write a few sentences introducing your research project by describing its broader context and motivation. I'm not going to collect this piece of writing, and you will not be graded on it – this is just an exercise to get your mind working on ways to articulate the underlying purpose of your investigations. Your target audience is a group of intelligent college students with no specialized background in your area of research. Begin by connecting your audience to the larger challenge and how your research project fits in, perhaps adding what's new or different about your approach, and why it matters, in a way that will make your reader truly interested in finding out what the outcome will be.

I recognize that at this point some of you may not yet have all the background necessary to address these questions with complete confidence. (You may have only recently arrived in this

lab.) That's OK. When you go back to your lab tomorrow, schedule some time to sit down and talk to your mentor or lab director and find out more about *why* you're doing *what* you're doing. In the meantime, do the best you can. If nothing else, this experience will give you a better idea of the questions you're going to want to ask.

You've got [3-5] minutes. Clearly you're not going to write a masterpiece in that amount of time. So, think of this as a rapid prototyping exercise. I'll let you know when you have just one minute left. Let's get going…

Debrief of Brief Writing Exercise

When the time is up, ask the students to partner with someone they don't already know well and to read their statements aloud to each other and comment. Then ask for a volunteer to stand up and read their statement to the group. Cue applause when they're done. If there is time, ask a few others. Be very encouraging. If they are still not getting to a broader challenge that most people can identify with, gently help them in a Socratic style dialogue to discover the broader context of their short-term research project. It can also help to ask if any student finds him or herself stumped by the question of broader context and willing to process it through with you. Some students find it difficult to work their way up the chain to the broader motivation for their work. Eventually, though there is always some human goal involved, be it glory, profit, insight, or a solution to a problem people face. (If any students are working on projects that are governed by confidentiality agreements, ask them to speak with their supervisors about what specific information needs to be withheld.) This activity prepares students for the Research Introductions Activity, which comes next.

(2:05) Part 5: Research Introductions Activity (Slide 21)

This is a core element of the workshop, and the one students appreciate the most. After giving students a few minutes to prepare, they gather in break-out groups, one facilitator per group, and take turns speaking and providing constructive feedback. The feedback is as important as the speaking, as it gives students experience listening, making assessments according to the guidance they have received thus far, formulating and articulating ideas for improvement, and participating in a supportive team culture.

5.1 Instructions for Developing Research Introductions

In a minute we're going to take a stretch break, and then each of you is going to prepare a [60 – 90 second] spoken introduction to your research project that you will share in small groups. You can use what you've already written and expand it a little further, or you may decide to take a different approach. [We're going to have two rounds of practice in small groups, so you'll have a chance to try a different pass.] Consider this as a rapid prototyping session, with feedback from your fellow students. Think about the most concise way you can interest your group in your research project. Use plain language. Feel free to provide examples or analogies that could help your listeners understand one or two of your key points. If you aren't yet sure yet about the broader context of your research project, just do the best you can.

Remember what we covered earlier about ways to connect with your audience – in this case, your break-out group. Make eye contact with each individual in your group. You can begin traditionally by introducing yourself and saying where you are from and what lab you are working in – OR, you might just boldly capture their attention, and launch into facts about the broader challenge that your research ultimately addresses. Take some time to build up the enormity of this challenge, and what sorts of approaches have been tried and failed previously, if you know about them. How might people benefit from finding a solution? What is special and distinct about the approach your group is taking? What do you hope to find out?

You will have [5-10] minutes to prepare. You can stretch, go the restroom, get some water, sit down and write out what you want to say, or you can walk around the room rehearsing it to yourself. Then I'll call you back and we'll break into small groups, you'll share what you have come up with.

One last piece of advice: Figure out how to end your talk. End it with something that feels like a concluding statement for where you are at this point in your research; don't just trail off…. Your ending completes the communication and invites others to respond.

Please begin. I'll let you know when you have about a minute left.

5.2   Instructions for Break-Out Group Work (Slide 22)

Leader calls students back to their seats to introduce this next activity. Students have been pre-assigned to break-out groups. Group facilitators have been briefed on their roles earlier. Written instructions for them are included in the Document Appendix. These facilitators manage timing so that each group member gets a turn, and they set an encouraging and courteous tone. They may check at the outset that members of the group are OK with giving permission to others to provide them with constructive feedback. They encourage every member of the group to give constructive feedback - at least one positive comment and then at least one suggestion for possible improvement. (Some facilitators ask all students to comment on what worked well first, and then go around again and ask all students to comment on ideas for improvement. It can be done either way.) Facilitators should provide their own comments last, so as not to unduly influence or inhibit the students. Comments should address oral delivery and audience connection, as well as content and organization. If a group finishes before the other groups, begin a second round, giving members a chance to implement improvements. We recommend having the groups stand in circles, spread across the room, during this exercise. The length of time spent in break-out groups is factored by (# students per group) x (length of each introduction) x (time allotted for feedback per student).

Now you get a chance to prototype this first draft of your research introduction in break-out groups. We'll have two rounds of this exercise, so that after you try out your first version and get some feedback, you'll have a chance to adjust it before the second round.

Here are the rules for small group sharing: Each group has a facilitator, and that person will appoint a timer. Each student will have [1 -2] minutes to deliver their research introduction.

Remember what we learned about connecting to your audience, and try to make eye contact and land points with each member of your group. The group will spend a total of [5] minutes providing feedback to each presenter, with the facilitator going last. Listeners, your job is to listen very carefully and attentively to the presenter, so you can give them helpful feedback. In giving feedback, we suggest that you begin by each member of the group identifying at least one thing that the speaker did well. Then go around again, with each person contributing ideas for how the presentation might be improved the next time around. You can address qualities like presence, connection, eye contact, vocabulary, or content. Did you understand the motivation behind the research? Were you curious to learn more? (That's a good thing.)

Now, sometimes people are shy to offer critical feedback. But I assure you that your colleagues would rather hear it from you here in this room, in this relatively safe place, than find themselves in a high stakes situation without having had the benefit of your feedback. But don't take it from me – the first thing you should do when you assemble into your small groups – is to check whether all members want to receive your feedback and advice. If any of you don't want to receive it – let your colleagues know. The rest of you should confirm to your group-mates that you do indeed want their feedback. Now, by agreeing to hear the feedback of your colleagues, you aren't necessarily agreeing with the feedback they give you. It is up to each individual to assess the feedback they've been given and decide whether to do something about it. We can do our best to help each other by pointing out what we think worked well and what we think might work better – but these are opinions and judgments and not mandates. Each of us must make our own judgments about our own performance in light of the feedback we are given. Now, if the speaker has asked for feedback, we'd like each person in the group to contribute it. No, sitting out on the sidelines. Your goal is to help everyone in your group – on your team - do their best. By listening carefully and formulating ideas for helping each person do their best, you will be reinforcing your own understanding of how best to design and deliver a talk like this.

If your group finishes before the other groups have finished, try going around a second time.

Now, you will see a number and a letter on the lower left corner of your nametag. The number indicates your break-out group. Break-out group 1 will meet there (point to area of room); Break-out group 2 will meet there (another area of room), etc. Have fun with this!

(2:45) 5.3 Debrief of Research Introductions Activity, Round One (Slide 23)
The workshop leader invites students to return to their original seats, and asks some debriefing questions, like whether students found it difficult to make eye contact with each member of their group. Did they get valuable feedback? Did anyone learn something about the way they speak that they hadn't been aware of previously? And, if there's time, does anyone want to try their talk in front of the whole group? [If so, reinforce what they are doing well, and provide some pointers for how to improve. If they have questions, try a Socratic approach, helping them tease out an answer.] Do you think it's going to be easier to do the second time you try it? I assure you it will be.

(3:05) 5.4 Instructions for Research Introductions, Round Two (Slide 24)

If there is time, split the group into a new set of break-out groups and do another round. (All of our evaluation studies show that students want to have at least one other go at this, after they've received the initial round of feedback. And the main message of the day is that THE SECRET IS PRACTICE. First give the students five minutes on their own to make adjustments to their research introductions based on the feedback they received and their own experience delivering the first draft. The second round can be shortened, by reducing the limit for each talk to 60-90 seconds, and reducing the amount of time for feedback. We like to mix up the groups for the second round. Do this either by coding the nametags in advance for the second round (with a letter code after the number code), or by asking two students from each group to move clockwise to the next group. This way each person will get feedback from students who will notice how the talk has changed, as well as feedback from students coming with fresh ears. Following the second round, spend a little more time debriefing the whole group.

Whether or not there is time for a second round…
Remind the students that "the Secret is Practice," and that the more they practice giving oral introductions, the more skilled and polished they will become. This will be helpful in their academic, professional, and social arenas. It's a good idea to have a few different versions of their oral research introductions, of varying lengths and varying levels of sophistication, for the various situations they might be encountering. Practicing aloud is essential, since it involves a different set of neural pathways that they will be using in front of a real audience.

(4:00) Part 6: Thinking Ahead To Your Final Research Presentation

During this last section of Session One, you will begin to prepare students for developing the final research presentation and/or poster they will be delivering at the end of their research experience. Make sure they are clear about what is expected of them (including any specific program requirements for content, attribution, format, or template), and when the PowerPoint slides and/or poster drafts are due and to whom. Let them know that they will be delivering a draft of their presentation (usually the first 5 or 10 minutes) in break-out groups at the next REU SCW session, and remind them of the date and time. Go over the handouts and point out the resources and guidance they offer. Take them out one-by-one while the students identify them in their own packets so that they recognize what they have been given. Walk students through the Research Presentation Reflection Sheet and/or the Poster Presentation Scoresheet, which they will use at Session Two to provide feedback to each other. Also advise students to observe and pay attention to the different ways they see science presented in classroom, seminars, on TED Talks, in the media, and elsewhere, and to notice - when they attend a good presentation - what characteristics made it good (likewise for poster sessions). And, of course, remind them to practice. There is no substitute for actually practicing their presentation aloud, either alone or with friends, before they give their poster or slide presentation at the next session. It will make a world of difference. If there is time, you may want to go ahead and show the students the 5-minute "Slide Presentation about Slide Presentations." (See the notes below the handouts list)

The handouts in the packet:

- P1 "Science Communication" introduction, often printed double-sided with
- P2 "Brief Writing Assignment: Broader Context & Motivation" worksheet.

- P3 "Research Presentation Pointers," which summarizes presentation and slide advice covered in Session One, usually printed two-sided with
- P4 "Research Presentation Assignment," customizable for each program.

- P5 "Presentation Reflection Rubric" (one-sided). We go over this sheet together, letting the students know that *this is the rubric* that we will use to guide feedback during Session Two. Leave the second side blank for additional notes.

- P6-P7 "Effective Science Posters – Quick Reference" (two-sided). This pamphlet by George Hess provides basic design guidelines.

- P8 "A Field Guide for Poster Sessions" (one-sided). An inquiry-based tool for students to use to observe a poster session and discover characteristics of effective poster and poster presentation styles.

- P9 "Poster Presentation Scoresheet" (one-sided). A tool to use to help students understand how posters may be judged. This can also be used for peer judging of posters in Session Two, if the students are being required to produce and present posters. Leave the back blank for additional notes.

- P10 "Science Communication Resources" This one-page list includes a few books, websites, and videos particularly helpful to young researchers.

- If the workshop is taking place in an unfamiliar location, we often provide a map and guide to areas students might want to visit close by.

Optional Part 7: A Brief Slide Presentation about Slide Presentations
(Slides 26-77)

This brief and fun slide sequence, a "A Brief Slide Presentation about Slide Presentations" moves quickly (about 5 minutes) and goes over some of the major do's and don'ts of slide graphic design. The sequence also introduces the "Hide Slide" and "Presenter View" features of PowerPoint. It graphically reinforces some of the material covered previously. The narrative introduction to this sequence is in the Notes section of Slide 26. Beginning with Slide 27, the slides transition automatically and require no narration. At Slide 53, the workshop provider takes over control of advancing slides, using the narration embedded in the Notes sections of the slides. This section has no video content.

Session Feedback Survey

If you are using the REU SCW online evaluation services, the Session One Feedback Survey link will be sent to your students the day after Session One, and the aggregated results will be reported back to you promptly. (Contact nano@mos.org for more information.) You also have the option of using hard copies of Session One Feedback Survey, included in the Documents Appendix, and even customizing it if you wish.

(4:15) Adjourn

Take a group picture! Wish the students good luck and good cheer - a round of applause for everyone.

Chapter Four
Session Two: Preparation, Materials, Leader Commentary & Activities

About Session Two
Preparation for Session Two
Session Two Materials and Props List
Session Two Annotated Agenda & Facilitator's Guide
About the Final Surveys

About Session Two

Students arrive to Session Two prepared to deliver the first 5-10 minutes of their final research presentation. The Session is, essentially, a dress rehearsal for their final presentation event. Although they may not have completed their project or finished gathering data, they will have done enough to deliver at least the first half of their final presentation, including the background and motivation for the project, perhaps a literature view, their distinctive approach, methodology, and preliminary results. Completing these sections a week or two ahead of the date for their final presentations will give students a head-start on managing the upcoming deadline, and ensure they give thoughtful consideration to these important contextual aspects of research. The practice they get designing and delivering these draft presentations, as well as the feedback they receive in Session Two, will help them give final presentations they can be proud of. A final presentation delivered with confidence will provide a fine conclusion to the research experience for all involved.

During Session Two, it will quickly become apparent which individuals have absorbed the Session One advice about planning and practicing their talk and designing their slides, and which students have fallen back on last-minute strategies.   For some, this will be a wake-up call, and give them the motivation they need to put the effort in before their final presentation. As in Session One, the main message of Session Two is that the cycle of practice, reflection, correction and more practice, does bring results, and that for oral presentations, practice *aloud* brings the greatest mastery.

Usually, Session Two begins and ends with everyone in the same room, with the bulk of the time in between spent in small working groups, as the students deliver their talks and provide each other with constructive feedback. Be sure to leave ample time for the break-out group work, as that is the most essential part of Session Two. If each group observes five ten-minute presentations and provides ten minutes of feedback to each presenter, that is a close to a two-hour stretch, so Session Two generally takes a half-day, as shown in the following Annotated Agenda. After the Agenda are some suggestions for alternative scheduling formats.

Session Two Brief Annotated Agenda

12:00   Arrival Time and Informal Welcome
Preparation Notes: Walk in music; lunch buffet, boxed lunches, 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 them to the buffet and to assigned lunch table groups. Ask them to turn off cell phones. The optional Lunch Table Activity prompts students to share "aha moments" and "bloopers" from their research experience, in an effort to warm them up to storytelling. During lunch, meet with faculty and facilitators to go over final logistics and to distribute laptops (or files on flash drives) pre-loaded with the presentations/posters of the students in their groups.

12:15   Welcome and Introduction to Session Two
- Timeline and logistics for the day.
- Debrief students on their observations, experiences, and assignments, since last meeting in Session One.
- Brief students on the findings from Session One Feedback surveys, ending with queries about how many had a chance to practice aloud.
- Today provides another opportunity to practice aloud.

12:30   Warm-up Activities
- Think-Pair Share Activity
- First-Minute Presentation Sharing Activity
- Instructions to deliver a 60 or 90-second introduction to their research, as if in a casual social situation, using their "connecting to the audience" skills. Option to ask for feedback and/or to do two rounds.

12:50   Small Group Research Slide or Poster Presentations
- Logistical instructions – pre-assigned groups, facilitators, rooms, when to return.
- Activity instructions – 5-10 minutes presentation time (time limit was decided in advance), followed by 5 minutes of silent individual reflection time using the Research Presentation Reflection Rubric or the Poster Presentation Scoresheets, followed by 5 minutes of verbal feedback from group members, then proceeding to the next student. Facilitator will collect Reflection Rubrics or Scoresheets in separate piles for each student to give them after everyone has had a turn.
- Small groups move off to small meeting spaces, where there are projectors pre-loaded with the presentations or posters, and begin working.

3:00   Debrief and Discussion *(All groups return to the main meeting room.)*
- Workshop leader draws students into discussion about the challenges they faced presenting their research, the value gained by practicing in advance (polling the room to see how many did, how many practiced aloud, or in front of others), and how today's experience will impact their preparations for finalizing their

presentations or posters and delivering them in front of an audience at the university.
- Q & A, and further advice.
- Logistical information from faculty on next steps.

3:30 Debrief and Closing Remarks
- Summarize main advice. Wish them all luck and remind them to practice *aloud* before their final delivery.

4:00 Adjourn

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* Regarding the Amount of Time for Break-Out Group Work:
This part of the workshop takes substantial time, according to the formula:

Total Small Group Time = (#students per group) x (# minutes per presentation + 1 min set-up time + 5 min silent reflection + 5 min oral feedback)

Example: (5 students) x (8 + 1 + 5 + 5) = 5 x 19 = 95 min

Add to that 5-10 minutes for groups to travel to and settle in the break-out room and 5-10 minutes for them to return.

Example: 95 min + 10 + 10 = 115 min = about 2 hours

Session Two Alternative Formats

Some workshop providers find it difficult to get all the students for a half-day, or to find enough break-out rooms, projectors, and small group facilitators. Here are some alternatives:

- Break Session Two into several meetings, with three - four students presenting and getting feedback at each meeting.

- Transform Session Two into a weekly meeting activity during the last month of the program, with one or two students giving presentations on their work and the group providing constructive feedback at each session.

- Streamline Session Two, by omitting the Lunch and Lunch Table Activity and/or the Warm-Up with brief research introductions.

Preparation for Session Two

Before planning Session Two, please consult the Advance Planning advice in Chapter Two. One important concern is to have all the break-out rooms you will need lined up in advance, with a projector and screen in each. (It is very difficult for speakers and listeners to concentrate when two break-out groups share one room.) Also ensure you have recruited and briefed a faculty or graduate student to serve a facilitator for each of the break-out groups.

We advise assigning students to break-out groups in advance and indicating that by code on their nametags. Give the students a deadline to deliver their slides 24 hours in advance, so that you can pre-sort them and load them into the computers for each break-out group. We find it helpful to have the students title their digital slide files in a particular format so that they are easy to distinguish, e.g. [Last Name]_[YR-MO-DA].pptx. Have them use a shared server, or a free large-file sending service. **If students are presenting posters**, have them deliver them either on a digital slide, or have 4-6 copies printed out in color on legal or tabloid-size paper.

A week before the session, send out an email reminding students of the due date, the presentation design resources they've been given, and the advice to practice their presentation aloud with their slides or posters before finalizing it. This final step can make the difference between them arriving with confidence or stumbling through unexpected coordination issues.

In preparation for the session, print out the Table Signs with the Lunch Table Activity if you will be including that part of the program. Also print out enough copies of the Research Presentation Rubric so that each person has one for themselves and one for each member of their small group. These will be collected after each presentation feedback period and given to the presenters at the end of the small group session. You may decide whether you'd also like to reprint any of the handouts from Session One.

Review the results of the Post Session One student feedback survey. There are places to plug in values or comments from these surveys in the Session Two leader commentary. Coordinate with nano@mos.org to arrange to have the Post Session Two Survey link emailed to your students the day following Session Two. Alternatively, it can be administered to students on paper students at the end of the session.

On the next few pages you will find a more detailed Materials List and the Session Two Detailed Agenda with suggested leader commentary, logistics, and activity guidance. Please feel free to adjust these to your own circumstances. There is no PowerPoint, nor are there videos for Session Two. It begins with a warm welcome, followed by a brief discussion concerning their preparation activities, and a warm-up speaking exercise. Then students assemble into their small working groups, and head to the break-out rooms. Be sure to coordinate with break-out group facilitators how you will signal to each other that it is time to reconvene in the original meeting room, so that groups aren't waiting outside the door while the group in the original meeting room is finishing up.

Materials List for 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, but sets the mood nicely)
- Enough break-out rooms or spaces as required by overall size of group, when broken into working groups of 4-6 students plus a facilitator.
- A laptop, projector and screen for each break-out room, preferably allowing speaker to control the slides from the laptop itself
- Timing devices with gentle alarms for each break-out group (usually people use their smart phone timers).
- *Mentor/Facilitator Guide* for each small group facilitator.
- Pitchers of water and cups, or bottles of water for each student.
- 4-6 copies of the "Research Presentation Reflection Rubric" per student. (Or, one for each presenter for whom they will be providing written feedback and for themselves).
    - Optional folders or packets for these, or clipboards.
    - Optional collection folders for Rubric sheets: 4-6 empty file folders or 9 x 12 envelopes for each break-out group.
- Other optional items:
    - Repeat handouts from Session One
    - Location map with break-out rooms and schedule (optional)
    - Pens, pads
    - Soft volleyball or soccer ball (to remind students of "connecting to audience" analogy)
    - Lunch vouchers, boxed lunches or lunch buffet, and/or snacks
    - Location map and Schedule (optional)
    - Video camera for recording presentations for students to see themselves later (optional)
    - Still camera for taking a celebratory group shot.
    - Celebratory "graduation" cake and/or fun workshop completion certificates
    - Session Two Feedback surveys (unless these are to be completed online)

For Poster Reviewing

If the focus on Session Two is on posters rather than slide presentations, then substitute the Poster Presentation Scoresheets for the Research Presentation Reflection Rubric worksheets, and provide students with an optional additional copy of "Effective Scientific Posters – Quick Reference." Draft posters can be presented on slides or printed in color on legal or tabloid-sized paper.

Session Two Detailed Agenda & Facilitator's Guide
With Sample Workshop Leader Commentary, *Notes,* and Activity Guides

... As implemented for a group of 18 to 24 students in a single afternoon session, with small-break-out group reviews of research slide presentations. [Replace items in brackets with ones pertinent to your group.]

<u>Preparation Notes</u>: *Walk-in music; lunch buffet, boxed lunches, or cafeteria vouchers; nametags coded with break-out group assignments, student packets. Table for small group facilitators with Facilitator Guidance sheets. Podium or lectern for workshop leader. Optional Session Two title slide on screen. Clear sign stands on each table with table number and instructions for the lunch table exercise.*

(12:00)   Students Arrive | Informal Welcome

> Greet students as they arrive and direct them to the lunch buffet and to the pre-assigned lunch table groups coded on their nametags. Invite them to turn off cell phones and begin the Lunch Table Activity. During this time period, deliver a final briefing to small-group facilitators on their roles, and decide how to coordinate reassembly after the small-group work.

Lunch Table Activity (optional)

> Students share "aha" and "blooper" moments from their research experience to help them warm up to storytelling.

(12:15) Welcome and Introduction

<u>Leader Commentary</u>

- 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 your research presentations so we can find out what you've been doing.

- In the weeks since we last met, [select which of these prompts to use...]

  o Did any of you find yourself listening to a research presentation as bad as the one given by Dr. Fisher-Katz?   [No? What a relief.]

- o Did you find yourself looking more critically at the presentations you did attend? Noticing what worked and didn't work so well in those presentations?
  - o Anyone have any stories to share – without naming names of course…

- o Did any of you attend any poster sessions?
  - o If so, what did you notice there; what kinds of poster presentations seemed most effective?

- o Did any of you find yourself asking more questions of graduate students, post-docs, or faculty about the context and meaning of the research?
  - o Anyone want to say something about how these conversations influenced your perceptions, understanding, and sense of connection with your colleagues and their work?

- o Did any of you practice your brief research introductions with other people?
  - o Did you find yourself making creative adjustments to them based on the listener's prior experience?
  - o Did any of you find that you were finally able to get a member of your family or a friend to understand what you're working on?

- ▪ Now I'd like to report out to you some of what we learned from your Session One Feedback Surveys.
  - o Based on those surveys, the element of Session One that you found most useful was the [practice speaking in small groups and the oral presentation advice. You also really valued the feedback you got from peers and faculty.] *Substitute your own findings here, such as:*
    - ▪ Practice providing others with constructive feedback
      - • That's terrific – it speaks to a certain mature generosity of spirit that this group has about not only being learners but also sounding boards and coaches for each other and collaborators in a learning community. *Or*
    - ▪ You also indicated that you enjoyed the opportunity to hear about each others' projects: another signal that you are forming a research community.

  - o I'd like to read a couple of particularly articulate comments that appeared in the surveys – *(It's nice to pick a few direct anonymous quotes that may resonate with the group.)* [One student wrote: "It made sense to me that even though you're not necessarily born with the talent of public speaking - it is actually something that you can improve with practice."]

  - o Somebody else said..., etc.

  - o [Many of you noted that if we'd had more time, you would've liked to have practiced your research introduction more - perhaps have had 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.]

- o [74%] of you said you definitely would practice giving your research talk aloud before presenting it at today's session. [The rest of you said you "maybe" or "probably would" practice aloud.
    - How many people intended to, but had trouble finding the time at the last minute?
    - How many of you actually had a chance to practice aloud?
    - How many of you practiced your presentation aloud, with slides?
    - Did anyone practice aloud with friends?

- o 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 on [date]. And, you'll see that it will make a huge difference.

- o Now we're going to do a few warm-up exercises together before we break into our working groups.

(12:30) Warm-Up Activities

Think-Pair-Share Activity (Five minutes)

I'd like you to pair up with someone in this room that you do not know that well, and spend a minute or two taking turns telling each other what you found the hardest about preparing your presentation for today, and how you feel about giving it today. You have about a minute each. Be good listeners for each other.

- o Some of you may be feeling a little nervous about giving your presentation today, and that's understandable. However, sometimes, a little excitement can lend energy to your speaking performance. Today is a chance for you to practice, in a safe environment, and a chance for you to get some helpful feedback from others on what is working well, and what might help to improve your talk or slides. Now we'll move on to the next warm-up.

First-Minute Presentation Sharing Activity (Ten minutes)

With your partner, team up with one other set of partners, and stand up in a group of four. Take turns delivering the first minute of your presentation, pretending you have your slides or poster behind or to the side of you. While you speak, focus on making eye contact with each person in your group. Speak slowly and clearly. Remember about landing your points with

each member of your group. *(Leader can demonstrate with volleyball, as in Session One.)* When all four of you have finished, sit down again with your original partner, and give each other some supportive coaching on their delivery and perhaps some suggestions perhaps for improvement. *(If there is time, you may allow the group to do a quick second round.)*

(12:50) Slide or Poster Presentations in Break-Out Groups

This is the heart of Session Two. After getting their instructions, the pre-assigned groups will move off with their facilitators to separate rooms. Each room will have a computer loaded with that group's presentation or poster slides, unless you are reviewing printed poster handouts. Each student has enough blank Presentation Reflection Rubric or Poster Presentation Scoresheets for each person in their group, including themselves. Facilitators will ensure adherence to timing and procedure, and coordinate the return to the large group meeting room. Each meeting room should have water bottles or pitchers and cups, or the students should bring them from the main meeting room. Remind them that hydration is important for good public speaking.

Break-Out Group Activity

Each student will have from 5-10 minutes to present (this will have been decided in advance). Facilitator will serve as timer, or appoint a timer. Ask the student whether he/she wants to receive feedback from the group. After each presentation, allow for applause, and then, if the student wants feedback, advise 5 minutes of silence as the students, including the presenter, and the facilitator jot down observations on their Presentation Reflection Rubrics or Poster Scoresheets. Remind students to write the name of the presenter on the sheet. After the 5 minutes of silent reflection, ask for the students to take turns delivering oral feedback. Then there will be a total of 5 minutes for feedback. You can either have all the students comment first on what worked well, and all of them give suggestions for possible improvements; or have each student give both in turn. Encourage each student to speak. The facilitator should be the last to speak, because often students will feel uncomfortable voicing their own opinions if the senior figure in the room has already spoken. Then, the Presentation Reflection Sheets will be collected and stashed into separate folders or envelopes to give to each student after all have had a turn. Some groups want to practice handling questions from the audience. If there is time, the facilitator can allow up to two questions for each presenter.

Leader Commentary

Alright, everyone, you're officially warmed up. In a few minutes we are going to split into our break-out groups. You'll find your break-out group number on the lower right corner of your nametag. We'll take a quick bathroom break, then…
>Group 1 will go with [facilitator] to [room]
>Group 2 will go with [facilitator] to [room]
>[Etc.]

You will spend about 2 hours in these small groups, taking turns delivering your presentations. The facilitator will appoint a timer. Each presenter will tell the group whether or not they would like to receive a round of constructive feedback following their presentation. Then they will deliver the [x] first minutes of their final presentation. We will applaud. Then we will have 5 minutes of silence to note down our observations on these Research Presentation Reflection Rubric Sheets. Then you will have a round of oral feedback. You should each have one for yourself and one for each of the other students in your group.

Then there will be a five minutes total for everyone to give constructive feedback. No one is exempt from providing constructive feedback. Give the kind of feedback that you would want to hear if you were preparing to give a high stakes presentation and you want to do your very best, and you especially want to be told about anything you can do to make it a bit better. The facilitator will collect the feedback forms after each round to give to each speaker at the end of the session. These forms are for the speakers only.

Then you will move on to the next presenter. If you group needs a brief break after a few presenters you can take one, but be sure to be finished up by [time].

Does anyone have any questions?
[respond to them]

Here's some last minute advice:
It's OK to be nervous. Harness that nervous energy to give your talk vigor.
Take some deep breaths.
Still yourself. Focus.
Make eye contact.
Speak slowly and deliberately.
Land your points and make sure they are received. Pause to let them sink in.
Clue your audience in as to when to look at you and when to look at your slides
Remember, you're with people who are supportive and want you to do well.
Also remember, when you are being a listener, listen well. Try to follow the presentation while you are also being an observer of what is working well, and where you see some improvements might be made.
(At this point, you may want to review the Rubric form with the students.)

Commentary If Questions are Being Allowed from the Audience

Let's talk for a minute about handling questions from the audience. Many people are nervous about taking questions. They're afraid of getting asked something they won't know the answer to. They're afraid someone is going to try to test them or embarrass them. They're afraid of giving a wrong answer. Let me tell you this: You're an undergraduate, and you've only been working in this area for [x] weeks. No one expects you to know all the answers. It's OK if you don't. You just don't want to pretend that you do and try to bluster your way through it. So, when you get a question, the first thing you do is listen to it very carefully. Repeat the question

to confirm that you understand what is being asked. This also serves the purpose of helping other people in the audience hear the question. Then, decide if you know the answer. If you think you do, then give a pretty concise answer, perhaps indicating your degree of certainty. If you don't know the answer, or are conflicted about whether you know it, be honest. You may ask a question back – like, "Just so I understand, better, why are you asking that?" Or, "I can see why that may be significant, but I'm not sure of the answer. Does anyone else here know the answer to that question?" An alternative approach is to suggest a way one might go about finding the answer to the question. Treat the question as a learning opportunity, and people will respect you for it.

(3:00) Debrief and Closing Remarks

Students will return to the main meeting room, relieved and hungry. It's great to have refreshments for them when they return. We often have a sheet cake with a congratulatory message. During the debrief, we ask student questions like:

- Are you glad you had a chance to practice your presentations today?
- How many of you were nervous giving your presentation?
- For those of you who practiced aloud before hand, do you think it helped?
- For those of you who didn't have a chance to practice aloud beforehand, do you think it would have helped?
- Does anyone know why it's so hard to break the habit of not practicing aloud beforehand?
- What suggestions do you have to make sure you leave time for that before your final presentation on [date]?
- Did anyone get feedback that really surprised you?

We usually end by reminding them how far they've come, and wishing them the best for the final week of the program and for their final presentation delivery. Reaffirm the notion that speaking confidently takes practice, and they will all get better over time. Tell them that they will soon receive the link for the Session Two Feedback Survey, and to please respond promptly. (You may ask them to fill it out on paper while they're there, but students are usually too eager to get moving by this point.)

And then, it's very nice to take a group picture, and have a final round of applause for all the work everyone did preparing for today, giving their presentations, and providing useful feedback to each other.

Session Two Feedback Survey
If you are using the REU SCW online evaluation services, the Session Two Feedback Survey link will be sent to your students the day after Session Two, and the aggregated results will be reported back to you promptly. (Contact nano@mos.org for more information.)

About the Final Surveys

The students' final presentations will represent their accomplishment and reward for all the hard work they put in during the course of the undergraduate research program.   The experience is often equally rewarding for their workshop providers, faculty advisors and mentors.

The final IRB-approved surveys provide valuable feedback on the implementation of the REU SCW program and its impact on students and faculty advisors. Contact nano@mos.org to have links sent directly to participants, and you will receive the anonymous aggregated data from your group promptly, including written comments. Paper versions are included in the printed and digital Document Appendices.

The Session Two Feedback Survey is administered to students online the day following Session Two, and completed before their final presentations. It captures student sentiment in this crucial in-between period.

The Science Communication Reflection Survey is administered to students after they deliver their final presentations, or before they leave the program.   This survey is intended to assist students in reflecting on their experience developing science communication skills, further reinforcing the learning and memory of those skills. It also provides the bracketing data that tracks student experience in the program from beginning to end. This data will be useful in assessing the impact of the entire program, both for reporting purposes and for making further incremental adaptations to improve the implementation. ***The questions on this survey could be included in the final REU program student survey.***

The Faculty/Mentor Feedback Survey gathers valuable feedback from the students' faculty advisors, mentors, and workshop facilitators. It is meant to facilitate communication about program goals and implementation and help providers make appropriate adjustments for future iterations.
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END NOTE

**This concludes the narrative portion of the
REU SCW Planning & Implementation Guide.**

Next comes the Appendix, organized chronologically by session. It includes signage, handouts, and surveys. Some of these documents will need to be customized for your particular implementation, and editable electronic versions of these and most of the others are included in the e-Document Folder of the Digital Appendix. The PowerPoint slides and videos are in the Multimedia Folder of the Digital Appendix.

If you are viewing this pdf in its electronic version, the editable versions of the Appendix materials will be found in the separate e-Document Folder available
by download from
http://www.nisenet.org/catalog/tools_guides/reu_science_communication_workshop
or by request from nano@mos.org
The digital slides will in the downloadable Multimedia Folder, but the videos will need to be requested from nano@mos.org

Research Experience for Undergraduates
SCIENCE COMMUNICATION WORKSHOP
Planning & Implementation Guide, v. 5.0

<u>Appendix Directory & Guide</u>

Note: Microsoft Word document versions of most of the following materials are available for customization in the e-Document Folder in the Digital Appendix located on the DVD included in the binder or by download from
http://www.nisenet.org/catalog/tools_guides/reu_science_communication_workshop
or by request from nano@mos.org

Poster Supplement:

Pre Session One: Guides, Handouts, Surveys:

Session One & Two: Signs, Handouts, Surveys: (assembled in order of use)

- **Student Packet Handouts**

Session Two: Handouts, Surveys

- You may wish to supply break-out group facilitators with a new or review copy of the **Mentor/Facilitator Guide.** ……………………………………………….. *(from pre Session One, p*. ***xi)***

- **Each student should have enough of the following to review every other presenter in their working group plus one for themselves.** *Use the same ones provided to students in the Session One Packet:*

- **Session Two Lunch Table Activity Signs** – **Groups One & Two**. Use the electronic version in the e-Document Folder to change the group number for each additional table. Print double-sided and place in vertical plastic sign holders at each table. …….…..… **xxxv**

- **Session Two Feedback Survey.** This paper version of the IRB-approved survey can be administered immediately following Session Two; however, it is best administered online, with results delivered promptly to providers. …………………………………. **xxxix**

Final Surveys: (also available online, from nano@mos.org)

- **Science Communication Reflection Survey**. This IRB-approved survey is designed to reinforce learning, and is administered to students after they deliver their final presentations, or before they leave the program. It is meant to help them solidify the lessons they learned during the Science Communication Workshop. ……………………. **xli**

- **Faculty/Mentor Feedback Survey.** This survey gathers valuable feedback from faculty advisors, mentors, and workshop facilitators, and facilitates communication about program goals and implementation, helping providers make appropriate adjustments for future iterations. ………………………………………………………………………………. **xliii**

Poster Supplement Guide
Including or Substituting a Unit on Poster Design and Presentation

Context

Some undergraduate research programs require students to produce final poster presentations rather than PowerPoint presentations, and some programs require students to produce both. We usually provide separate poster design and presentation workshops, with many of the same characteristics as the sessions focused on PowerPoint presentations; however the same content can be integrated into the REU SCW Sessions One and Two, as a replacement for other content, at the provider's discretion.

General Outline for a 90-minute Introductory Session

- <u>First half-hour</u>:
  - o Welcome and overview of goals for the session
  - o Context and motivation: the purpose of poster sessions from two perspectives: visitors and presenters
  - o Designing for impact
    - Message
    - Title
    - Content
    - Structure and organization: story and line-of-sight
    - Graphics, illustrations, captions
    - Overall design

- <u>Second half-hour</u>:
  - o "You be the Judge" Activity: Critique of sample posters using a poster-judging rubric.

- <u>Third half-hour</u>:
  - o Presenting a poster: guidelines and practice

General Outline for a 90-minute Follow-up Session
Students come to this session with their draft posters (either printed in 11x17 or 8.5x14 color format or e-versions for projection). The session is timed so that they may revise their posters after receiving feedback from the session, before their final poster presentations.

- First half-hour:
  - o Welcome and overview of goals for the session
  - o Review of poster presentation guidance
  - o The art of providing constructive feedback and using a poster judging rubric

- Second half-hour (for more than six students, break into small groups):
  - o Students take turns presenting their posters while observers make notes on judging rubrics.
  - o Students visit posters individually, using judging rubrics and written comments to provide additional feedback.

- Third half-hour:
  - o Workshop provider points out common issues and takes questions for discussion.

Materials for Poster Sessions

Handouts

The Student Packet Handouts for Session One (in the Appendix) contains four poster resource sheets that can be photocopied and distributed to students.

P6 and P7 are two sides of a quick reference pamphlet provided with permission from George Hess. Hess's website, listed in the pamphlet, provides additional resources. [A higher resolution pdf version of this pamphlet is included in the e-Document Folder.]

P8, the "Field Guide to Poster Sessions" is provided to students to use as an anthropological exercise. They are meant to bring it to a poster session on campus and use it to make observations that can help inform their own poster and presentation practices.

P9, is a poster presentation judging rubric that C. L. Alpert produced after examining many rubrics used by professional associations in their poster judging contests.

Sample Posters, Slides and Narrative

For the sample poster examples and critique exercises, many workshop providers like to provide their own selections of posters culled from their research center or from previous student presenters. Those who would like to use our selection and our PowerPoint presentation and narrative on poster design and presentation may contact us at nano@mos.org

Science Communication Experience Survey

Hello. During your upcoming research program, you will take part in science communication workshop sessions. This brief survey queries you about prior science communication experiences. Please respond to each question as accurately as possible. There are no right or wrong answers. Your confidentiality will be protected, and your program providers will see only anonymous aggregated data. The purpose of the survey is to help workshop providers adjust content and emphasis to the needs of your group.

This survey has 13 questions and should take about ten minutes to complete.

Research Program Host University: _____

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 6th year senior   O Graduate School   O Other _____

Undergraduate Major _____

1. a) Have you previously participated in an undergraduate research program?
   (If no, skip to question 2).
                O No   O Once   O Twice   O Three or more times

   1. b) Have you previously participated in this particular undergraduate research program?
                O No   O Once   O   Twice   O Three or more times

   1. c) Have you experienced the REU Science Communication Workshop previously?
                O No   O Once   O Twice   O Three or more times

2. Have you previously…	No, never	Yes, once	Yes, twice	Yes, 3 or more times
a) Participated in any kind of public speaking or presentation workshop?	❑	❑	❑	❑
b) Participated in a science communication workshop or course?	❑	❑	❑	❑
c) Prepared and delivered a presentation with accompanying slides, on any topic?	❑	❑	❑	❑
d) Prepared and delivered a presentation with accompanying slides, on a science research project?	❑	❑	❑	❑
e) Prepared and presented a poster on a science research project?	❑	❑	❑	❑
f) Presented a science fair project?	❑	❑	❑	❑

3. Please rate your current impression of the importance of good science communication skills to a successful career in science:

Minor importance   Moderate importance   High importance   Very High importance
    O   O   O   O

4. Please rate your approximate skill level planning and organizing presentations:

No experience   Beginner-level skills   Moderate skills   Advanced skills
    O   O   O   O

5. Please rate your approximate skill level designing slides:

No experience   Beginner-level skills   Moderate skills   Advanced skills
    O   O   O   O

6. Please rate your approximate skill level designing research posters:

No experience   Beginner-level skills   Moderate skills   Advanced skills
    O   O   O   O

7. Please rate your usual comfort level delivering presentations to an audience:

No experience   Quite uncomfortable   Slightly uncomfortable   Mostly comfortable   Quite comfortable
    O   O   O   O   O

8. Please rate your usual comfort level presenting research posters:

No experience   Quite uncomfortable   Slightly uncomfortable   Mostly comfortable   Quite comfortable
    O   O   O   O   O

9. When preparing to deliver a presentation with slides, do you….	No	Sometimes	Often	Always
a) Prepare a speaking script or outline separate from what will be projected on the screen?	❑	❑	❑	❑
b) Finish the writing and slide design in time to practice delivery from beginning to end?	❑	❑	❑	❑
c) Practice delivering the presentation ALOUD with slides?	❑	❑	❑	❑
d) Ask other(s) to provide constructive feedback?	❑	❑	❑	❑
e) Prepare to use PowerPoint's "Presenter View" with speaking notes on your laptop monitor?	❑	❑	❑	❑

10. What aspect(s) of presenting science to an audience do you like _the most?_

11. What aspects of presenting science to an audience do you like _the least?_

12. Please assign personal priority ratings to the following science communication skills.	No improvement needed	Slight improvement needed	Moderate improvement needed	Much improvement needed
a) Oral presentations without slides	❑	❑	❑	❑
b) Oral presentations with slides	❑	❑	❑	❑
c) Slide design	❑	❑	❑	❑
d) Poster design	❑	❑	❑	❑
e) Poster presentation	❑	❑	❑	❑
f) Engaging your audience	❑	❑	❑	❑
g) Explaining the relevance or importance of the research	❑	❑	❑	❑
h) Explaining complex topics	❑	❑	❑	❑
i) Adjusting your explanations for different audiences with varying background knowledge	❑	❑	❑	❑
j) Deciding how much detail to include	❑	❑	❑	❑
k) Representing your data clearly	❑	❑	❑	❑
l) Handling questions from your audience	❑	❑	❑	❑
m) Giving yourself enough time to practice your presentation in advance	❑	❑	❑	❑

13. Please feel free to comment on anything else pertaining to your interest, skills, or prior experience in science communication, or related topics you would like to learn more about.

Thank you for your participation in this survey.

Science Communication

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

Examples:

- *A deeper understanding of ourselves and our world;*
- *A solution to a challenge people face;*
- *A better way of doing something;*
- *A savings of cost, resources, energy, time;*
- *An opportunity to build a business and create jobs;*
- *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 awareness of prior efforts, techniques, approaches, and results. **Designing an innovative approach** takes knowledge, experience, creativity, ***and the willingness to risk failure.***

Whether or not the results of your research project turn out as you expected or hoped, if you have followed the scientific process rigorously, documented your procedures and results, and communicated them clearly, you will have made a meaningful contribution to tackling the overall challenge.

Building good science communication skills will make you a more successful scientist, collaborator, and contributor to your field.

ASSIGNMENT FOR SESSION ONE

REU Science Communication Workshop

[Date] [Time] [Location]

Have a discussion with your research advisor or mentor, and come to Session One prepared to share a few words about the following….

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

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

You may also come prepared to share a few words about the following, if you have gotten far enough into your project at this early stage…

- o **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?)*

- o **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?**

(It's OK if you don't know all the answers to these questions yet. But keep them in mind as you delve into your research over the next few weeks.)

MENTOR – FACILITATOR GUIDANCE

Philosophy
When facilitating workshops for college students, it's best to treat them as adults, allowing debate and challenging of ideas. Listen to and respect their opinions, while encouraging them to be resources to the group, the facilitator, and to each other. That being said, it is also the role of the small group facilitators to foster an attitude of respect and collegiality, to ensure that each student has the opportunity to participate fully, and to maintain the workshop schedule.

Facilitator Guidance
- Listen carefully to the instructions the workshop leader gives the students for their presentations and for the small group break-out sessions and timing.
- Make sure everyone knows what to call you. Wear a nametag.
- Be practice-oriented, rather than performance-oriented.
- Ensure that everyone gets their full turn. Be the timer, or ask for a volunteer.
- Make the judgment on when to gently cut speakers off if they go on beyond their time.
- Allow for a moment of applause.
- Allow students to choose whether or not to receive constructive feedback from the group.
- Ensure that each member of the group participates in providing constructive feedback. They may all first mention what worked well, and then suggest possibilities for improvement. Remind students that these are only suggestions – and they need to apply their own judgment on whether to accept them.
- Gently guide student feedback efforts. Help students coach each other in suggesting ways to improve. Be the last to provide feedback, in order to encourage students to think for themselves.
- Counsel the group, if necessary to have a little extra patience with English-as-a-second-language (ESL) speakers. Encourage ESL speakers to speak at a pace comfortable for them.
- Offer students the opportunity to try a second time, if the first round finishes early.
- Ensure each participant leaves feeling respected and supported.

Brief the group at the start on their role as supportive listeners
- Look at the speaker and listen carefully. Be kind, patient, and attentive.
- Try to hear what the message is, even if the delivery is not yet polished.
- Constructive feedback involves noting what the speaker did or said that was effective, as well as anything they did or said that was distracting from getting their message across. It may also include providing ideas for possible improvement of content or delivery. Each student should understand that feedback is always variable, because different people respond in different ways to spoken and visual cues. It is up to the speaker to assess the value of each comment and decide whether to address it with alterations to their content or delivery. What we are looking for is clarity, engagement with listeners, and the arousal of interest in what is being described.

GROUP 1
Instructions

Welcome to the REU Science Communication Workshop
This Workshop begins over lunch.

Here are your instructions:

Go around the table and introduce yourselves, including:

- Name, college, year, and major.

- The lab you're working in.

- The focus of the lab's research.

- The focus of your research project.

    o What are you trying to find out?

    o How will it matter in the larger context of the group's research?

GROUP 1
Instructions

Welcome to the REU Science Communication Workshop
This Workshop begins over lunch.

Here are your instructions:

Go around the table and introduce yourselves, including:

- **Name, college, year, and major.**

- **The lab you're working in.**

- **The focus of the lab's research.**

- **The focus of your research project.**

    - **What are you trying to find out?**

    - **How will it matter in the larger context of the group's research?**

GROUP 2
Instructions

Welcome to the REU Science Communication Workshop
This Workshop begins over lunch.

Here are your instructions:

Go around the table and introduce yourselves, including:

- **Name, college, year, and major.**

- **The lab you're working in.**

- **The focus of the lab's research.**

- **The focus of your research project.**

  - **What are you trying to find out?**

  - **How will it matter in the larger context of the group's research?**

GROUP 2
Instructions

Welcome to the REU Science Communication Workshop
This Workshop begins over lunch.

Here are your instructions:

Go around the table and introduce yourselves, including:

- **Name, college, year, and major.**

- **The lab you're working in.**

- **The focus of the lab's research.**

- **The focus of your research project.**

    - **What are you trying to find out?**

    - **How will it matter in the larger context of the group's research?**

REU SCIENCE COMMUNICATION WORKSHOP   ◆   FEEDBACK SURVEY 1

Hello! Please give us some feedback on your experience participating in the Science Communication Workshop session(s) thus far. We are always eager to improve the design of these sessions. Your confidentiality will be protected, and your REU program providers will see only anonymous aggregated data. Please answer all the questions as accurately as possible. The survey should take about 5 minutes to complete. Thank you.

Host University/REU Program: _____

1. **Did your workshop leader ask you to complete a preparatory assignment asking you to discuss the broader context of your research project with your advisor or mentor?**

Yes ❑	No ❑

  1a. If yes, were you able to complete this assignment?

Yes ❑	Partially ❑	No ❑

  1b. If yes partially, how useful did you find this assignment?

Not Useful ❑	Slightly Useful ❑	Useful ❑	Very useful ❑

  1c. Please feel free to comment on this assignment here:

2. Please rate the following elements of the Science Communication Workshop session(s) you attended. (Check one box on each row)	**Not Covered**	**Not Useful**	**Slightly Useful**	**Moder-ately Useful**	**Very Useful**
Introduction to science communication	❑	❑	❑	❑	❑
Discussion of the broader context and motivation of a research project	❑	❑	❑	❑	❑
Guidance on designing and delivering research presentations	❑	❑	❑	❑	❑
Guidance on designing and delivering research posters	❑	❑	❑	❑	❑
Guidance on adjusting content & approach for particular audiences	❑	❑	❑	❑	❑
Guidance on connecting with an audience	❑	❑	❑	❑	❑
Seeing and discussing the example of a bad research presentation	❑	❑	❑	❑	❑
Seeing the video clips of good presentation practices	❑	❑	❑	❑	❑
Practice speaking in small groups about your research project	❑	❑	❑	❑	❑
Practice providing others with constructive feedback	❑	❑	❑	❑	❑
The feedback you received from peers	❑	❑	❑	❑	❑
The feedback you received from workshop facilitators	❑	❑	❑	❑	❑
The opportunity to hear about other students' research projects	❑	❑	❑	❑	❑
Guidance on preparing your final research presentation	❑	❑	❑	❑	❑

3. What did you find most useful about the Science Communication Workshop session(s) you attended and why?

4. If there had been more time in the session(s), what would you have liked to use it for?

5. What questions did the session(s) leave you with, if any?

6. Please share other comments, observations, or suggestions here:

Thank you.

The following 10 pages are handouts that can be assembled into packets to give to each student during Session One.

These may be photocopied directly from these pages. Some of them may be customized and printed from the Word Doc versions contained in the e-Document Folder in the Digital Appendix. The Research Presentation Assignment (P4) requires some "fill in the bracket" editing to adapt to your program's requirements.

You may also print the following pairs as double-sided documents:

P1 with P2, P3 with P4, P6 with P7, and P8 with P9. P5 and P9 should remain as single pages, so that notes can be taken on the reverse sides.

- o P1 Science Communication Intro
- o P2 Brief Writing Assignment: Context & Motivation

- o P3 Research Presentation Pointers
- o P4 Research Presentation Assignment [this requires customization]

- o P5 Presentation Reflection Rubric Worksheet

- o P6 Effective Scientific Posters – Quick ReferenceV3
- o P7 (back side of Effective Scientific Poster pamphlet)*
  [a higher resolution pdf version of this pamphlet is in the e-Document folder]

- o P8 Field Guide to Poster Sessions

- o P9 Poster Presentation Scoresheet

- o P10 Science Communication Resources

- o <u>Optional items to add to packet</u>:

  - ▪ Agenda for the day
  - ▪ List of participants and contact info

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Science Communication

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

Examples:

- *A deeper understanding of ourselves and our world;*
- *A solution to a challenge people face;*
- *A better way of doing something;*
- *A savings of cost, resources, energy, time;*
- *An opportunity to build a business and create jobs;*
- *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 awareness of prior efforts, techniques, approaches, and results. **Designing an innovative approach** takes knowledge, experience, creativity, ***and the willingness to risk failure.***

Whether or not the results of your research project turn out as you expected or hoped, if you have followed the scientific process rigorously, documented your procedures and results, and communicated them clearly, you will have made a meaningful contribution to tackling the overall challenge.

Building good science communication skills will make you a more successful scientist, collaborator, and contributor to your field.

Brief Writing Assignment: Context & Motivation

Draft a few sentences introducing your research project. Your target audience is a group of intelligent college students with no specialized background in your area of research. Begin by connecting your audience to the larger challenge your project is designed to help address. Why is a solution needed? What is distinct about the approach your group is taking? How does your research project fit into the goals of the group? How might it help them address the larger challenge? Why might your reader care about the outcomes of this research? *(It's OK if you don't know the answers to these questions yet. Keep them in mind as you delve into your research over the next few weeks, and do the best you can now.) Continue on another page if you need more space.*

Research Presentation Pointers

Your audience may include researchers from other areas. Try to make your presentation accessible for everyone in the room. *It's OK not to know the answer to all the possible questions that may be asked.*

Content

- **Structure the talk for the amount of time you have available – when speaking slowly and clearly, with pauses for emphasis.**
- Think of it as a narrative, telling the story of your research.
- Begin with the motivation; tell the audience why the research may be significant; why they or others should care about it.
- Be clear on what is unique or special about your approach.
- Emphasize the most important findings.
- Favor big messages over procedural detail.
- Know your audience: provide context and clarify procedures, technical terms, and acronyms peculiar to your field.
- Plan a clean ending with a clear concluding statement.
- Let people know where they can go for more information

Slides

- **Design so that people in the back half of the room can see what's on them**.
- Use them for illustration, not as an outline or notes for your talk.
- Slides are free! Don't cram them with too much information or they will be unreadable and may distract from what you are saying.
- One or two big images per slide is best; use a minimum of words per slide.
- Don't include data unless you've made it viewable.
- Dark backgrounds are less tiring and allow the pupils to take in more detail.

Delivery

- **Practice your talk ALOUD in advance; modify as needed.** Scripting your talk and choreographing with slides will help you avoid nervous filling-in of extraneous information.
- Use PPT "Presenter View" to clue you in to your notes, and to the next slide coming. (In Settings, cancel "mirroring" for projection displays.)
- Marshall your nervousness and excitement to give energy to your talk.
- Relax, breathe, have water handy, reduce room and window light hitting the screen.
- Greet your audience - enjoy the opportunity to speak to them!
- Make eye contact with as many audience members as possible.
- Speak slowly and clearly, landing your points, using pauses, and indicating when your audience should look at you and when they should look at your slides.
- Do not face your slides or read off them.
- Do not use a laser pointer unless absolutely necessary, and then briefly.
- Props, gestures, and movement add dynamism.
- Repeat each question; and clarify whether you *know* the answer or are speculating.

RESEARCH PRESENTATION ASSIGNMENT

[X] - Minute Introduction to Your Research Project

At the next session, you will present a polished draft of [the first half] of your final [x]-minute research project presentation with slides. Design a set of slides to accompany the presentation, and use the Notes section of each slide to paste your speaking notes or script. Consult the handouts on slide design and delivery. Practice your talk aloud with the slides, and revise a few times. You will receive instructions for delivering the slide set to [the workshop coordinator] by [date] and [time.] Name the slide set [Last Name]-slides.pptx. Include the following elements in your talk, adapting the order to make the story you tell accurate and compelling.

Motivation
What larger societal challenge (or knowledge gap or technical need) is your research group attempting to address? *How might these research efforts benefit people in the future?*

Approach
What's the approach your group is taking? *What component of the problem is the group targeting, and what hypothesis is driving the approach? What types of design constraints must be considered (cost, safety, ethical, environmental, materials, engineering, etc.)*

Research Project Objective
How is your research project designed to contribute to the work of the group? *What do you hope to find out? How will your efforts advance the group's work?*

Literature Review
What is the current 'state-of-the-art' in this area of research, informing your approach? *What other approaches have been tried and what were their outcomes?*

Experimental Procedure
How are you designing your investigation so that you will be able to produce *at least one* meaningful result, even if it is not the one expected or hoped for? *Broadly outline the steps you will take, emphasizing the logic of the approach.*

Results/Conclusions/Discussion
Include any results to date, knowledge gained, lessons learned, and next steps. You will add final results, conclusions and discussion when you complete your project.

Tell your research story in a way that scientists outside your field can understand it. If you need to describe a technical process or use a technical term or acronym, explain it in simpler terms. If a picture will save a thousand words, show it. If gestures, props, or analogies will help, use them. You may make as many slides as you wish, as long as your presentation takes no longer than [x minutes]. Do not cram too much information on each slide: optimize them for projection in a large room. **For best results, practice giving the presentation aloud, with slides, in advance.** The better you have worked out how to articulate each of the points you want to make - coordinating what you say with what you show on the screen - the better you will be able to be in the present, maintain eye contact, and engage your audience.

Research Presentation Reflection Rubric

Presenter Name _____

Instructions:
- Assess the *presentation* of the research, not the research itself or the progress of the research.
- Take into consideration that the presenters had limited time to cover all the required segments**.**
- Add suggestions for improvement below each line, at the end of the sheet, or on the back.

Circle one number on each 1 to 7 scale: Needs considerable improvement = 1   Outstanding = 7

Clarity of the context and motivation for the research.   **1   2   3   4   5   6   7**
Suggestions:

Clarity on what distinguishes the approach and the logic behind it.   **1   2   3   4   5   6   7**
Suggestions:

Technical terms, procedures, and phenomena well-explained.   **1   2   3   4   5   6   7**
Suggestions:

Efficacy of slides and graphics in enhancing understanding.   **1   2   3   4   5   6   7**
Suggestions:

Visibility of information on slides.   **1   2   3   4   5   6   7**
Suggestions:

Poise, comportment and connection with audience.   **1   2   3   4   5   6   7**
Suggestions:

Speaker's ability to engage me in the story of the research.   **1   2   3   4   5   6   7**
Suggestions:

A couple of things this speaker could do to make this presentation even better:
(Use the back of this sheet if you need more space.)

Effective Scientific Posters

Quick Reference

George R. Hess

A poster is a *visual* communication tool.

An effective poster will help you …

… engage colleagues in conversation.

… get your main points across to as many people as possible.

Posters serve as …

» a source of information

» a conversation starter

» a summary of your work

» an advertisement of your work

Keep Posters Visual!!

Use BIG Text

Resources for Poster Presenters

Hess, G. & L Liegel. 2008. Creating Effective Poster Presentations. URL=http://www.ncsu.edu/project/posters, visited 2010 June 15.

Block, S.M. 1996. Do's and dont's of poster presentations. Biophysical Journal 71: 3527-3529.

Briscoe, M.H. 1996. Preparing Scientific Illustrations: A Guide to Better Posters, Presentations, and Publications. Springer, New York.

Gosling, P.J. 1999. Scientist's Guide to Poster Presentations. Kluwer Academic Press, New York.

Harms, M.I. 1995. How to prepare a poster presentation. Physiotheraphy 81: 276.

Hess, G.R., K. Tosney, L. Liegel. 2009. Creating effective poster presentations. Medical Teacher 31(4): 356-358.

Nicol, A.A.M., P. M. Pexman. 2003. Displaying your findings: a practical guide for creating figures, posters, and presentations. American Psychological Association, Washington, DC.

Teixeira, A. 1997. Preparing posters for technical presentations. Resource 4: 15-16.

Tosney, K. undated. How to create a poster that graphically communicates your message. URL=http://www.bio.miami.edu/ktosney/file/PosterHome.html, visited 2010 Jun 22.

Tufte, E. 1983. The Visual Display of Quantitative Information. Graphics Press, Cheshire, CT.

Tufte, E. 1997. Visual Explanations: Images and Quantities, Evidence and Narrative. Graphics Press, Cheshire, CT.

Woolsey, J.D. 1989. Combating poster fatigue: How to use visual grammar and analysis to effect better visual communication. Trends in Neurosciences 12: 325-332.

Tips for Effective Poster Presentations

Get your message across with effective *visual displays of data* and small blocks of supporting text. Think of your poster as an illustrated abstract.

Tell readers why your work matters, what you did, what you found, and what you recommend. Avoid excessive focus on methods – it's the results and implications that count!

Overall appearance. Use a pleasing arrangement of graphics, text, colors. Your poster should be neat and uncluttered – use white space to help organize sections. Balance the placement of text and figures.

Organization. Use headings to help readers find what they're looking for: objective, results, conclusions, etc. A columnar format helps traffic flow in a crowded poster session.

Minimize text – use graphics. Keep text in blocks of no more than 50-75 words – don't create large, monolithic paragraphs of prose.

Text size. All text should be large enough to read from 1-2 meters, including the text in figures. Title should be larger, to attract attention from far away.

Use color cautiously. Dark letters on light background are easiest to read. Stick to a theme of 2-3 colors. Avoid overly bright colors – they attract attention but wear out reader's eyes.

Don't fight reader gravity, which pulls the eyes from top to bottom (first), and left to right.

Include full contact information. You want to be found – the reader should not have to look up anything to find you.

Clean graphs show data clearly!

Desired message: Prey decreased as predators increased.

Focus on relationships – exact values are usually not important.

Eliminate "chart junk" to keep focus on data (Tufte 1983). Grid lines, detailed ticks on axes, data markers, and grey background are not needed.

Label data directly, when possible. Legends force reader to look back and forth to decode graph.

Message is now loud and clear!
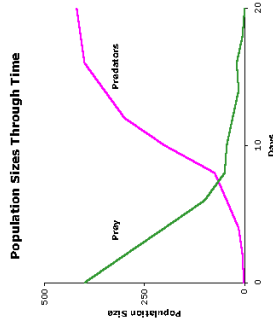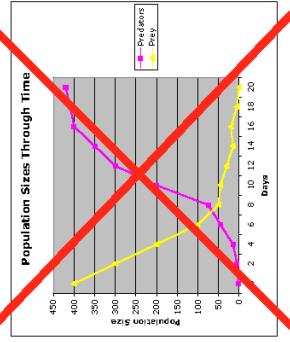
Prepare a 3-5 minute verbal explanation. Some people will ask you to "walk me through your poster." In making such a presentation, don't read the poster. Instead, give the big picture, explain why the problem is important, and use the graphics on your poster to illustrate and support your findings and recommendations.

Prepare a summary handout. You want people to remember your work – a handout provides a written record for readers. You can include a miniature version of your poster plus more detailed graphics, tables, and prose. The handout is something else you can refer to when talking to people about your work. Be sure to include complete contact information.

SCIENCE AND ENGINEERING POSTER SESSIONS
A Field Guide for Observers

By carefully observing posters, presenters, and attendees at science and engineering meetings, you can gain valuable insights for informing your own design and presentation strategies.

Sample Observational Queries:

1. **Which posters seem to be attracting a lot of *attention* and why?**
   - Are they near the food?
   - Graphically appealing? Colorful? Big images? Big bold title?
     Do they call attention to themselves from across the room?
   - Clear and compelling title - Provocative title?
   - Compelling research findings, significant, or unusual?
   - Is the presenter present? Observe their appearance and attitude.
   - Is the presenter actively engaging visitors?
   - Is there a lively conversation occurring around the poster, and, if so, is it
     focused on the research being presented? (If not, is the lively conversation
     perhaps blocking people from visiting the poster?)
   - Are there handouts, and are people taking them?

2. **Which posters do you find *yourself* attracted to?**
   - What matters most - the subject, the lab group, the title, the graphic design,
     your interest in the presenter?
   - What design features do you find appealing? Use of color? Photos? Titles?
     Layout? Density of information? Details? How much text is too much?
   - Would you rather approach a poster and read it yourself, without having to
     engage in conversation, or do you want a quick briefing? If so, what kind of
     information do you want from the presenter and how much?
   - What makes a presenter seem more approachable?
   - Do you like having handouts available?

3. **Which posters do you find most *satisfying?***
   - Which posters seem to have just the right amount of information – not too
     much; not too little?
   - How much time do you want to have to spend at a poster in order to get the
     gist of the research question and motivation and results?
   - Do you like posters to tell you a story from A to B?
   - What little touches do you find yourself most appreciating?
   - Did any of them give you an "ah ha" moment?
   - Which make you want to engage in conversation with the presenter? Why?

4. **What do you most want to get out of your experience at a poster session?**

Poster Presentation Score Sheet

Poster #: ☐

Author/Presenter: _____ Judge's Initials: _____

I. Technical: Score each item on a 1 - 4 scale: 1 = marginal; 2 = adequate; 3 = good; 4 = excellent.

Overall visual appeal (Attracts attention, pleasing layout & design; integration of graphics)	1 2 3 4
Organizational design (Poster tells a story from start to finish with clear signposting)	1 2 3 4
Balance of words and pictures/graphs (Information kept from being too dense or wordy)	1 2 3 4
Legibility (Good font size, helpful captions/labels, correct grammar/spelling, good writing.)	1 2 3 4

(1) Total technical score: _____

II. Content: Score each item on a 1 - 4 scale: 1 = marginal; 2 = adequate; 3 = good; 4 = excellent. 0 = no, 1 = yes.

Some research projects will be incomplete at the time of the poster presentation. Such posters should be evaluated based on what is available at the time of presentation. Not all the following sections may be included.

Title (Effectively highlights the poster's subject matter / key finding for non-specialists)	1 2 3 4
Authors (All listed; institutional affiliations clearly identified)	No = 0 Yes = 1
Abstract (Succinctly summarizes the project in language that non-specialists can understand)	1 2 3 4
Introduction/Motivation (Clarifies significance of the research and of the approach)	1 2 3 4
Methods (Provides essential information without unnecessary detail)	No = 0 Yes = 1
Results (Clarifies significant findings, referencing tables/figures as needed)	1 2 3 4
Tables & Figures (Effectively communicate/distinguish key facts/results, well-labelled)	1 2 3 4
Conclusions/Future Directions (Clarity from perspective of progress-to-date)	1 2 3 4
Acknowledgements / Funding Attributions listed (grant # displayed?)	No = 0 Yes = 1

(2) Total content score: _____

III. Presentation: Score each item on a 1 - 4 scale: 1 = marginal; 2 = adequate; 3 = good; 4 = excellent. 0 = no, 1 = yes.
(Note: Students can be hesitant when first approached, becoming more comfortable as their presentation progresses.)

Student was available to present the poster (Visit poster at least twice before scoring zero)	No = 0 Yes = 1
Student's grasp/understanding of materials	1 2 3 4
Student's ability to engage poster visitor (eye contact, poise, clarity, responsiveness, initiative)	1 2 3 4

(3) Total presentation score: _____

☐ **CUMULATIVE SCORE: 2x(1) + (2) + (3) =** ⬭

Judge's Pick: A check in this box indicates this was the judge's favorite poster presentation in a given judging session. This selection need not correspond with the highest total point score.

JUDGES: feel free to add comments here, or on the back of this form.

Selected Science Communication Resources

General Advice on Science Communication: Books and Websites

- *Explaining Research* by Dennis Meredith. Can be ordered from http://explainingresearch.com. Covers it all.
- *Communicating Science: Tools for Scientists and Engineers.* Curated by the American Association for the Advancement of Science. http://communicatingscience.aaas.org/
- *Am I Making Myself Clear?* by Cornelia Dean, 2011. Emphasis on working with journalists. ISBN 978-0674036352.
- *Escape from the Ivory Tower: A Guide to Making Your Science Matter,* by Nancy Baron, 2010. ISBN 978-1597266642. A classic in the field.
- *Marketing for Scientists,* by Mark Kuchner. http://marketingforscientists.com/
- *Start With Why* and *The Golden Circle,* by Simon Sinek. www.startwithwhy.com. Written for business people, but still applies.

Videos about Making Good Slide Presentations

- *Undergraduates Students Unwittingly Subjected to World's Worst Research Presentation,* by the Museum of Science. Dr. Fisher-Katz shows you what *not* to do. Watch past the credits for the animated tutorial.
  http://www.youtube.com/watch?v=nSGqp4-bZQY
- *Mastering Science and Public Presentations,* by Tim Miller
  (this one is specifically about science research presentations) Download video:
  http://www.nisenet.org/catalog/tools_guides/mastering_science_public_presentations_video
- *Steal This Presentation,* by Jesse Dejardins
  http://www.slideshare.net/jessedee/steal-this-presentation-5038209
- *Death by PowerPoint (and How to Fight It),* by Alexei Kapterev
  http://www.slideshare.net/thecroaker/death-by-powerpoint
- *Brain Rules for Presenters,* by Garr Reynolds (based on book *Brain Rules* by John Medina)
  http://www.slideshare.net/garr/brain-rules-for-presenters

Books about Making Good Slide Presentations

- *slide:ology: The Art and Science of Creating Great Presentations,* by Nancy Duarte.
- *Resonate: Present Visual Stories that Transform Audiences,* by Nancy Duarte, 2010. ISBN 978-0470632017
- *Presentation Zen,* and other books by Garr Reynolds. http://www.presentationzen.com and http://www.garrreynolds.com/Presentation/

Some good examples of science communication to broader audiences with slides:
- Al Gore, *An Inconvenient Truth,* the movie.
- Eric Mazur, *Guiding Light with Nanowires,*
  http://www.youtube.com/watch?v=MIgWz3yw39k&feature=c4-overview-vl&list=PL16AB911A121E6D01
- George Whitesides, *Perspectives on Nanotechnology*, http://www.youtube.com/watch?v=gBhqYpltRbE
- Master Storytellers channel on TED.com, http://www.ted.com/themes/master_storytellers.html
- Hans Rosling on Ted.com,
  http://www.ted.com/talks/hans_rosling_shows_the_best_stats_you_ve_ever_seen.html

GROUP 1

Welcome! Please start right in on a conversation sharing stories about your research experience

<u>Here's how:</u>

- Take turns introducing yourselves, including:
    - Name, undergrad school and major
    - The topic and motivation for your research

- Share:
    - Any "aha!" moments you've had so far...
    - Any "bloopers" or funny things that have happened so far...

(Be inclusive of everyone at your table;
make eye contact with all as you speak.)

GROUP 1

Welcome! Please start right in on a conversation sharing stories about your research experience

Here's how:

- Take turns introducing yourselves, including:
    - Name, undergrad school and major
    - The topic and motivation for your research

- Share:
    - Any "aha!" moments you've had so far...
    - Any "bloopers" or funny things that have happened so far...

(Be inclusive of everyone at your table;
make eye contact with all as you speak.)

GROUP 2

Welcome! Please start right in on a conversation sharing stories about your research experience

Here's how:

- Take turns introducing yourselves, including:
    - Name, undergrad school and major
    - The topic and motivation for your research

- Share:
    - Any "aha!" moments you've had so far...
    - Any "bloopers" or funny things that have happened so far...

(Be inclusive of everyone at your table;
make eye contact with all as you speak.)

GROUP 2

Welcome! Please start right in on a conversation sharing stories about your research experience

Here's how:

- Take turns introducing yourselves, including:
    - Name, undergrad school and major
    - The topic and motivation for your research

- Share:
    - Any "aha!" moments you've had so far...
    - Any "bloopers" or funny things that have happened so far...

*(Be inclusive of everyone at your table;
make eye contact with all as you speak.)*

REU SCIENCE COMMUNICATION WORKSHOP ◆ FEEDBACK SURVEY 2

Hello! Please take a moment to reflect back on your experience participating in the Science Communication Workshop sessions up to this point. The thoughts you share will help workshop providers better understand your experience, and will inform the design of future iterations of these sessions. Your confidentiality will be protected, and your research program providers will see only aggregated, anonymous data. Please answer all the questions as accurately as possible. The survey should take about 5 minutes to complete.   Thank you.

1. Host University/REU Program Title: _____

**2. If there were break-out groups at the most recent session,
the group number or the name of the group facilitator**: _____

3. How useful were the following aspects of the Science Communication Workshop sessions overall? *(Check just one box in each row)*	**Not Covered**	**Not Useful**	**Slightly Useful**	**Useful**	**Very Useful**
a) The encouragement to explore and find ways to communicate the broader context and motivation for my research.	❑	❑	❑	❑	❑
b) The guidance provided on planning, preparing, and delivering a good research presentation.	❑	❑	❑	❑	❑
c) The guidance provided on designing and presenting a good research poster.	❑	❑	❑	❑	❑
d) The guidance provided on working with visual materials.	❑	❑	❑	❑	❑
e) The opportunity to practice presenting my research to an audience.	❑	❑	❑	❑	❑
f) The opportunity to practice evaluating other people's presentations and providing constructive feedback to them.	❑	❑	❑	❑	❑
g) The feedback I received from peers.	❑	❑	❑	❑	❑
h) The feedback I received from workshop facilitators.	❑	❑	❑	❑	❑
i) The opportunity to hear about the research projects of other students in my group.	❑	❑	❑	❑	❑
j) Getting to know other students through the workshop sessions and building a sense of community.	❑	❑	❑	❑	❑
k) Learning how to describe my research to family and friends.	❑	❑	❑	❑	❑
j) The inclusion of science communication workshops as an integral part of this research experience training program.	❑	❑	❑	❑	❑

4. How has your participation in the science communication workshop sessions affected your CONFIDENCE in your ability to present your research?

I'm **much less** confident than before	I'm **slightly less** confident than before	I have **about the same** level of confidence as before	I'm **slightly more** confident than before	I'm **much more** confident than before
❑	❑	❑	❑	❑

5. If there had been more time in the Science Communication Workshop sessions, what would you have liked to use it for?

6. Did you practice your presentation aloud in advance before coming to the meeting?

6a.	Yes ❑	No ❑

6b. Why or why not?

7. Will you practice your final presentation aloud in advance?

7a.	Yes, probably. ❑	No, probably not. ❑

7b. Why or why not?

8. Please feel free to provide other comments about your science communication skills or about the workshop sessions here:

Thank you.

SCIENCE COMMUNICATION REFLECTION ◆ FINAL FEEDBACK SURVEY

Hello! Now that you've completed your research program, please take a moment to reflect on the practice you've had developing new science communication skills, and the impact of the Science Communication Workshop sessions. Your confidentiality will be protected, and your research program providers will see only aggregated, anonymous data. The survey should take about 5 minutes to complete.   Thank you.

1. Host University/REU Program: _____

2. Did you give a final SLIDE PRESENTATION on your research?

Yes ❑	No ❑

3. Did you give a final POSTER PRESENTATION on your research?

Yes ❑	No ❑

4. Did you practice your final presentation aloud in advance?

Yes ❑	Yes, but not as much as I would have liked ❑	No ❑

5. How satisfied were you with… (check one box in each row)	Not applicable	Very Unsatisfied	Mostly Unsatisfied	Mostly Satisfied	Very Satisfied
a) Your presentation overall.	❑	❑	❑	❑	❑
b) Your ability to clearly communicate the most important aspects of your research.	❑	❑	❑	❑	❑
c) The effort you put into preparing your presentation.	❑	❑	❑	❑	❑
d) Your poster design or slide design.	❑	❑	❑	❑	❑
e) How well you connected to your audience.	❑	❑	❑	❑	❑
f) The response from the audience.	❑	❑	❑	❑	❑
g) The response from your advisor(s).	❑	❑	❑	❑	❑
h) Your research project overall.	❑	❑	❑	❑	❑

6. What new science communication skills were you *most* pleased to be utilizing in your final presentation?

7. How much have your science communication skills improved as a result of your participation in the science communication workshop sessions?

No improvement	Slightly improved	Moderately Improved	Much Improved	Very much improved
❑	❑	❑	❑	❑

8. How has your participation in the science communication workshop sessions affected your CONFIDENCE in your ability to present your research?

I'm much less confident than before	I'm less confident than before	I'm about as confident as before	I'm more confident than before	I'm much more confident than before
❑	❑	❑	❑	❑

9. How has your ability to seek out and communicate the broader context and motivation for a research project improved as a result of your participation in the science communication workshop sessions?

No improvement	Slightly improved	Moderately Improved	Much Improved	Very much improved
❑	❑	❑	❑	❑

10. Please rate the importance of good science communication skills to a successful career in science:

No importance	Slight importance	Moderate importance	High importance	Very high importance
❑	❑	❑	❑	❑

11. Would you recommend that students in *other* undergraduate research programs be offered the opportunity to participate in a similar set of science communication workshops?

No	Not that Important	Yes	Most Definitely
❑	❑	❑	❑

12. Which particular communication skills would you like to improve further over the coming year?

13. Please provide other comments, observations, or recommendations here:

Thank you, and best wishes in your future endeavors.

REU SCIENCE COMMUNICATION ◆ **FACULTY/MENTOR FEEDBACK SURVEY**

The undergraduate student(s) that you have been advising participated in a set of Science Communication Workshop sessions. These focused on research presentation skills. Students were also asked to seek a thorough understanding of the broader context and motivation for their research project, and to practice communicating this broader context. From your perspective as an advisor, please help us evaluate the strengths and weaknesses of the Science Communication Workshop design and implementation. We will take your comments into account as we design future iterations of the program. This survey should take about 5 minutes to complete. Thank you.

1. REU Host University/ Program: _____

2. Are you a…

Faculty Member ❑	Post-Doctoral Researcher ❑	Graduate Student ❑	Other ❑

3. How many undergraduate students did you advise this time?

1 ❑	2 ❑	3 ❑	More than 3 ❑

4. Were you pleased with your student(s)' final presentation(s)?

Yes ❑	Partially ❑	No ❑

Why or why not?

5. Did you notice an improvement in the overall quality of the research presentations for this cohort compared to previous cohorts?

Yes ❑	No ❑	Not Applicable ❑

If yes, please characterize the differences you noticed.

6. Did the student(s) receive any guidance from the Science Communication Workshop sessions that differed from guidance you gave or would have given them?

| Yes ❑ | No ❑ |

If yes, please characterize the differences.

7. Did your REU student(s) *initiate* discussion(s) with you about the broader context and motivation for their research project?

| Yes ❑ | No ❑ |

If yes, please describe any noticeable impact of these discussions.

8.   How pleased are you overall that the Science Communication Workshop sessions were incorporated into the undergraduate research program?

Not pleased	Somewhat pleased	Moderately pleased	Very pleased
❑	❑	❑	❑

Please comment on your selection. We also welcome your feedback, comments and suggestions on the future design and implementation of these Workshops.

Thank you. For more information regarding the REU Science Communication Workshop program, please contact the coordinators at the Museum of Science, Boston, at nano@mos.org.

END of APPENDIX