SHARING SCIENCE:
Communcation, Education and Outreach

A WORKSHOP & PRACTICUM
FOR EARLY-CAREER RESEARCHERS

A NISE NETWORK PROFESSIONAL DEVELOPMENT GUIDE

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About this Guide

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

Karine Thate was a major contributor to the logistical and organizational development of the *Sharing Science Workshop & Practicum.* Other contributors include Carol Barry, Jacqueline Isaacs, Alex Fiorentino, Timothy Miller, and Lisa Regalla.

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Executive Summary

This guide provides information and resources for planning and hosting a *Sharing Science Workshop and Practicum* for early career researchers that will

- Enhance their science communication skills
- Engage their interest in education and outreach, and
- Prepare them for providing effective and rewarding education outreach experiences

The *Sharing Science Workshop & Practicum* can be implemented by science and children's museum staff and other informal science educators, either separately or in collaboration with university faculty, and is highly adaptable to a variety of situations.

Designed to accommodate up to 24 participants at a time, the Workshop and Practicum can be delivered in a single 6-7 hour day. It can also be divided into two 4-hour days, which can be scheduled up to four weeks apart. It's a good idea to plan the workshop and practicum to conclude a few weeks in advance of a major outreach event, such as NanoDays or a community science festival. This timing provides participants with a follow-on opportunity to apply and reinforce their skills in a new context, often in collaboration with the mentoring organization, with familiar staff support and supervision.

The *Sharing Science Workshop & Practicum* helps to build stronger ties between universities, researchers, educators, and the community. University faculty members appreciate the mentoring provided for their graduate students in science communication and outreach, and students appreciate the opportunity to contribute their knowledge in meaningful ways. Workshop graduates often continue to volunteer at science museums, schools, and community centers, forging longer-term relationships and bringing back new ideas and experiences. Young science museums visitors in particular benefit from authentic face-to-face experiences with young scientists who typically bring greater diversity to the museum's cadre of long-term volunteers.

Funding for workshop materials and staff time can often be provided through mentoring and education outreach budgets built into grant funded research projects. The university can provide a sub-award or small contract to cover program expenses. The workshop can be organized within the context of a multi-faceted research center – science museum education outreach partnership.

This package includes this pdf file, a document appendix file of printable hand-outs, activity guides, and editable survey forms, and a PowerPoint appendix file with optional Workshop slides.

Comments from Sharing Science *participants:*

"It was nice to work with such young audiences, even though it was a bit challenging."

"It made me think about my research from a different perspective."

"While explaining to kids, asking questions would encourage and excite them to learn something more."

It increased my confidence and made me more relaxed. I had to go for an interview that evening and the workshop experience gave me an idea of communicating better with professionals and nonprofessionals in daily life."

"I feel like getting involved with the education and outreach program. To intrigue kids' interest in science has great significance."

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Overview

Many scientists and engineers are interested in participating in education outreach, and science museums are often eager to recruit them to share their enthusiasm and knowledge with visitors. However, science and engineering content expertise doesn't always translate into quality interactions and learning experiences for visitors on the museum floor. How can we better prepare these valuable partners for effective and rewarding engagement with our visitors?

This package provides materials and guidance for science center staff or university research center faculty wishing to prepare scientist volunteers for interactions with visitors of all ages – helping these scientists to communicate effectively with broader audiences and to "share science" through interactive conversation and hands-on demonstrations.

The Workshop focuses in particular on two skill areas:

- Sharing Science with Words – Engaging visitors with conversation; speaking about complex science research using simple terms and easy-to-understand language that a layperson could understand; making the research relevant and engaging to visitors by focusing on motivation and the greater challenge that's being addressed.

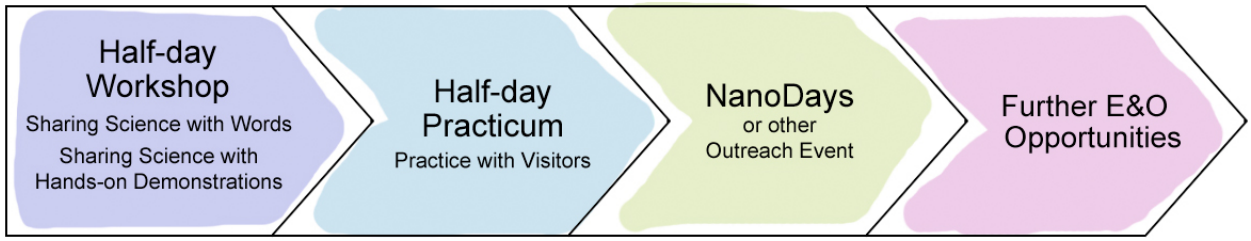
- Sharing Science with Hands-on Demos – Understanding inquiry-based learning; engaging visitors with hands-on demonstrations; using physical props, analogies, and experiences to communicate complex science phenomena with visitors of all ages

Evaluation results over several years of program research and iterative development show that participants find the workshops useful and enjoyable; they report increased confidence and skill in engaging visitors with hands-on demonstrations and conversations about science; and they express interest in becoming more involved in education outreach.

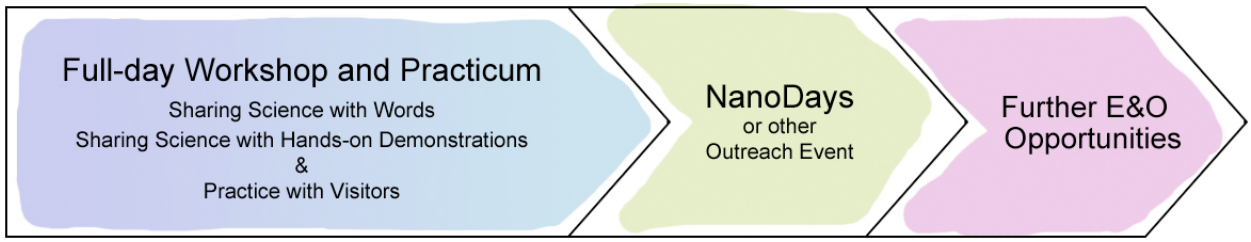
The *Sharing Science Workshop & Practicum* has three main components: Sharing Science with Words, Sharing Science with Hands-On Demonstrations, and a Practicum on the museum floor. The first two components take place in the Workshop setting, where students learn and practice these skills with their peers, with the guidance of Workshop leaders and facilitators. The third component, the Practicum, takes place in public areas of the museum (or other settings), where participants hone their skills with target audiences. We normally schedule the Workshop and the Practicum on two separate days, one to several weeks apart; however, they can be condensed into one very full day (see diagram, next page). Often, we add on an additional component – we invite the program graduates back to help us out at a special event such as NanoDays, where they have a chance to apply their new skills in a festive setting. To continue the momentum of the partnership, participants are also invited to return to contribute to other education outreach events as they

wish, and to become further involved with the development of other Museum or research center education and outreach activities.

Scheduling Option One



Scheduling Option Two



When the Workshop and Practicum occur on separate days, as in Option One above, we schedule 4 to 4.5 hour blocks for them, generally starting each with a brief lunch mid-day. (The late start and early lunch seems to appeal to many graduate students, and when we hold the workshop on a Friday, when the Museum is open late, the participants can stay and browse the offerings.) When the Workshop and Practicum are condensed and combined into a single day, plan on a 7-hour day, including a lunch break.

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Program Goals and Learning Objectives

The *Sharing Science Workshop and Practicum* was designed to help participants:

- Gain greater appreciation for the importance of science communication skills to successful careers in science and engineering;
- Gain greater appreciation for the important contributions they can make to enhancing science literacy and interesting young people in careers in science;
- Experience the rewards of successful science communication and educational outreach;
- Become further involved with education outreach in our communities.

Specific learning objectives include:

- Tailoring science communication and presentation of one's own research for specific audiences, settings, and timeframes;
- Presenting research within the larger context of human social and scientific goals so that audiences can better connect to its meaning, relevancy and motivation;
- Developing brief introductions to one's own research that can be used with both scientific and non-scientific audiences;
- Mastering basic oral presentation skills that allow one to successfully connect with an audience of one or many;
- Mastering inquiry-based learning techniques that enhance engagement by encouraging experimentation, discovery, questioning and curiosity;
- Becoming adept at giving and receiving constructive feedback to one's peers in a collaborative learning community.

Planning your *Sharing Science Workshop & Practicum*

Participants

These workshops were developed initially for early-career researchers (graduate students post-docs and junior faculty); however, the content is appropriate and suitable for scientists and engineers at any stage of their careers interested in improving their science communication skills and education outreach practices. The number of participants that can be accommodated in a single workshop depends on the staff, resources, and space available. We recommend keeping the number of participants to 24 or less, because of the importance of ensuring an adequate amount of individual practice and feedback during the very essential small group activities.

If more students need to be accommodated, then the Workshop will need to be extended to ensure all participants get sufficient practice and receive appropriate feedback. Additional mentor/facilitators may be required as well. We recommend breaking groups larger than 24 into two cohorts and offering the Workshop twice.

Workshop Leaders and Facilitators

With a reasonably sized group, a single, well-organized Workshop leader can do a solo facilitation, but we recommend including at least one additional staff member, faculty mentor or experienced graduate student per 5-7 Workshop participants, to facilitate the small group work, which is key to the success of the Workshop. You will brief and prepare these mentors in advance of the Workshop sessions.

For example, for a group of 24 participants, you'll need four facilitators or staff members. The first portion of the workshop (Sharing Science with Words) includes a small group activity, best done in groups of 5-6 participants, each with a facilitator. The second portion of the workshop (Sharing Science with Hands-On Demos) includes small group practice, and is best done in groups of 2-3. For this portion, one facilitator can oversee and guide two groups at time.

Room Requirements

The Sharing Science Workshop works best in a large room, with sufficient space for up to 30 adults, as well as tables to gather for the small group activities and hands-on demonstrations. There also needs to be sufficient space for the participants to visit each of the demo tables, engage in conversation, and experience the demos without too many distractions. A projector and screen are also required. Ideally, there'd also be a spot for a lunch buffet and trash, and bathrooms near by.

Space for the Practicum depends on your institution – perhaps there is already a space in your museum dedicated to cart demos or hands-on lab activities, or perhaps you can adapt a space that can temporarily accommodate a number of tables or carts for demonstrations and has sufficient

traffic to give the volunteers exposure to a wide range of visitors. Non-museum based program participants can bring their tables and demos to a science fair, a classroom, or even a shopping mall. If the museum has a middle school or high school volunteer program, those students can often provide terrific feedback.

Demo Materials

Since the students are practicing hands-on demonstrations, it is critical to have the materials on hand for the demos. The NISE Network's NanoDays kit demos (http://www.nisenet.org/nanodays)are ideal for this purpose, but you can easily use any other well-vetted hands-on demonstration activities which include educator guides, and for which you have the materials and experience. In later workshops, with participants who have already mastered the art of the science demo and inquiry-based education, we explore the design and development of brand new hands-on demonstration activities, often related to the participant's own research. However, for this basic Workshop, it is important that the demonstrations and materials have already been tested and proven sound, so that the participants have only to concentrate on their mastery of the engagement process with visitors. Just make sure you are well-stocked with the necessary materials and accessories for each demo, including written instructions, so that demonstrators can experience learning the demos on their own, without needing to be shown how the demo is done. If the demos require significant set-up or preparation ahead of time, be sure to do this before the workshop or you will have your participants twiddling their thumbs while you rush around making last-minute preparations. (This same advice holds true for organizing the Practicum.)

Workshop Materials and Amenities

Each participant receives a nametag upon arrival, and usually, the nametag is pre-marked with a color, number and/or letter code that discretely notes the small group assignments for each individual. We try to mix the small groups so that participants are likely to meet others from different labs, schools, or disciplines, both to broaden their experience and to prevent familiarity from interfering with the role-playing aspects of the Workshop. Well-fed participants are more likely to be happy, focused and productive, so, if the resources are available, we typically begin a Workshop with a buffet lunch or provide a voucher so participants can stop off at the cafeteria on their way in. A boxed lunch can also be served as a break mid-day, for instance, if you are combining the Workshop and Practicum in a single day. We like to have friendly tone-setting walk-in music playing when participants arrive. Each participant is also provided with a packet containing the assignment and resources for the day. Finally, we like to make sure there is fresh water – usually in bottles – available for students during both Workshop and Practicum, as presenting demos and talking with visitors for extended periods of time can produce unusual thirst.

For the Practicum, it's a nice idea to provide participants with a program t-shirt or museum apron or lab coat – something that identifies them as a museum volunteer. Or you might try buttons saying "Hi, I'm a graduate student," or "Hi, I'm a scientist." Otherwise, encourage them to wear a t-shirt representing their institution. Graduate students can be a very casual group, so be sure to

specify in advance if there is a dress code for museum volunteers. You can also help identify the group by having a greeter, or a sign on a stanchion that identifies what is happening in this area.

Visual Documentation

Take a few photos of the participants engaged in activities at your Workshop and Practicum! They'll be quite useful for you and your university partners when you are reporting on your work together. Remember to have the appropriate institutional photo releases handy.

Budgeting

The most expensive budget item is your time and the time of the other Workshop leaders and planners. Where the university has a pre-established education outreach partnership with a science museum, these expenses may be covered by a sub-award or contractual arrangement. Or, the university could supply funds from its own education and outreach and/or student mentoring budget. If the participants are preparing to help out at a special event (such as NanoDays) that has received dedicated funding, costs for the Workshop and Practicum could be included in that event budget. Food and drink for participants is the second biggest cost concern, followed by demo materials (and niceties like t-shirts or buttons if these are to be provided). We are assuming that room space, demo tables and chairs, and projector and screen can be scrounged up from existing organizational resources. Oh yes, and there is always a set of photocopies of workshop materials to be made.

Evaluation

Evaluation of your Workshop and Practicum is not essential, but highly recommended. We know the Workshop and Practicum works well for its target audience. However, through simple surveying efforts, you may gain invaluable insight into the particular experiences *your* participants are having, and you may discover some low-cost, high-benefit modifications you can make to better serve your participants the next time you offer the Workshop and Practicum. This package includes sample evaluation forms we have used successfully. There is a pre- and a post-survey for the Workshop, and an alternative post-survey to use if you offered the Practicum on the same day as the Workshop. There is also a post-survey for the Practicum when it is held on a separate day, and a post-survey for a follow-up event involving the participants, such as NanoDays. See the evaluation section for guidance on evaluation and a summary of past findings.

A Sample *Sharing Science Workshop & Practicum* Planning Timeline

DATE	EVENT/PURPOSE	DESCRIPTION	OUTCOMES
2 or more months before workshop	**Strategic Planning**: Science museum and university faculty partners coordinate plans, goals, and schedules for the Workshop and Practicum.	- Confirm decision to hold Workshop and Practicum and determine optimal timing (to coincide with an event, to coincide with start of academic year and orientation activities, or to build into an academic year professional development calendar). - Agree on learning goals and adjust agenda as appropriate. - Book rooms. - Set remainder of planning schedule. - Choose demos and order demo materials.	Partners have agreed on how this professional development workshop will fit into joint education outreach goals and are prepared for the next stage – recruitment and logistics.
1 month before workshop	**Advance Preparation and Recruitment**	- Finalize logistics (space, equipment, food, materials, table set-ups, signage, permissions). - Recruit or notify participants. - Recruit facilitators and brief them. - Finalize agenda. - Finalize presentation materials. - Order t-shirts/buttons (if available). - Review kit demos and replenish supplies if necessary.	Everything that requires third-party commitments and resources is put in place ahead of time.
1 week before workshop	**Final Preparations**	- Finalize list of attendees. - Pre-sort and assign participants into several small working groups for the various Workshop activities. - Make nametags, coded with group assignments. - Communicate with participants and facilitators regarding logistics for the day (directions, parking, timing, meals, rules, dress code). - Finalize Pre- and Post-Surveys and make copies. - Make photocopies of handouts and sort into packets.	Everything is ready to go before the day of the Workshop.

Day of Workshop and/or Practicum	**Sharing Science Workshop (and Practicum)**	(See sample Agendas and notes.)	Participants engaged and enriched.
Days following Workshop & Practicum	**Post-Workshop Assessment**	- Debrief with workshop facilitators on workshop experience and outcomes. - Note what worked and what could have worked better and jot down ideas for modifications for the next iteration. - Tabulate survey data. - Email students with appreciation for their efforts, advice on next steps, opportunities for outreach. OR – Remind students of schedule for upcoming Practicum session.	Outcomes and ideas for improving future iterations have been gathered and analyzed.
Optional separate Practicum day	**Sharing Science Practicum** and **Post-Practicum Assessment**	(See sample Agendas and notes.)	Participants engaged and enriched.
Next education outreach event or opportunity	**Workshop/Practicum "graduates" engage visitors with hands-on demos and discussion.**	- Workshop leaders and facilitators provide materials, resources, support and mentoring. - Informally debrief with students about their experiences and their sense of preparedness and confidence, and satisfaction. (This could also be accomplished through a survey.) - Informally debrief with staff and faculty mentors on outcomes observed.	Participants are now prepared to apply their education outreach skills in broader contexts. They may choose to become more actively engaged, coming back for other events, reaching out in other settings, or designing their own hands-on demos or interactive learning experiences.
Month following SSWP experience	**Stakeholders Analysis**	- Stakeholders (university faculty and science museum partners) analyze data and assemble report, noting outcomes and including recommendations for further iterations. They decide on next steps.	A learning community has been established.

SAMPLE AGENDA 1: WORKSHOP & PRACTICUM *ON DIFFERENT DAYS*

DAY 1: Workshop *An optional PowerPoint file is included that supports this agenda, as well as a sample workshop presenter's script, activity guides, and evaluation forms.*

12:00 Arrival Time

Preparation Notes: If needed, have a greeter in the lobby and/or instructions for where students should proceed. In the workshop room, have walk-in music; lunch buffet/boxed lunches (optional); nametags coded with small-group assignments; pre-assigned lunch table assignments (if desired); pre-survey forms and pens for students to fill out during lunch. Greet students when they arrive and direct them to get lunch and where to sit for lunch. Ask them to turn off cell phones and to fill out the pre-surveys. If using PowerPoint, title slide can be on screen. While students are eating lunch, take the time to meet with staff members, faculty mentors, experienced graduate student facilitators to prep them for the workshop explain the coaching roles during the small group activities. One advantage of having lunch first on the agenda is to leave a buffer zone for late arrivals, and one option is to turn the lunch time itself into an exercise where participants take turns introducing themselves to their small groups following guidelines posted in a vertical clear plastic sign stand at each table. [A "Lunch Table Activity" instruction sign is included in Workshop Activity Guides section.]

12:45 Sharing Science with Words: Introduction and Workshop Exercises.

- Why are we here? Review Workshop goals. (PowerPoint slide 2)
- Role of communication in science, especially in era of increasing specialization yet increasing need for interdisciplinary effort.
- Critical importance of science education and outreach
- Exploring the essence of face-to-face communication:
    - Being there
    - Voice, body, gesture: Landing a point (sports demo)
    - Who's the audience? Language choice and emphasis adjustment
    - Why should I care? Context and meaning
    - Using what's available – props, analogies, etc.

1:00 Activity Introduction: The Dinner Table Challenge

- Introduction, goals. Who's at the table? (PowerPoint slide 3)
- Advice.
- Constructive Feedback.
- Instructions: Break into groups of 4-7 people (nametags pre-coded for group assignments).

1:10 The Dinner Table Challenge

Small group members take turns being focus of attention and receiving feedback. (1-2 minutes per person presenting; 3 minutes of feedback from the group)

1:40 Debrief the Activity

- Ask participants to share their experiences, feelings, things they discovered. Was it harder then they thought it would be?
- Does anyone want to present their introduction in front of the room?

1:50 *Optional Second Round*

If there is time (30 minutes for another round and 10 minutes for second debrief), allow the groups to reassemble and redo the exercise. Participants usually enjoy having a chance to try to improve their introductions based on the feedback they received and the ensuing discussion. It is often a good idea to reassemble participants into new groups, so they have a few fresh faces to make first impressions with, and also one or two from the prior group who can note the improvements they made. (We pre-code nametags with these second group designations.)
SHIFT ALL TIMES BELOW AHEAD BY 40 MINUTES IF DOING SECOND ROUND

1:50 Break. Let participants know what's coming next. Set-up room for next activity.

2:00 Sharing Science with Hands-On Demonstrations: Introduction

- Why do hands-on demos? (Clip from "The Office" on Slide 4).
- (Slide 5) Hands-on demos can be extremely effective and engaging. Topics we will cover in this part of the Workshop: What is inquiry-based learning? What makes a good hands-on demo? What makes a good visitor experience? What do visitors bring to the experience? The hook (attracting an audience).
- But now we are going to demonstrate an example of engaging visitors with a hands-on demo. (Slide 6, leave on during *Demo Demo*)

2:10 The *Demo Demo*

Straight-faced, the Workshop leader announces that he/she or an experience museum educator is going to role-play an example of engaging a young visitor with a hands-on demonstration activity. Then he/she acts out a terrible hands-on demonstration embodying some of the worst mistakes a demonstrator can make with museum visitors. The "museum visitors" for this demo can be a pair of volunteers from the audience who act as a child/parent pair coming up to the demonstrator. It sometimes helps to have one of the visitors played by another staff member or facilitator who is "in on the hoax" and who has rehearsed with the "bad demonstrator" behind the scenes to coordinate the skit and enhance the mistakes. A sample "bad demonstrator" script for a demo called the "Atomic Trampoline" is provided in the Materials Section of this guide – the skit can be easily be adapted to any of the NanoDays kit demos. Mistakes that the presenter should try to highlight include: being distracted, texting or on phone when visitors approach, not having any kind of "hook," not letting the visitor touch any materials, doing the demo for the visitor, giving away the "aha" moment of discovery, explaining exactly what will happen before it happens, discouraging questions, using overly technical and complex vocabulary, or using much too simple language and treating the visitor like he/she is stupid, not providing a satisfying closure to the experience, etc. Be creative! The worse it is, the better it will be! Students quickly catch on and enjoy the spoof.

2:15 *Demo Demo* Debrief

- Participants debrief in groups of two (Think-Pair-Share), identifying all the ways the Demo Demo Demonstrator failed the visitors. Which were the worst?
- Workshop leader asks members of the group to call out the errors, repeating them, and adding context as needed. (An easel pad can be used to jot down salient points).
- Workshop leader directs the discussion toward a construction of what makes a demo good or bad? What is inquiry-based learning? What makes a good visitor experience? How can we best attract visitors? What might visitors be bringing to the experience?

2:25 A Better *Demo Demo:* on Video

- Participants view brief video of Lauren Zarzar testing her hydrogel demo with museum visitors (Slide 7).
- Discussion of what Lauren did right and how the parent helped. (Option to jot down some of the observations participants make on easel pad). This leads to…
- (Slide 8) Review of "The Nanoscience Demonstrator's Guide" (in packet and also on Slides 9, 10, 11).

2:45 Hands-On Demonstrations - Small Group Practice & Coaching (Slide 12)

Participants assemble into pre-designated groups of 2-3. Each group is provided with a demo kit (such as one of the NanoDays demos or another that is vetted and is complete with materials and instructions).

- Small groups spend about 15 minutes exploring their assigned demo and coming up with ways to use it with "visitors." The workshop leader and facilitator(s) check in with small groups to offer guidance and discuss questions that arise.
- (Slide 13) Small groups then spend about 15 minutes total exchanging demo experiences with another small group, practicing their approach and getting feedback.

3:15 Rotation – Presenting Demos, Experiencing Demos, Offering Feedback

- 3:15 – 3:30 – Rotation 1 (Slide 14). One or two people from each group act as demonstrators, while their partners rotate through the other demo stations, experiencing each demo and offering constructive feedback.
- (Slide 15) Switch!
- 3:30 – 3:45 – Rotation 2 (Slide 16). Demonstrators and "visitors" switch roles.

3:45 Debrief and Discussion (Slide 17)

- Small group partners reassemble to discuss what they learned about engaging visitors in their own demo and what they learned from visiting others.
- The group as a whole readdresses the questions of what makes a good demo, how to attract and engage visitors, and aspects of inquiry-based learning. What will be different on the museum floor with family groups and youngsters? Often participants have ideas for improving the demos, and this kind of discussion should be encouraged, because we want participants to begin to think about designing their own demos. However, there won't be time to go too deeply into this. Let them know you would be happy to discuss their ideas when there is time.

4:00 Concluding Thoughts

- Acknowledgements (local sponsors and NISE Net credit slide 18)
- Review what's been covered.
- Preview what will happen during the Practicum.
- Complete the post-workshop worksheet.
- Sign up for Practicum day.

4:15 Adjourn.

DAY 2: Practicum

Note: *The practicum day is flexible in format depending on your institution's needs, resources and the number of participants. Ideally, you'd schedule volunteers to each have about 2 hours for hands-on demo practice with museum visitors, and another hour or two to either explore other programming formats in the museum (live stage programs, science theater, multimedia, permanent exhibits, etc.), or to observe other demonstrators in action. Seeing other educational formats or other demonstrators in action helps students be reflective about their own practice, noticing what works/doesn't work and what they find most appealing and engaging. Keep in mind that for new demonstrators, continuously talking to and engaging with museum visitors can be very tiring, especially if the museum is crowded, so be mindful in your scheduling and either offer breaks/coverage, or limit the demo time to 2 hours per person/shift. You may want to arrange for special signage or make announcements on this day to increase traffic at the demo tables if you're concerned about the number of visitors. If it has been a number of weeks since the Workshop participants may need a review of what they learned in the workshop and a chance to re-familiarize themselves with the demo they are using. They may even want to do some warm-up exercises, like an "elevator speech" type exercise in pairs. This day is very flexible to suit different situations. Here is a sample agenda to give some guidance/suggestions.*

12:00 Arrival Time, Preparation

- Greet participants in the lobby and direct them to a "briefing" room if available, otherwise direct them to where they will be doing demos. Pass out nametags and t-shirts (if available). Assign 2 people to each demo and assign them into two shifts.
- Give participants 30 minutes to orient and prepare. Spend a few minutes reviewing the demonstrator's checklist and refreshing their memories on good demo technique. Give a brief tour of the space to get them oriented (entrance/exit, bathrooms, major attractions/exhibits, info desk, etc), and direct visitors if need. Review any important museum policies/expectations for volunteers. Give them a few minutes to re-familiarize themselves with the hands-on demo and get set up.

12:30 Hands-on Demos with Museum Visitors

- 12:30 – 2:00 – Shift 1 participants will engage with visitors during this first round, while second shift participants will experience the demos, give feedback and pointers, and then go off to explore the application of inquiry based, hands-on learning in other areas of museum programming.
- 2:00 – 3:30 – Shifts 1 and 2 switch roles.

3:30 Clean Up and Debrief

- Participants help organizers pack up demo materials and clear the area. Return to "briefing room" if available.
- Debrief and discuss the experience with volunteers. How did it go? What did they enjoy the most? What did they struggle with? Was anything more difficult then they expected? What do they feel they need more practice with? What strategies worked well with visitors?
- What's next? Discussion on how participants can continue their involvement. Sign up to learn about further volunteer opportunities.
- Participants fill out Post-Survey.

4:00 Adjourn.

SAMPLE AGENDA 2: WORKSHOP & PRACTICUM *ON THE SAME DAY*

Note: *Hosting the* Sharing Science Workshop and Practicum *on the same day may be more time-effective if your volunteers are coming from far away or if scheduling doesn't permit two separate days. However, this means that some activities must be condensed and it can be trickier to plan and execute, since you likely have to arrange and plan the logistics for 2 spaces – 1 room for the workshop and another space on the museum floor where students can practice with museum visitors. You'll want to arrange the timing so that the Practicum will be happening at a time that offers enough traffic to provide a steady flow of visitors. The day will be very full, and we recommend building in lunch, snack, and break times. Feel free to modify the Workshop PowerPoint to adapt to this shortened agenda.*

Morning Workshop

9:30 Arrival Time

Preparation Notes: If needed, have a greeter in the lobby and/or instructions for where students should proceed. In the workshop room, greet students as they arrive. Have walk-in music; coffee/snacks if available, and pre-survey forms and pens for students. Ask them to turn off cell phones and pages, and to fill out the pre-surveys. While students are filling out surveys, take the time to meet with staff members, faculty mentors, experienced graduate student facilitators to prep them for the workshop explain the coaching roles during the small group activities.

9:45 Sharing Science with Words: Introduction (abridged)

- Why are we here? Review Workshop goals.
- Role of communication in science, especially in era of increasing specialization as well as increasing need for interdisciplinary effort.
- Critical importance of science education and outreach
- Exploring the essence of face-to-face communication:
    - Being there
    - Voice, body, gesture: Landing a point
    - Who's the audience? Language choice and emphasis adjustment
    - Why should I care? Context and meaning
    - Using what's available – props, analogies, etc.
- Instructions for warm-up activity

10:00 Warm-up: Introducing Oneself and One's Work [this activity replaces "The Dinner Table Challenge" included in the two-day version of the Workshop & Practicum]

- Assemble into pre-arranged groups of 4-6; one workshop leader/facilitator/mentor per group (who also serves as timer).
    - Each participant briefly introduces themself and their research to the group, assuming it is a group of non-scientists. (1-2 minutes each, about 10 minutes total).
    - The group facilitator offers general constructive feedback and suggestions, reminding the group of communication qualities noted in session introduction. (5 minutes)
    - Participants introduce themselves a second time. The group facilitator asks each group member to practice providing constructive feedback following each introduction, pointing out at least one positive thing about the introduction and suggesting at least one possible improvement. (1-2 minutes each, with three minutes each for feedback, about 25 minutes total)

- Group Debrief or Second Round of Introductions (Reassemble into new groups)
    - Reinforce characteristics of good introductions or "elevator speeches."
    - Discuss how to continue working on these with others outside the Workshop.

11:00 Break. Let participants know what's coming next. Set-up room for next activity.

11:10 Sharing Science with Hands-On Demonstrations: Introduction

- Why do hands-on demos? (Clip from "The Office")
- Topics we will cover in this part of the Workshop: What is inquiry-based learning? What makes a good hands-on demo? What makes a good visitor experience? What do visitors bring to the experience? The hook (attracting an audience).
- But now we are going to demonstrate an example of engaging visitors with a hands-on demo.

11:15 The *Demo Demo*

Straight-faced, the Workshop leader announces that he/she or an experience museum educator is going to role-play an example of a engaging a young visitor with a hands-on demonstration activity. Then he/she acts out a terrible hands-on demonstration embodying some of the worst mistakes a demonstrator can make with museum visitors. The "museum visitors" for this demo can be a pair of volunteers from the audience who act as a child/parent pair coming up to the demonstrator. It sometimes helps to have one of the visitors played by another staff member or facilitator who is "in on the hoax" and who has rehearsed with the "bad demonstrator" behind the scenes to coordinate the skit and enhance the mistakes. A sample "bad demonstrator" script for a demo called the "Atomic Trampoline" is provided in the Materials Section of this guide – the skit can be easily be adapted to any of the NanoDays kit demos. Mistakes that the presenter should try to highlight include: being distracted, texting or on phone when visitors approach, not having any kind of "hook," not letting the visitor touch any materials, doing the demo for the visitor, giving away the "aha" moment of discovery, explaining exactly what will happen before it happens, discouraging questions, using overly technical and complex vocabulary, or using much too simple language and treating the visitor like he/she is stupid, not providing a satisfying closure to the experience, etc. Be creative! The worse it is, the better it will be! Students quickly catch on and enjoy the spoof.

11:20 *Demo Demo* Debrief

- Participants debrief in groups of two *(Think-Pair-Share),* identifying all the ways the *Demo Demo* Demonstrator failed the visitors. Which were the worst?
- Workshop leader asks members of the group to call out the errors, repeating them, and adding context as needed. (An easel can be used to jot down salient points).
- Workshop leader directs the discussion toward a construction of what makes a demo good or bad? What is inquiry-based learning? What makes a good visitor experience? How can we best attracting a visitor?
- Participants review the checklist provided – "The Nanoscience Demonstrator's Guide"

11:30 Hands-On Demonstrations - Small Group Practice & Coaching

Participants assemble into pre-designated groups of 2-3. Each group is provided with a demo kit (such as one of the NanoDays demos or another that is vetted and is complete with materials and instructions).

- Small groups spend about 15 minutes exploring their assigned demo and coming up with ways to use it with "visitors." The workshop leader and facilitator(s) check in with small groups to offer guidance and discuss questions that arise.
- Small groups then spend about 15 minutes total exchanging demo experiences with another small group, practicing their approach and getting feedback.

12:00 Rotation – Presenting Demos, Experiencing Demos, Offering Feedback

- 12:00 – 12:15 – Rotation 1. One or two people from each group act as demonstrators, while their partners rotate through the other demo stations, experiencing each demo and offering constructive feedback.
- 12:15 – 12:30 – Rotation 2. Demonstrators and "visitors" switch roles.

12:30 Lunch Break - Debrief and Discussion

Boxed lunches or lunch buffet is ideal, so group can stay in the room debriefing over lunch.

- Lunch groups discuss what they learned about engaging visitors in their own demo and what they learned from visiting others, as well as ideas for improving demos.
- The group as a whole readdresses the questions of what makes a good demo, how to attract and engage visitors, and aspects of inquiry-based learning. What will be different on the museum floor with family groups and youngsters?

Afternoon Practicum

1:15 Instructions and Orientation

- Group is briefed on what will happen during Practicum on museum floor and assigned to Shifts One or Two. Review any important museum policies/expectations for volunteers working with visitors. Pass out identifying museum lab coats or buttons if you have them.
- Group brings demo materials to set up in demo area, and gets oriented to locations of entrance, exit, bathrooms, info desk, etc.

1:30 Hands-on Demos with Museum Visitors

- 1:30 – 2:30 – Shift 1 participants will engage with visitors during this first round, while second shift participants will experience the demos, give feedback and pointers, and then go off to explore the application of inquiry based, hands-on learning in other areas of museum programming.
- 2:30 – 3:30 – Shifts 1 and 2 switch roles.

3:30 Clean Up and Debrief

- Participants help organizers pack up demo materials and clear the area. Return to workshop room.

- Debrief and discuss the experience with volunteers. How did it go? What did they enjoy the most? What did they struggle with? Was anything more difficult then they expected? What do they feel they need more practice with? What strategies worked well with visitors?
- What's next? Discussion on how participants can continue their involvement. Sign up to learn about further volunteer opportunities.
- Acknowledgements.
- Participants fill out Post-Survey.

4:00 Adjourn.

Materials List for the *Sharing Science Workshop & Practicum*

Hand-outs and surveys are included in this package, along with an optional set of PowerPoint slides.

- Nametags (marked with pre-assigned small groups)
- Large workshop room with tables and chairs, water and trash cans
- MP3 or CD player and walk-in music (optional)
- Laptop, projector, and screen for optional PowerPoint slides
- Instructions/Guidelines for facilitators
- 4-6 vertical clear plastic holders with optional Lunch Table Activity instructions and table group number
- Pre- and Post-Survey Instruments
- Participant packets including the following handouts:
    - "The Dinner Table Challenge" and "Possibly Life-Saving Pointers"
    - "The Nanoscience Demonstrator's Guide"
    - "Additional Resources for Nanoscience Education and Outreach"
    - Optional Museum Map and Schedule
- Pens, pads
- Soft volleyball or soccer ball
- Baseball mitt, basketball, and ping pong ball (or other mis-matched sporting equipment)
- Demo and script for the "really bad *Demo Demo"* activity
- Hands-on demo kits, boxed or packaged with all necessary materials and instructions. (From NanoDays kit* or other similarly vetted kits) Lunch vouchers, boxed lunches or a lunch buffet and snacks (Add coffee and breakfast breads and extra snacks for full day version) Bottles of water
- Camera for documenting the Practicum activities
- Optional easel stand and pad for recording ideas in group discussions

For the Practicum:

- Nametags (marked with pre-assigned small groups)
- Identifying t-shirts, aprons, buttons, or lab coats from the science center/museum (if available)
- Hands-on demo kits, boxed or packaged with all necessary materials and instructions. (From NanoDays kit* or other similarly vetted kits)
- Demo staging area behind the scenes
- Demo staging area in public space, possible signage
- Lunch vouchers, boxed lunches or a lunch buffet and snacks (Add coffee and breakfast breads and extra snacks for full day version) Bottles of water
- Camera for documenting the Practicum activities
- Post-Survey Instruments

For info on NanoDays kits: http://www.nisenet.org/nanodays
Physical Kit contents (with links for downloading materials): http://www.nisenet.org/nanodays/kit/physical
Digital Kit contents (with links for downloading materials): http://www.nisenet.org/nanodays-digital-kit-contents

Sample Workshop Leader Talk

This is an edited transcript of the introductory parts of a Sharing Science Workshop led by Carol Lynn Alpert at the Museum of Science (the version in which the Practicum is held on a separate day). It is provided as a sample and as a rough guide to help other Sharing Science Workshop leaders prepare their own approaches. As you will see, slides are not necessary for this approach, though they can be used. (We want to emphasize face-to-face interaction in this Workshop – not the aversion of eyes from speaker to screen.) The accompanying but optional digital slide PowerPoint file is appended to this package.

Sharing Science: Introduction (Slide 1)

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

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

(Slide 2) The reason why we asked you here today is simple. We want to engage you as our partners in developing a more science literate society, and in inspiring and empowering young people to focus on learning science, engineering, and math, perhaps following in your footsteps and preparing for careers in research, science, and technology. Some of the children you will interact with in our exhibit halls during the Practicum to this Workshop may end up being your graduate students and lab technicians when you are tenured leaders in your field, or CEOs of technology firms.

We also think you're going to find the experience extremely rewarding. How many of you can remember a visit to a science museum that inspired you to think about going into science as a career? How many of you can remember an adult introducing you to science or engineering in a way you'd never before experienced? A mentor you had? A particular teacher? You are going to have the opportunity here and in the coming years to inspire some young people and help them gain confidence and vision. There's not a better feeling in the world.

And your ability to successfully engage others in not only the knowledge that science gives us, but also in the process by which we obtain that knowledge – is also what is going to make you an outstanding educator and leader in your field. You will be able to capture the imaginations of potential colleagues, co-workers, funders and investors. You will be sought out as a speaker at conferences and as a champion for fact-based rational approaches to many of the challenges we face. You may finally be able to explain to your mother what your work is all about.

So we urge you to really engage today. Give it your all. Successful science communication skills are important to a career in science – especially these days – in fields like nanotechnology – where research teams include specialists in areas as diverse as chemical engineering, bioinformatics, optics, and medicine. All of these specialists use different jargon, different tools, different units of measurements, different abbreviations, and different acronyms. So if you can explain what quantum dots are to a high school student, you are also going to be able to explain them to the biologist next door who is looking for a better way to illuminate sub-cellular structures. It all helps.

Today, we only have a few hours together, and we're going to concentrate on just a few key aspects of communication, education & outreach.

First we're going to focus first on Sharing Science with Words - introducing yourself, who you are and what you do - and then on Sharing Science with Hands-on Demos - using hands-on demonstrations to engage students and other folks in interesting conversations about science.

And, if you like doing this, we're going to give you some opportunities in the future to come back to the Museum and continue to work with us to develop your skills as science educators.

Sharing Science with Words

Now, can everybody stand up and stretch?
While you're up, say hello to your neighbor
Did you remember to smile when you said hello?
Did you remember to look your neighbor in the eye?
Try it again, keeping those things in mind.
This is just a little warm-up to get you ready.

When you're with people face-to-face, you use your whole body when you communicate – your voice, your eyes, your expression, your gestures, your movement. The connection to the Other is multi-dimensional. You're giving a gift – sharing a message – and idea - sharing your voice, your enthusiasm, your energy with another. Communication is a connection. It's a 2-way street – an exchange between 2 people or more.

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

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

audience will likely respond by being there too. Putting down their smartphones. Looking you back in the eye. Focusing their attention.

Now, the first thing you need to do when you are preparing to speak to a person or a group of people, is to figure out *who they are.* We often get caught up thinking about who we are to them, or how we are coming across to them, but if we take the time to turn our attention on them, and to consider what they are bringing to the table – what they might already know or not know – what language seems real to them – what experience they can or cannot identify with – we will just have increased our chances of success a hundredfold.

[Demonstrate] I don't want to toss a basketball to a guy wearing a baseball glove. But neither do I want to try to toss him a ping pong ball. I don't want to bring hot dog buns to a cookout where only hamburgers are being served, or bring ice cream without spoons. You get the idea. You have to shape your message and your delivery vehicle so that they match the needs and capacities of your audience.

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

You see, your lab partners already understand why you're spending two months trying to figure out how to get this chemical to react with that chemical, or wiring this connection to pick up that faint signal. But a lot of audiences won't. And you're going to have to work to make them care. Usually your research project is a part of a bigger research project, which may be part of a bigger investigation that may help to accomplish a major scientific goal or meet an important engineering challenge. But unless you brief your audience on what this larger overall goal is about – unless you find a way to connect your day-to-day work with a larger human goal or purpose, very few people will have the stamina to listen to the details of your progress. So, when you're trying to share your science with people outside your lab or your area – say, with your gang from the neighborhood, or, your soccer buddies, or your little brother or sister, you have to think about a way to capture their attention, hook their interest, understand why you care and why they should care about what you do. Our jargon for this is "context and meaning." You supply context for your efforts and help make them meaningful.

For example, your research may be focused on figuring out what temperature works best for using particular tools to try to lay identical carbon nanotubes evenly and uniformly across a silica substrate. But you know what? That could also be part of a much larger effort to find a way to build a smaller, cheaper, faster, more powerful computers by getting around the power density problem of today's computers – the fact that your laptop is practically burning your legs after an hour or two of work on the couch.

Will your efforts some day have the potential to ease the pressure on our strained health care budget? Could you come up with a way to decrease the need for the burning of fossil fuels? Will your widget save people hours of effort each week? Will you come up with the material strong enough to build an elevator to space? Tell us. Tell us what your dream application might be. And then tell us the story of trying to get there. You can use anything to help you. Analogies. Anecdotes. Word pictures. Gestures. Napkin drawings. Anything.

Anyone want to try this right now? We can workshop it through with you in front of the group. [Ask a volunteer from the audience to explain their research in simple terms focusing on the greater context and meaning behind their work. Workshop it through with them if they miss the mark, and help guide them with questions to uncover the larger motivation of their research. What's the real world challenge that's being addressed?]

So, now we're going to do a little exercise we call "The Dinner Table Challenge." *[In the single day combined Workshop and Practicum version, a simpler exercise, called "Introducing Oneself and One's Work" is substituted.*

(Slide 3) The idea is, you're a post-doc, looking for a faculty position, and you're interviewing at the university at which you most want to gain tenure. The night before the interview, the dean has invited you to a dinner party at her home with some of her colleagues from the Faculty of Arts and Sciences.

When you get there, you find you are seated at a table with a physicist, a social worker, an artist, a journalist, and the department head's 16-year old son. The department head is in the middle of the table, well within earshot.

Wanting to help you feel at home, the journalism professor invites you to tell her what kind of research you do.

With this type of mixed audience, what are you going to say? What language are you going to use? Are you going to just give the title of your research paper – are you going to go through all the steps of your experiment?

No, probably not. Instead, you're going to think back to this workshop, and you're going to think -
"Who is my audience?"
"What would be interesting to these folks about me and what am I doing?"
"What challenge am I trying to address that they could relate to?"
"How might a potential outcome of my work impact the lives of the people I am speaking with – or their children - or someone else in their community? "
"What inspired me to work on this problem? What am I hoping to find?"
"What interesting story can I tell that illuminates some of the challenges I am dealing with?"

In other words, you're going to look for areas of potential connection to the people sitting at the table with you. And that, in a nutshell, is what this exercise is about. If you can do that in this situation, you can do it in many other challenging situations.

Now the smart person will prepare ahead of time for situations like these. They won't have to take too many sips from their wineglass before they start telling their story. So think of this exercise as a part of your preparation for that day, those many days ahead of you, and keep working on it even after you leave here.

So we're going to break into four groups of five, and try this. There's a handout in your packet with instructions and "life-saving pointers" on the back. Each of you plays the role of one of these dinner table guests, and each of you takes a turn being the junior faculty job applicant who gets asked what your research is about. Assign someone to be the timer, so that everyone gets a turn. Make time to give everyone some constructive feedback after their turn.

Now when I say constructive feedback, I don't mean criticism and I don't mean applause. I mean go around the table and each person tell the person in the hot seat one or two things you thought worked well, and then offer one or two suggestions for improvement. If you finish ahead of the other groups, go around again, trying to incorporate some of the feedback you received.

Now as you are going to your groups, take a moment and think to yourself about how you explain your research – what you do and why – the very essence of it – in a way the non-scientists attending the dinner party might understand. Make a real effort not to use complex jargon and vocabulary. Meet their eyes. Keep it simple. Oh, and you might want to take a look at those "Possibly Life-Saving Pointers" on the back of the Dinner Table Challenge assignment sheet.

[Begin Dinner Table Challenge Activity.}
[After it's complete, lead the discussion and debriefing.
So, how did it go? Did anyone find it difficult? What did you struggle with? Would anyone like to volunteer to try theirs again in front of the group? (If there's time.)].

Good job, everyone. Remember, this is something you can continue to work on and try out on other people in your life. We're going to take a quick break to set up the next activity, and there are…..

[Ten-minute break to set up Demo portion of workshop]

Sharing Science with Hands-On Demos

This part of the workshop will focus on sharing science with hands-on demonstrations.
[Optional use of brief "The Office" video clip, Slide 4.] How many of you remember when Michael Scott was still the manager of the Scranton office of Dunder Mifflin? Well even Michael wanted to educate his staff about the value of hands-on "show and tell" versus simply tell," and he knew that science museums are all over this. [Watch "The Office" clip]. Science museums are all about *experience* - hands-on experience.

(Slide 5) Guiding inquiry-based learning with hands-on demos can be a lot of fun and also very effective. Topics we will cover in this part of the Workshop include:
What is inquiry-based learning?
What makes a good hands-on demo?
What makes a good visitor experience?
What do visitors bring to the experience?
The hook: how do we attract an audience?

(Slide 6) True to the experience of "show, don't just tell, we're going to start by doing a little role play about engaging visitors with a hands-on demos. We call this role play the *Demo Demo.* My associate, who's very experienced at this, is going to play the role of the demonstrator, and I'm going to play the role of the kid who approaches. I need a volunteer to play the child's parent. Anyone? OK, we're in the science museum. Here we go….

The *Demo Demo*
[See the sample script for the Demo Demo *using an activity called the "Atomic Trampoline" - provided in the materials section. The approach can be easily adapted to other NanoDays kit demos or other demos. Mistakes that the role-playing demonstrator should highlight include: being distracted (such as texting or*

on phone when visitors approach), not having any kind of "hook," not letting the visitor touch any of the materials, doing the demo for the visitor instead of letting them do it, giving away the "aha" moment of discovery, explaining what will happen before it happens, discouraging questions, using overly technical and complex vocabulary, being rude, not making a satisfying closure, etc. Students quickly catch on and enjoy the spoof.]

Now, that was truly terrible, wasn't it?
Don't bring your children to *this* museum.
But what's important, here, is to tease out exactly what were the elements that made it so terrible? Because therein lie all the clues to what makes a good hands-on demo interaction. So, I'd like you to pair off with a neighbor and come up with a few specific things that this demonstrator did wrong in this scenario. Take three minutes to do this.

[Think-Pair-Share Discussions]

So, what made this experience so terrible?
[Take comments from the audience and underscore the critical points. If comments peter out, remind the group of a few things they have not mentioned yet. Feel free to use an easel and marker to jot down ideas for this and/or the next section.]

OK, we've identified what was bad. Now let's see if we can identify – by contrast – some good ways to lead a hands-on learning experience. First of all – what attracts people to come to a science museum and what makes them want to approach a particular exhibit….

[This guided discussion touches on these points:

- *Free-choice learning – the need to attract and entertain*
- *Inquiry-based learning – the idea that people learn best when they drive the inquiry process - they discover an inner curiosity or motivation to find out something or to try something and see what happens.*
- *Constructivist learning – the idea that people are more likely to understand a concept if they've experienced making the observations and logical steps leading to that conclusion.*
- *Pride of discovery – allowing the visitor to feel empowered and competent.*
- *People bring prior knowledge, experience, and assumptions to an experience that influences what they take from it.*
- *Situational influences – visitors may be tired, hungry, in a hurry, etc.*
- *Personal connection – the engagement between demonstrator and visitor.]*

So, we showed you a really bad Demo Demo, and now we're going to show you one that's actually pretty good. (Slide 7) Lauren Zarzar was a graduate student at Harvard when she came to the Museum of Science for a 6-day Science Communication Internship in 2010. Her research was in hydrogels, and for her internship project she decided to develop a hands-on demo to help people explore the extraordinary water retentive qualities of hydrogels. This is a handheld video of her interacting with visitors the day she decided to try out her demo prototype on the museum floor. Let's take a look, and consider the ways that Lauren engages with one of her first sets of visitors… (play video).

Now, let's discuss what happened here. What did you notice? *[ensuing discussion].*

By the way, Lauren's hydrogel demo proved so successful that it has been added to the NISE Net catalog of excellent nano demos. But more about that later. But just so you know – you guys may be able to help us develop some new demos too at some point…

(Slide 8) Now, to help you remember some of these key points about doing science demos, we've put together this handy Nanoscience Demonstrator's Guide –you will find it in your packet. These are 10 questions you should ask yourself and consider how to engage with your audience. They remind you that you are not here to fill up people's minds with facts - you are here to guide them to make their own explorations and conclusion.

[Review "The Nanoscience Demonstrator's Guide." It's also on Slides 9, 10, and 11.]

And, now, it's time for us to get our own hands on….

[Proceed to small group work with demo kits as noted in Agenda.]

Sample Script for a *really bad DEMO DEMO*

Based on a UW Madison MRSEC demo "Atomic Trampoline"
Demo Description: http://mrsec.wisc.edu/Edetc/supplies/amorphous/index.html
Activity Instructions & Background: http://mrsec.wisc.edu/Edetc/IPSE/educators/amMetal.html
(Real) Training Video: http://mrsec.wisc.edu/Edetc/IPSE/educators/amMetal.html

Role players for this spoof:

- Demonstrator (workshop leader/staff member)
- Ten-year-old child (staff member or audience volunteer)
- Parent (audience volunteer – no written script – but will chime in as appropriate)

Scene opens with Demonstrator sitting behind the table texting on his phone. Child and Parent walk up to table, curious about what's happening.

Child: What's going on here?
(She picks up a ball bearing, bounces it in one of the trampolines.)
Wow, look at that…

Demonstrator: *(Looks up irritated, grabs the ball back)*
Don't touch that… I'll be with you in a minute.
(She finishes texting)
Thanks for waiting… you shouldn't just walk up and start touching this stuff – you don't know if it's dangerous…

Now before we do anything, let me tell you what's going to happen.
This demonstration compares how a stainless steel ball bearing will bounce differently on 2 different types of metal: stainless steel on one side and vitreloy amorphous metal on the other side. Now stainless steel has a polycrystalline structure that allows the atoms to dislocate pretty easily, while vitreloy amorphous metal is cooled very quickly, so it does not form a crystalline structure – it is comprised of 5 different elements (42% zirconium, 22% beryllium, 13% titanium, 12% copper, and 10% nickel). Here read this background information [hands child stack of papers]. The different atomic radii in this metal promote a highly disordered arrangement of the atoms in a tightly packed solid form. Although it looks similar the other metal, the physical properties are different. Now, when I bounce this steel ball bearing on the steel base, you can see that it loses energy and deforms the steel base. The bouncing stops pretty quickly - it has to do with the coefficient of restitution.

Child: *(Looks bored and tugs hand of parent to go…)*

Demonstrator: Wait, you can't go yet, I haven't gotten to the main part of the experiment… Now give me that ball. Next, I'll drop onto the amorphous metal, and you'll see that the

ball retains most of its energy due to the higher coefficient of restitution and it bounces much higher for much longer.

Child: *(Tentatively raises hand)*
Can I ask a question? What happens if…

Demonstrator: Not now… Let me finish first. You see, because of the arrangement of atoms in the amorphous metal *(shows the diagram)* the material doesn't deform and the ball retains its energy.

Child: What would happen we try to bounce a ball made of rubber?

Demonstrator: Well that's a stupid idea…. why would you want to try that? Haven't you been listening to what I've said? You need to keep the same steel ball for both trials in a proper scientific investigation.

So, you might be wondering what this could be used for? Well not much yet – just high tech classified military uses … nothing you'd really understand.

(Child and Parent walk away)

Demonstrator: *(Calls after them…)* By the way, if you continue in school and study science and engineering for 10 or 15 more years, you could know as much as I do!

(To self) Well, I think that went pretty well… Given, that kid is no Einstein, and I don't have many high hopes for her… and that mom (dad)… no control over the kid… But all in all, I'm pretty happy about it…

Coaching for Facilitators & Mentors

Either before the workshop, say, during a conference call - or at the start of the workshop when participants are having lunch or filling out the pre-survey - take some time with the staff, faculty or graduate students who are helping to facilitate the small groups to review the goals of the Workshop, the day's schedule, and the protocols for the small group activities. Since one of the goals of the workshop is for participants to gain experience mentoring each other, go over the characteristics of constructive feedback, and ask the facilitators to try to let the small group participants take the lead on this aspect, with facilitators being the last to comment.

Dinner Table Challenge Coaching Guide

- We will have groups of 5-6 participants, each group seated around a single table. We have only (usually 30-40) minutes for the exercise, so let's get organized quickly.

- Assign roles at the table: a physicist, a social worker, an artist, a journalist, and the department head's 16-year old son.

- Assign one person to double as a timer or perform that role yourself. There will be a total of 5 minutes spent listening and providing feedback for each participant.

- Find a volunteer to go first and then proceed clockwise around the table.

- Have the person playing the journalist ask, "*So, [name of participant], what kind of research do you do?"*

- Don't interrupt, unless the person goes well beyond a minute or two.

- Before you give your own feedback, ask the participants to give theirs. Instruct them to first briefly comment on what they thought was effective about the introduction and to mention any suggestions they might have for improving it.

- If the person needs help – say, on thinking about the "big picture," or coming up with helpful analogies, or using simpler language, or maybe a way of using the "props" available at a dinner table to make a visual point – by all means, brainstorm together. But keep it to a five minutes focus for each person, to ensure all get a turn.

- If everyone has had a chance to try it, and there's still time, do another round: this time the participants should focus their attention specifically on the 16-year old son (this *ups the ante!).*

Small Group Hands-On Demo Practice Coaching Guide

- There will be 2-3 participants assigned to each of the hands-on demos. Each facilitator can guide 2 groups.

- Each group will have 15 minutes to learn their demo. Give them a few minutes to explore the materials on their own and see if them can figure it out. If needed, you can provide some guidance on how the demo works.

- Encourage the groups to use 'The Nanoscience Demonstrator's Guide' as they plan how to deliver their demo. Help them identify when they are using vocabulary that's too complex, or where an analogy could be helpful. Remind them to shape the experience for the visitor – it's not about getting across a lot of content – it's about providing the opportunity to the visitor to explore and discover and experience an investigation of their own.

- After the 15 minutes, have one group practice engaging another group in their demo. After receiving some feedback, they should switch roles. Try to hold your feedback until the participants have had a first go around. Refer them back to points made in the 'The Nanoscience Demonstrator's Guide' to reinforce future use of that resource. Remind them that peer learning and feedback includes both encouragement for what is working well and help brainstorming possible improvements.

Workshop Activity Guides and Handouts

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

Included:

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

- **"The Dinner Table Challenge"** and **"Possibly Life-Saving Pointers"** (Print as two-sided page and include in each participant packet if you are including this activity in your Workshop.)

- **"The Nanoscience Demonstrator's Guide"** (Include in each participant packet. You may want to distribute fresh copies of this to participants if they return for a separate Practicum day, or even to refresh them at a further education outreach event like NanoDays.)

- **"Additional Resources For Nanoscience Education and Outreach"** (Print as two-sided page and include in each participant packet.)

Note: Sample Evaluation Survey forms are included in a later section.

GROUP 1

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

Instructions:

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

THE DINNER TABLE CHALLENGE:

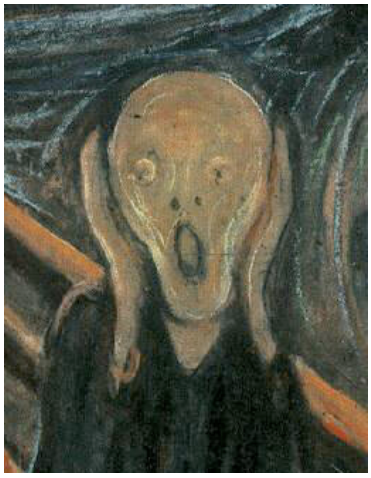
☞ **You have been invited to interview at the university at which you most want to eventually gain tenure. You are staying at a hotel in town.**

The night before the interview, the Dean has invited you to join her and her colleagues from the Faculty of Arts and Sciences at her home for a catered dinner.

When you get there, you find you are seated next to a physicist, a social worker, an artist, a journalist, and the department head's 16-year old son. The Dean is in the middle of the table, well within earshot.

Wanting to help you feel at home, the journalist invites you to tell her what kind of research you do.

The people around you are all ears. *How will you respond?*



☞ Possibly *Life-Saving* **POINTERS:**

- **Courtesy Essentials:**
  - Make eye contact.
  - Include everyone at the table.
  - Use language they can all understand. (If you have to use a technical term, define it clearly.)
  - Show interest in them as well.

- **Engagement Ideas:**
  - Hook the audience with an interesting idea or a "what if?" that points to a possible long-term goal of your research – something that almost anyone can identify as valuable.
  - Identify the broader challenge your research is intended to address.
  - Use examples or analogies or provocative questions that can clarify the big picture. Try to pick ones that relate to the experience or expertise of the people around you.
  - Use hands or nearby objects as props, to help visualize your point.

- **Signs of Success:**
  - The audience finds you interesting. (They do not immediately turn to another dinner guest and avoid you the rest of the evening.)
  - They want to know more; they ask further questions.
  - Other people overhearing the conversation want to get in on it.

Common Pitfalls:

- **Too Long (TMI):** You go on and on, and they can't wait to find a way to politely escape.
- **Too Short:** You say as little as possible, and they find you stiff and boring.
- **Too Technical**: Too detailed; too much about how; not enough about why.
- **Too Jargony:** You use terms, acronyms, units of measure, and concepts they may not understand.
- **Too Far Removed:** You don't find a way to relate what you research to something they might care about.
- **Too Relentless:** You don't give people an opportunity to ask questions or discuss.
- **Too Exclusive:** You focus in on the one scientist in the group who starts drawing you out with technical details and jargon, to the exclusion of others.
- **Lacking Affect:** You speak in a monotone, show little enthusiasm, don't meet people's eyes, seem bored with what you do,
- **Self-Absorbed:** You show no interest in what they do.

The Nanoscience Demonstrator's Guide

1. **What is there for the visitor or student *to DO?***

2. **How can I *pique their curiosity* about what I have to offer?**

3. **Where is the *"aha"* moment? How can I *enhance* or *dramatize* this moment of discovery?**

4. **What does the demo *reveal?* (e.g., observable phenomena). How does it compare to "normal" or "expected" behavior?**

5. **How can I help them *guess* at possible explanations*?***

6. **How can I help them think of ways *to test* possible explanations?**

7. **What does the demo reveal about *underlying nanoscale properties* or behavior*?* How can I explain this in *very simple* language? *What analogies* can I suggest?**

8. **How can I help them begin to imagine ways that this behavior could be *harnessed to help us* do something?**

9. **How can I bring the interaction to a *satisfying* close*?***

10. **How can I tell if it was a *successful* interaction?**

Additional Resources for Nanoscience Education and Outreach

Part 1 - Sharing Nanoscience with Public Audiences

The following resources include hands-on demonstrations, videos/podcasts, and content guides from a variety of organizations involved in fostering public engagement in nanoscale science and engineering. These links can provide additional ideas about what content to present, how to present it, and the language/style to use that is most appropriate for public and school audiences.

- **NISE Network Catalog** - http://www.nisenet.org/catalog/programs
  An online catalog of nanoscience programs and activities that have been developed, tested and evaluated by museum professionals and scientists active in the NISE Network - a nationwide community of researchers and informal science educators dedicated to fostering public engagement in nanoscale science, engineering and technology.

- **Exploring the NanoWorld Activities & Resources** - https://mrsec.wisc.edu/Edetc/index.php
  An online collection of materials, activities and resources from the University of Wisconsin – Madison MRSEC (Materials Research Science and Engineering Center) developed by their Interdisciplinary Education Group.

- **NanoNerds YouTube Channel** - http://www.youtube.com/user/NanoNerds
  For examples of how to talk about nanoscience with public audiences, check out the NanoNerds channel. Created by the Strategic Projects Group at the Museum of Science, Boston, the NanoNerds channel includes a variety of videos and podcasts from museum educators and scientists on a variety of nanoscience topics. Includes several clips from the popular *Talking Nano* DVD set, which can be purchased at www.talkingnano.net.
  - Moving Atoms by Don Eigler - Chapters 1&2, 3, 4, 5, 6, 7, 8, 8b, 8c, 9, 10, 11, 12, 13, 14, 15, 16, 17&18
  - Guiding Light with Nanowires by Eric Mazur - Part 1, Part 2, Part 3

- **NISE Network Content Map** -
  http://www.nisenet.org/catalog/tools_guides/nanoscale_science_informal_learning_experiences_nise_network_content_map
  The NISE Network content map articulates the 4 key ideas the network has identified as the most important for engaging the public in learning about nanoscale science, engineering, and technology. *(Adapted content map for nanoscience demonstrators to be available in November 2011 at* http://www.nisenet.org/catalog/tools_guides/engaging_public_nano).

- **National Nanotechnology Initiative's Nanotech 101** - http://www.nano.gov/nanotech-101
  A general introduction to nanotechnology and its potential for broader audiences by the National Nanotechnology Initiative (NNI) - a multi-agency U.S. Government program that coordinates Federal efforts in nanotechnology. You can also download/print a copy of their brochure for the public – "Nanotechnology: Big Things from a Tiny World" (http://www.nano.gov/node/240).

- **The Big Ideas of Nanoscale Science & Engineering** –
  http://www.nsta.org/store/product_detail.aspx?id=10.2505/9781935155072
  An overview of the "big ideas" of nanoscience that children/teens need to understand about this emerging field. This guidebook by Shawn Stevens, LeeAnn Sutherland and Joseph Krajcik covers pathways to the learning goals and children's likely misconceptions about the concepts.

Additional Resources for Nanoscience Education and Outreach

Part 2 – Learning in 'Free Choice' Settings and Inquiry-Based Learning Theory & Practice

The following resources give more background and context for how people learn in informal settings, such as science museums, and inquiry-based learning theory and practice. Understanding this type of learning can help demonstrators create an engaging learning experience for public audiences.

- **Science Centers as Learning Environments** - http://www.astc.org/resource/education/johnson_scicenters.htm
  A 2005 article by Colin Johnson for the Association of Science and Technology Centers (ASTC) that describes what's different about learning in informal, "free choice" settings like science centers.

- **What is Inquiry?** - http://www.exploratorium.edu/IFI/about/philosophy.html
  A general introduction to inquiry-based learning by the Exploratorium's *Institute for Inquiry*. From this site, you can also access *Pathways to Learning*, an article which delves deeper into teaching and learning through inquiry; and *Inquiry Structure*, a map showing an approach to inquiry that can guide your activities. You can also access an NSF Foundations publication the Institute staff wrote, called *Inquiry: Thoughts, Views, and Strategies for the K-5 Classroom* (http://www.nsf.gov/pubs/2000/nsf99148/htmstart.htm). While this document focuses on inquiry the elementary school classroom, the Introduction and Chapters 1 and 2 offer general background and context for this style of learning.

- **Bringing Nano to the Public: A Collaboration Opportunity for Researchers and Museums** – http://www.nisenet.org/catalog/tools_guides/bringing_nano_public_collaboration_opportunity_researchers_museums
  This guide provides an introduction to informal science education and to science museum practice for nano and materials science researchers. It advises researchers on ways to collaborate with science museums to increase the impact of their education outreach activities, and includes a rich bibliography. Pages 8-9 and 13-15, in particular, provide information on how learning occurs in science museums and tips to make researchers successful in these settings.

- **Sharing Science with Children: A Survival Guide for Scientists and Engineers** – http://www.noao.edu/education/ncmlssg.html
  This guide from the North Carolina Museum of Life and Science is written for scientists and engineers interested in making effective classroom presentations. Much of the content and many of the tips and recommendations can be applied to the interactions in a museum setting.

- **Planning for People in Museum Exhibitions** – http://www.astc.org/pubs/mclean.htm
  This book by Kathleen McLean is one of ASTC's best sellers. Taking a detailed look at all aspects of exhibit design, it also gives good insight into what the visitor brings to the museum experience, how and what they learn, and what they take away from the experience.

- **Learning from Museums: Visitor Experiences and the Making of Meaning** – http://www.altamirapress.com/isbn/0742502953
  This book by John Falk and Lynn Dierking explains the nature and process of learning as it occurs within the museum context (emphasizing constructivism and free-choice learning) and provides advice on to create better learning environments for museum visitors.

Evaluation Studies of the *Sharing Science Workshops & Practicum*

These programs were in development over a four-year period, with ongoing formative evaluation and subsequent improvements. With the assistance of the University of Massachusetts Donahue Institute for Research and Evaluation, the Museum of Science and the Center for High-rate Nanomanufacturing evaluated two different *Sharing Science Workshop and Practicum* formats – holding the workshop and practicum on separate days in 2009, and hosting a single day with the workshop and practicum combined in 2011. The participants of the workshops in both cases were graduate students associated with the NSF Center for High-rate Nanomanufacturing at the University of Massachusetts Lowell, Northeastern University, and the University of New Hampshire. Overall impressions of the workshop and practicum were very positive. The evaluation results showed that participants found the workshops useful and enjoyable; they reported increased confidence and skill in engaging visitors with hands-on demonstrations and conversations about science; and they felt motivated to get more involved in education outreach. Highlights from the evaluation reports follow.

From the 2009 two-day Workshop and Practicum post-survey:

- 89% of participants rated the workshop as very or extremely useful.
- The vast majority of participants agreed that as a result of the workshops:
    - improving their science communication skills became a greater priority (89%).
    - they had a better understanding of the purposes of education outreach (96%).
    - they felt more confident engaging people with science demonstrations (93%).
    - they were more motivated to get involved in education outreach (90%).
    - they felt better equipped to explain their research to non-scientists (90%) and children (83%).
- All participants in the Practicum day reported that they had a good time and enjoyed working with visitors.
- All participants reported that the Workshop had helped prepare them for the Practicum, and that they had learned a lot about engaging visitors with hands-on demonstrations.
- They reported that the hands-on science education training and practice would help them in their careers in science and teaching.
- All but one of the Practicum day participants would encourage other graduate students to engage in this training experience.

From the 2011 single day Workshop and Practicum post-survey:

- All the participants enjoyed engaging with museum visitors during the workshop.
- 85% of participants agreed that they'd learned a lot about how to engage public audiences with hands-on science demos.
- All participants reported an increase in confidence in engaging public audiences with science demos, and more than ¾ of participants were more motivated to get more involved with education and outreach.
- 85% of participants felt the Workshop and Practicum would help them in their careers, and would recommend the training to their peers.

From the 2011 NanoDays Post-Survey:

- 83% of the participants in this additional outreach event reported that the Sharing Science Workshops and Practicum had prepared them very well for doing outreach with museum visitors at the event.

The UMass Donahue Institute also conducted focus groups with graduate students who had participated in the Museum of Science Sharing Science programs and events and interviewed faculty. This research led to the decision by CHN faculty to continue to place a high priority on integrating the Sharing Science programs and events into their graduate education curricula. Evaluation reports on *Sharing Science* are posted in the NISE Net catalog.

Evaluation Instruments and Protocols

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

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

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

For the Workshop and Practicum on DIFFERENT days

- Pre-Survey for the Workshop Day
- Post-Survey for the Workshop Day
- Post-Survey for the Practicum Day

For the Workshop + Practicum in a SINGLE day

- Pre-Survey for Workshop + Practicum Combo Day
- Post-Survey for Workshop + Practicum Combo Day

For a follow-on educational outreach event, such as NanoDays:

- Post-Survey for Outreach Event

[Date]

Sharing Science Pre-Workshop Survey

Please help us improve future workshops. Your responses will remain confidential.

Sex:
❑ Male
❑ Female

Graduate Education Level
❑ Year One ❑ Year Two
❑ Year Three ❑ Year Four
❑ Year Five ❑ Year Six
❑ Post-Doc ❑ Other _____

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

Temporary or Permanent Disabilities:
(Check all that apply)
❑ None
❑ Mobility
❑ Cognitive
❑ Visual
❑ Auditory
❑ Learning:
❑ Other:

Discipline / Field of Research:

University (circle one) [if applicable]: [School One] [School Two] [School Three]

Since beginning graduate school, how often have you…

	Never	1-3 times	4-5 times	more than 5 times
Given a talk on your research to other researchers.	❑	❑	❑	❑
Given a talk on your research to non-scientists.	❑	❑	❑	❑
Participated in education and outreach activities in a non-school setting	❑	❑	❑	❑
Participated in educational and outreach activities in a school setting. Circle (Grades): K-5 6-8 9-12	❑	❑	❑	❑
Engaged kids with science demos	❑	❑	❑	❑
Mentored an undergraduate student	❑	❑	❑	❑

Please rate your agreement with the following statements:

	Strongly Disagree	Disagree	Agree	Strongly Agree
Improving my science communication skills is a high priority for me.	❑	❑	❑	❑
I'm good at explaining my research to other scientists.	❑	❑	❑	❑
I'm good at explaining my research to non-scientists.	❑	❑	❑	❑
I'm good at explaining my research to kids.	❑	❑	❑	❑
Participating in education and outreach is an important part of a scientist's job.	❑	❑	❑	❑
I have a clear understanding of one or more potential applications of my research.	❑	❑	❑	❑

OVER ➔

Why do you think your faculty supervisors asked you to participate in this workshop?

How would you describe your research, in a few sentences, to a 16-year-old who has had little or no exposure to science and engineering?

Thank you for your responses.

[Date]

Sharing Science Post Workshop Survey

Please help us improve future workshops. Your responses will remain confidential.

Circle your host university: [if applicable]

How useful to you were each of the following aspects of today's session?
(Check one box for each.)

	Not very Useful	Somewhat Useful	Very Useful	Extremely Useful
Interacting with other graduate students	❑	❑	❑	❑
Opening talk: sharing science	❑	❑	❑	❑
Introducing Yourself and Your Work exercise	❑	❑	❑	❑
Dinner Table Challenge exercise	❑	❑	❑	❑
Feedback from my peers	❑	❑	❑	❑
Feedback from workshop leaders & faculty	❑	❑	❑	❑
Introduction to hands-on learning experiences	❑	❑	❑	❑
Practice with hands-on demos	❑	❑	❑	❑
Discussion and Q & A	❑	❑	❑	❑
Today's workshop session overall	❑	❑	❑	❑

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

Please rate your agreement with the following statements. (Check one box for each.)

After having this workshop experience…	Strongly Disagree	Disagree	Agree	Strongly Agree
Improving my science communication skills is a greater priority for me.	❑	❑	❑	❑
I have a better understanding of why we do education and outreach.	❑	❑	❑	❑
I feel better equipped to explain my research to non-scientists.	❑	❑	❑	❑
I feel better equipped to explain my research to kids.	❑	❑	❑	❑
I feel more confident about engaging people with science demonstrations.	❑	❑	❑	❑
I'm more motivated to try getting involved in doing some education and outreach	❑	❑	❑	❑

OVER ➔

How could we have improved today's workshop?

Now that you've taken this workshop, how would you, in a few sentences, describe your research to a 16-year-old who's had little or no exposure to science or engineering?

Thank you for participating.

[Date]

Sharing Science Practicum – Post-Survey

Please help us improve future workshop experiences. Your responses will remain confidential.

Circle your host university: **U 1** **U2** **U3**

Which shift were you assigned to today? (circle one) **Shift One** **Shift Two**

Did you work with visitors on a hands-on science demo today? (circle one) **Yes** **No**

Which demo did you use? (check one)
Alka Seltzer/Surface Area ❑ Magic Sand ❑ Ferrofluid ❑
Nasturtium Leaves/Nano Fabric ❑ Memory Wire ❑ Tiny Teacup ❑
Atomic Trampoline ❑ Liquid Crystal ❑ Other:_____ ❑

Please rate your level of agreement with each of the following statements:

	Strongly Disagree	Disagree	Agree	Strongly Agree
I had a good time at the Museum today.	❑	❑	❑	❑
I enjoyed getting a chance to work with visitors.	❑	❑	❑	❑
The Sharing Science Workshop helped prepare me for working with visitors today.	❑	❑	❑	❑
Today I learned a lot more about how to engage Museum visitors with hands-on demos.	❑	❑	❑	❑
Working with visitors was harder than I thought it would be.	❑	❑	❑	❑
The demo I used was well designed.	❑	❑	❑	❑
I have ideas for improving this demo.	❑	❑	❑	❑
Working with visitors was personally rewarding.	❑	❑	❑	❑
I would like to take advantage of other opportunities for engaging people in hands-on science education and outreach.	❑	❑	❑	❑
I'm interested in designing a hands-on demo related to my own area of research.	❑	❑	❑	❑
This professional development program will help me in my career in science and teaching.	❑	❑	❑	❑
I would encourage other graduate students to go through this professional development program.	❑	❑	❑	❑
Since the earlier Sharing Science Workshop, I have put into practice the skills we developed in presenting ourselves and our work.	❑	❑	❑	❑

OVER ➔

What did you learn about doing science demos with museum visitors today that hadn't been as clear from simply attending the Sharing Science Workshop?

What strategies did you find worked best for attracting and engaging visitors?

What suggestions do you have for improving your demo, or for creating a new demo?

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

Any comments on other programs or experiences you observed today at the museum?

Any suggestions for improving this professional development program or for additional programs?

Thank you for your participation.

[Date]

Sharing Science Pre-Workshop and Practicum Survey

Please help us improve future workshops. Your responses will remain confidential.

Sex:
- ❑ Male
- ❑ Female

Graduate Education Level
- ❑ Year One
- ❑ Year Two
- ❑ Year Three
- ❑ Year Four
- ❑ Year Five
- ❑ Year Six
- ❑ Post-Doc
- ❑ Other: _____

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

Temporary or Permanent Disabilities:
(Check all that apply)
- ❑ None
- ❑ Mobility
- ❑ Cognitive
- ❑ Visual
- ❑ Auditory
- ❑ Learning
- ❑ Other: _____

Discipline / Field of Research: _____

Which School do you attend (check one): ❑ **U1** ❑ **U2** ❑ **U3**

Since beginning graduate school, how often have you…	**Never**	**1-3 times**	**4-5 times**	**More than 5 times**
Given a talk on your research to other researchers.	❑	❑	❑	❑
Given a talk on your research to non-scientists.	❑	❑	❑	❑
Participated in education and outreach activities in a non-school setting	❑	❑	❑	❑
Participated in educational and outreach activities in a school setting. **Circle (Grades): K-5 6-8 9-12**	❑	❑	❑	❑
Engaged kids with science demos	❑	❑	❑	❑
Mentored an undergraduate student	❑	❑	❑	❑

Why do you think your faculty supervisors asked you to participate in this workshop?

Thank you for your participation.

[Date]

Sharing Science Post-Workshop and Practicum Survey

Please help us improve future workshops. Your responses will remain confidential.

Which School do you attend (check one): ❑ **U1** ❑ **U2** ❑ **U3**

Which demo did you use? (check one)

❑ Surface Area/Alka Seltzer	❑ Memory Wire	❑ Exploring Size: Card Games
❑ Nano Sand	❑ Static Electricity	❑ Mitten Challenge
❑ Ferrofluid	❑ Thin Films	❑ Scented Balloons
❑ Nano Fabric/Nasturtium	❑ Special Microscopes (SPMs)	❑ Sunblock

How useful to you were each of the following aspects of today's session?	**Not Very Useful**	**Somewhat Useful**	**Very Useful**
Visiting with other graduate students	❑	❑	❑
"Introductions" workshop activity	❑	❑	❑
Learning and practicing the hands-on science demo	❑	❑	❑
Leading demos with museum visitors	❑	❑	❑
Debrief & discussion	❑	❑	❑
Today's workshop session overall	❑	❑	❑

Please rate your level of agreement with the following statements.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I had a good time at the Museum today.	❑	❑	❑	❑	❑
I enjoyed engaging people in science with hands-on demos and discussion.	❑	❑	❑	❑	❑
Working with visitors was personally rewarding.	❑	❑	❑	❑	❑
Working with visitors was harder than I thought it would be.	❑	❑	❑	❑	❑
This science demo workshop will help me in my career in science and teaching.	❑	❑	❑	❑	❑
I'd recommend this workshop to my peers in graduate school	❑	❑	❑	❑	❑

As a result of this workshop experience…	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I learned a lot about how to engage museum visitors with hands-on demos.	❑	❑	❑	❑	❑
I feel more confident about engaging people with science demonstrations.	❑	❑	❑	❑	❑
I feel I could facilitate hands-on demos with museum visitors again with no additional training.	❑	❑	❑	❑	❑
I feel more confident engaging people in a conversation about science.	❑	❑	❑	❑	❑
I'm more motivated to try getting involved in doing education and outreach.	❑	❑	❑	❑	❑

Was this workshop? ❑ too short ❑ too long ❑ just right

What did you find most difficult about today's experience as a whole?

What do you think you need more help/practice with?

What suggestions do you have for changing or improving today's workshop? What would you have liked to spend more time on?

Are there ways the experience you had today may help you in other social or educational settings? If so, please mention one or two of them.

Would you like to be contacted when we have other opportunities for you to engage in hands-on science demos with visitors at the museum?

❑ Yes ❑ No

(If so, please sign the "Please contact me" list before you leave.)

Thank you for your participation.

[Date]

NanoDays Post-Survey

Please help us improve future events. Your responses will remain confidential.

Which school do you attend? ❑ **U1** ❑ **U2** ❑ **U3**

Had you previously participated in any…?	**Yes**	**No**
NanoDays or any other outreach event at the Museum	❑	❑
Sharing Science workshop at the Museum	❑	❑
Other workshop at the Museum	❑	❑

If you participated in *Sharing Science* or another workshop at the Museum, how well did it help prepare you for this event?

❑ **Very Well** ❑ **Somewhat** ❑ **Not at all** ❑ **I did not participate previously**

Please rate your level of agreement with the following statements.	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I enjoyed the NanoDays event.	❑	❑	❑	❑	❑
Interacting with visitors went smoothly.	❑	❑	❑	❑	❑
Museum staff did a good job coordinating my participation in this event.	❑	❑	❑	❑	❑
The expectations regarding my role were clear.	❑	❑	❑	❑	❑
I received the information I needed to be comfortable participating in this event.	❑	❑	❑	❑	❑

Which activity did you participate in? (check one)

❑ Surface Area/Alka Seltzer
❑ Nano Sand
❑ Ferrofluid
❑ Nano Fabric/Nasturtium
❑ Measurement
❑ Stretchability/Twister
❑ Static Electricity
❑ Thin Films
❑ Special Microscopes (SPMs)
❑ Other: _____
❑ Exploring Size: Card Games
❑ Buckyball models/Tatoos
❑ Scented Balloons
❑ Sunblock

Do you have suggestions for improving this activity?

Were you able to experience any of the following NanoDays activities OTHER THAN your assigned activity? If so, which ones?

Do you have any comments or insights related to these activities or how to improve them?

Do you have suggestions for improving the NanoDays event or your participation in it?

Did you learn anything new about doing science demos with museum visitors at this event?

❑ **Yes** ❑ **No**

If so, what?

Additional comments about participating in the NanoDays event?

Thank you for your participation.

Conclusion

Questions, comments, and suggestions for improvement to this Guide and to the Workshop, Practicum and materials are encouraged and welcome.

Please send them to nano@mos.org.
For more information, or to inquire about consulting, also write to nano@mos.org.

The Museum of Science has developed another science communication program guide for NISE Network museums and research centers, targeting undergraduates. The ***REU Science Communication Workshops*** professional development guide focuses on workshops for participants in Research Experience for Undergraduate (REU) and other similar university-based undergraduate research programs. Find this guide in the NISE Net catalog under Tools and Guides. www.nisenet.org/catalog/category/tools

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