SHARING SCIENCE

Workshop & Practicum for Early-Career Researchers

Planning & Implementation Guide, v. 3.0

Written by Carol Lynn Alpert and Karine Thate

Designed and produced at the Museum of Science, Boston

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Background & Acknowledgements Version 3.0

The *Sharing Science Workshop & Practicum* was developed by Carol Lynn Alpert, Karine Thate, and other members of the Strategic Projects Group at the Museum of Science, Boston, in collaboration with CHN, 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. We wish to thank Carol Barry, Ahmed Busnaina, and Jacqueline Isaacs of CHN for their thoughtful participation in the iterative development of the SSW&P and their long-term commitment to engaging university research students in education and outreach. Thanks also to Jeanne Antill for her artwork and graphic support.

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This is version 3.0, updated in November 2014. It is currently available at http://www.nisenet.org/catalog/tools_guides/sharing_science_workshop_practicum.
Please contact nano@mos.org with any questions or to inquire about further updates.

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<u>Digital Appendix on DVD</u>:

- E-version of this Guide, customizable agendas, activity guides, hand-outs, and surveys.
- PowerPoint slides and movies.

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Executive Summary

This guide provides information and resources for planning and hosting a one-day or two-half-day *Sharing Science Workshop & Practicum* for early career researchers. The SSW&P is designed to:

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

The SSW&P is typically implemented by staff at science museums, children's museums, and other informal science organizations, in collaboration with university science and engineering faculty, and is highly adaptable to a variety of situations. Designed to accommodate up to 24 participants at a time, the Workshop & Practicum can be held during a single day, or divided into two half-days scheduled up to four weeks apart. Both sessions can be timed to conclude a few weeks in advance of a major outreach event, such as NanoDays or a community science festival, thus allowing participants the opportunity to apply and reinforce their new skills in a community-serving context, 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. Students gain skills and confidence in sharing their interest and knowledge of science with members of the community. Young people benefit from face-to-face encounters with youthful graduate students and early-career researchers from diverse backgrounds. Museums and other science outreach organizations benefit from engaging the enthusiasm and energy of skilled volunteers populating their exhibit halls and community spaces. Participating in the SSW&P can initiate life-long engagement in education and outreach for scientists and engineers, on campus, in schools, and with local community organizations.

The SSW&P is often organized within the context of comprehensive research center – science museum collaborations, with funds for materials and staff time provided through education-outreach and professional-development budgets built into grant-funded research projects. *A Guide to Building Partnerships Between Science Museums and University-Based Research Centers* by C. L. Alpert provides detailed guidance on forming such collaborations. It is available at http://www.nisenet.org/partner_guide.

This package includes this step-by-step planning and implementation guide, a document appendix of hand-outs, activity guides, and survey forms, and a Digital Appendix on a DVD with electronic versions of all these, plus the PowerPoint slides and movies. You may check for updates to Version 3.0 at http://www.nisenet.org/catalog/tools_guides/sharing_science_workshop_practicum or contact us at nano@mos.org.

Comments from Sharing Science *participants:*

"This was a wonderful experience. I feel much more confident about explaining a complicated topic to non-scientists."

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

"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."

"Hands on demonstrations make you understand the concepts of science in a better way."

"I really liked interacting with museum visitors. The best part was that the adults were as excited to find out about nano-technology as the children."

"As a child, I wish I had more exposure to scientists and demos like this one. My favorite part was the possibility of inspiring a child to enter the STEM field."

"It gave me ideas about communicating with different audiences which is very useful, even for writing scientific papers."

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Section One: Overview

Many scientists and engineers are interested in sharing their knowledge and enthusiasm through education and outreach, and informal science education organizations typically welcome their participation and the opportunity to foster face-to-face engagement with broader audiences. However, science and engineering content expertise doesn't always translate into quality interactions and learning experiences at science museums, science festivals, university open-houses, and in other "free-choice" learning settings, like after-school programs. How can we better prepare scientists and engineers for effective and rewarding engagement with broader audiences?

This package provides materials and guidance for planning and implementing a Sharing Science Workshop & Practicum designed to prepare university and industry researchers for successful interactions with young people, families, and other community members, using hands-on demos and face-to-face discussion.

The SSW&P 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; listening to visitor's questions and concerns.

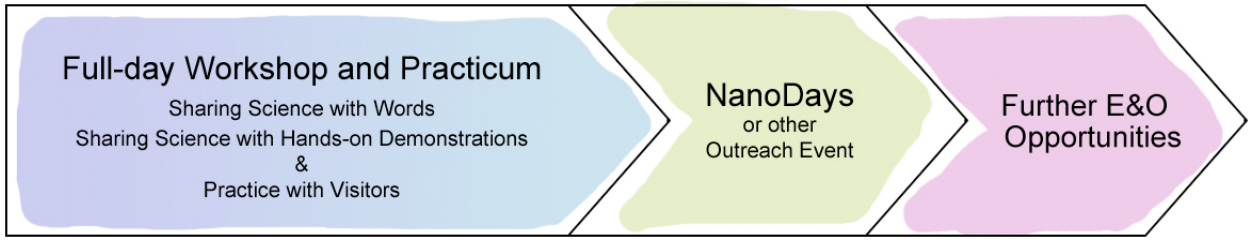
- Sharing Science with Hands-on Demos – Understanding inquiry-based learning; engaging visitors with hands-on demonstrations; using physical props, analogies, and experiences to stimulate creative thinking about scientific phenomena and investigation with visitors of all ages.

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.

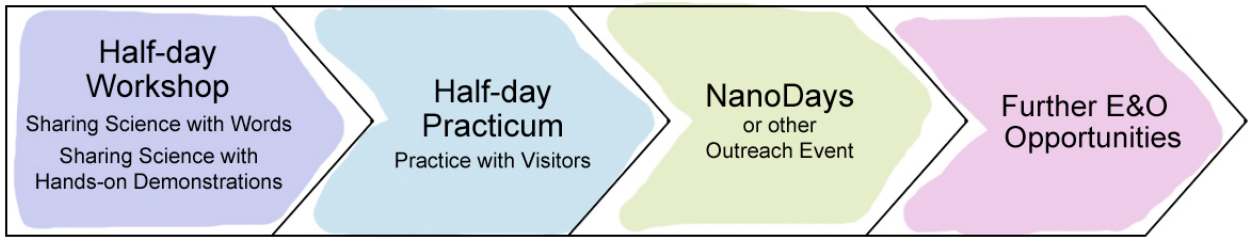
The *Sharing Science Workshop & Practicum* has three main components: Sharing Science with Words, Sharing Science with Hands-On Demonstrations, and a Practicum on the museum floor or in another community outreach space. The first two components take place in a workshop setting: participants learn and practice these skills with their peers, under 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 & Practicum for the morning and afternoon of a single day, typically a Saturday at the science museum; however, we sometimes break it into two separate sessions, held one to two weeks apart. Often, we add on an additional component – we invite the program graduates back to help us out at a special event such as NanoDays or a community science festival, where they have the opportunity to apply their new skills in a festive setting. To continue the momentum of the partnership, participants are also invited to return to volunteer at other education outreach events and to become further involved with the development of other museum or research center education and outreach activities.

Scheduling Option One



Scheduling Option Two



Hosting the Sharing Science Workshop & Practicum on the same day can be more efficient than spreading it over two days, especially if significant participant travel is involved or if it's difficult to coordinate schedules for two separate sessions. In the single day version, you will be arranging logistics for two spaces – the workshop/debrief space and the museum floor or other public outreach space, where you can supervise participants as they practice with visitors. You'll want to time the Practicum to occur when visitor spaces are fairly busy, so there are lots of people for the trainees to work with. The day will be very full, and we recommend building in morning coffee, lunch, refreshments, and break times.

When the Workshop & Practicum occur on separate days, as in Option Two, we schedule 4 to 4.5 hour blocks for each, usually beginning with a breakfast or a lunch. (When we hold the workshop on a day the museum is open late, the participants can stay on and browse the offerings.) When the Workshop & Practicum are condensed and combined into a single day, as in Option One, plan on a 7-hour day, including a lunch break. Section Three contains sample agendas for each option.

Sharing Science Goals and Learning Objectives

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

- Gain greater appreciation for the importance of engaging in science and engineering education and outreach with members of the broader community.
- Gain an understanding of the kinds of approaches that are effective at engaging people in free-choice learning environments.
- Develop skills for engaging non-experts in discussions about science and engineering goals, processes, and outcomes.
- Develop skills for using hands-on demos to stimulate inquiry-based learning and discussion.
- Understand the factors that go into designing effective hands-on demo activities.
- Become further involved with education and outreach in their communities.

Specific learning objectives include:

- Tailoring science communication content and approaches 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.

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Section Two: Planning your *Sharing Science Workshop & Practicum*

Participants

The *Sharing Science Workshop & Practicum* was developed primarily for early-career researchers (graduate students, post-doctoral fellows, 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 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, the Workshop can be extended to ensure all participants get sufficient practice and receive appropriate feedback. Additional mentors/facilitators may be required as well. We recommend breaking groups larger than 24 into two cohorts and offering the Workshop & Practicum twice.

Recruitment

These workshop and practicum experiences are fun and useful, and can get quickly oversubscribed. We normally arrange in advance to provide the service for a particular research center, laboratory, or company, with a particular number of participants in mind, based on space, staff, and budget. If the SSW&P is being offered to a large pool of people, but spaces are limited, we use an online application form to help select participants for the upcoming program. (A "Sample Application Form" is included in Section Five.) Typically, we ask the applicant to indicate whether they can commit to attending the full Workshop and Practicum dates and times, and to volunteering at a follow-up outreach event, where they can practice their new skills with supervision. We ask them about their motivation for participating. And, we ask them about their prior experience working in science and engineering education and outreach. (The application form and the Pre-Workshop survey can also be merged.)

Workshop Leaders and Facilitators

With a small group of 5-7, a single, well-organized Workshop leader can run a solo facilitation, but we recommend including at least one additional experienced staff member, faculty mentor, or graduate student per 5-7 additional participants, in order to facilitate the small group work that is key to the success of the Workshop. For example, with a group of 24 participants, you'd want three additional facilitators. The first portion of the Workshop (Sharing Science through Words) includes a small group activity that can be done either in groups of 5-7 participants, each with a facilitator, or more expeditiously, in groups of 2-3, with no 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 or three groups at a time. All the facilitators should be familiar with the Workshop design, content, and the demos being used. Adjust the timing of the agenda according to the size of the small groups.

Room Requirements

The ***Sharing Science Workshop*** is best held in a large room, with sufficient space for up to 30 adults, and 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 and engage in conversation, without too many distractions. A projector and screen are need for the slide portion of the Workshop. Ideally, there's also space for a lunch buffet and trash, with bathrooms nearby.

The ***Sharing Science Practicum*** location depends on your setting – 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 programs can bring their tables and demos to a dedicated area at a science fair, a university lab or classroom, or even a shopping mall – anywhere where families with time on their hands can be found.

Demo Materials

Since Workshop participants practice with already well-vetted hands-on demos, it is critical to have sufficient materials on hand for the demos. The NISE Network's NanoDays kits (http://www.nisenet.org/nanodays) are ideal to use for this purpose, but you can also use any other well-vetted, hands-on demonstration activities, for which you have the materials and experience. (In later workshops with participants who have already mastered *Sharing Science* we explore the design and development of 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 proved sound, so that the participants have only to concentrate on their mastery of the engagement process with visitors.) Make sure you are well-stocked with the necessary materials and accessories for each demo, including written instructions, so that participants can learn the demos on their own, without needing to be personally 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 & Practicum Materials and Amenities

Each participant receives a nametag upon arrival. Usually, the nametag is pre-marked with a color, number and/or letter code that discretely indicates their small group assignments. 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 be served as a mid-day break 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. If there are a lot of materials to hand out, pre-collated packets can be distributed. We prefer to hand out things as needed. Ensure there is plenty of fresh water available during both Workshop and Practicum; presenting demos and talking with visitors for extended periods of time requires frequent hydration!

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. (We often use our NanoDays t-shirts.) 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 volunteers for your organization.

We provide buttons saying "Hi, I'm an engineer" and "Hi, I'm a scientist," and we further identify the group by having a greeter, and/or a sign on a stanchion that identifies what is happening in this area and what universities, companies, or research centers the volunteers represent. The buttons and the sign can encourage teen and adult visitors to ask questions of the volunteers about their own research activities. That's one reason it is helpful to have pairs of volunteers assigned to each demo; the partner can take over working with the group in line.

Visual Documentation

Take a few photos of the participants engaged in activities at your Sharing Science Workshop & Practicum. The photos will be quite useful for you and your university or company partners when you report on your work together. Have the appropriate institutional photo releases handy.

Budgeting

The most expensive budget item is your time and the time of the other Workshop & Practicum leaders and facilitators. 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 with an event budget, costs for the Workshop & 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 and photo releases to be made.

Evaluation

Evaluation of your Workshop & Practicum is not essential, but highly recommended. We know the SSW&P 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 also discover some low-cost, high-benefit modifications you can make to better serve your participants the next time you offer the Workshop & Practicum. See Section Six (Evaluation) for further guidance on evaluation, a summary of past findings, and sample evaluation instruments. The Digital Appendix includes editable versions of the sample evaluation instruments we have used. There is a pre- and a post-survey for the Workshop & Practicum. There is also a post-survey for a follow-up outreach event involving the participants as volunteers, such as a NanoDays event. Most recently, we have been moving toward using online surveys. This is particularly helpful for the pre-Workshop survey, because it allows us to begin the Workshop right away with an immersive activity, the Meet & Greet.

Preparing Participants for the Workshop & Practicum

About a week before the Sharing Science Workshop (or Workshop & Practicum), we send all the participants a welcoming email letting them know what to expect, with specific information about start and end times, travel, parking, food, and other logistics. (A "Sample Preparatory Email" is in Section Five.) We include our contact information for their day of arrival, and we include a link for the brief online "Pre-Workshop Survey" (see Section Six) which we ask them to complete a few days before the Workshop to help us understand their prior experience and current interests. We also ask them to prepare for the Meet & Greet role-playing exercise that will begin the moment they get their nametags and walk into the Workshop space. They are to prepare in advance a 30-second introduction to themselves and their work that would be suitable to use at a broadly interdisciplinary scientific workshop or conference, where they would not be likely to meet many fellow specialists in their field of expertise. This elevator-speech-style exercise gets the participants thinking in advance about more accessible and engaging ways they might talk about their research than what they might ordinarily use with experts in their field. The role-play begins when they get arrive in the room, and it also doubles as an ice-breaker and intro session.

Sharing Science Workshop & Practicum Planning Timeline

DATE / PHASE	ACTIVITIES	OUTCOMES
2 -3 months before Workshop **Strategic Planning** Science museum and university faculty or industry partners coordinate plans, goals, and schedules for the Workshop and Practicum.	- Confirm decision to hold Workshop & Practicum as a one-day or two half-day events and determine optimal timing (e.g., 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 number of participants, scheduling, long-term goals, budget, and funding. - Adjust agenda as appropriate. - Book Workshop and Practicum spaces. - 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.
5-6 weeks before Workshop **Advance Preparation & Recruitment**	- Email and post recruitment fliers with links to an online application form (unless it's a small group). - Recruit facilitators, if needed for larger group. - Order t-shirts/buttons (optional). - Review kit demos and replenish supplies if necessary. - Take care of logistics (space, equipment, food, materials, floor plans signage, permissions).	Everything that requires third-party commitments and resources is put in place ahead of time.
2-4 weeks before Workshop **Preliminary Preparations**	- Notify selected participants at least three weeks in advance, option to send link to pre-survey. - Finalize agenda. - Finalize presentation materials and hand-outs. - Draft welcome and instruction email for participants. - Finalize pre-workshop survey if using one.	Everything that can be done ahead of time is completed to avoid last-minute stress.
1 week before Workshop **Final Preparations**	- Communicate with participants and facilitators regarding pre-survey and logistics for the day (directions, parking, timing, meals, rules, dress code). - Pre-assign participants into small working groups for the various Workshop activities (unless it's a small group). - Make nametags, coded with group assignments. - Finalize Post-Workshop surveys, if using them - make copies or make online versions. - Analyze pre-survey results and what might be useful to report out to the participants. - Make photocopies of handouts and sort into packets.	Everything is ready to go before the day of the Workshop.
Day of Workshop & Practicum	- Your participants arrive! - See the Agendas and notes on making this a great day.	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 the next iteration. - Email participants follow-up note, sharing appreciation for their efforts, advice on next steps, opportunities for outreach, OR remind students of schedule for upcoming Practicum session if splitting them into two days. Include link to post-Workshop survey if administering it online. - Analyze survey data.	Outcomes and ideas for improving future iterations have been gathered and analyzed.
One to two weeks later…. ***Optional* Separate Sharing Science Practicum**	(See sample Agendas and notes for this alternate version and adjust pre-planning accordingly.	Participants have had the opportunity to hone their skills with real visitors.
Days following Practicum ***Optional* Post-Practicum Assessment**	- Debrief with Practicum facilitators on Practicum experience and outcomes. Note what worked and what could have worked better and jot down ideas for the next iteration. - Email participants follow-up note, sharing appreciation for their efforts, advice on next steps, reminding them of the upcoming opportunity for outreach. Include link to post-Practicum survey if administering it online. - Analyze survey data.	Outcomes and ideas for improving future iterations have been gathered and analyzed.
Next education outreach event **SSW&P Workshop & Practicum graduates successfully engage audiencs with hands-on demos and discussion.**	- Plan to include SSW&P participants. Give them advance information and instructions. Prepare spaces and tables for them to work. Prepare signage, nametags, t-shirts, buttons. Have plenty of supplies. Credit them in printed materials associated with the event. - Informally debrief with students about their experiences and their sense of preparedness and confidence. (This could also be accomplished through a paper or online survey.) Let them know about other opportunities to volunteer. - Informally debrief with staff and faculty mentors on outcomes observed. Make notes on ideas for improvement in next iterations.	Participants are now prepared to apply their public engagement skills in a variety of broader contexts. Many are interested in continuing to participate as volunteers in museum or other outreach activities.
Months following SSW&P experience **Stakeholders Analysis**	- Stakeholders (e.g. university faculty, science museum partners) analyze data and share outcomes, photos, and reporting materials. They contemplate next steps to furthering the partnership and the contributions they can make to science education and outreach.	A collaborative learning community has been established.

Materials Lists for the *Sharing Science Workshop & Practicum*

Note: All written materials and hand-outs are included in Section Five of this Guide. Customizable electronic versions and an optional set of PowerPoint slides can be found in the Digital Appendix on the accompanying DVD. All are also available for download from *http://www.nisenet.org/catalog/tools_guides/sharing_science_workshop_practicum or from nano@mos.org.*

For the Workshop

- Nametags (marked with pre-assigned small groups).
- Large workshop room with tables and chairs, trash cans.
- MP3 or CD player and walk-in music (optional).
- Laptop, projector, and screen for optional PowerPoint slides.
- Post-it notes, whiteboards, or easel stands and pads for recording ideas during group discussions and debrief.
- Instructions/Guidelines for facilitators.
- Pre- and Post-Survey Instruments (online or on paper).
- Participant handouts:
    - "The Nanoscience Demonstrator's Guide"
    - "Additional Resources for Nanoscience Education and Outreach"
    - Optional Museum Map and Schedule
- Pens, pads.
- Demo and script for the "*Demo Demo"* activity.
- Hands-on demo kits, boxed or packaged with all necessary materials and instructions. (From NanoDays kit* or other similarly vetted demo kits).
- Coffee, breakfast, lunch, refreshment items, depending on time of day. Water.
- Camera for documenting Workshop activities.

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 demo kits).
- Demo staging area behind the scenes for pre- and post- discussion, and where participants to leave their belongings. Post-it notes, whiteboards, or easel stands and pads for recording ideas during group discussions and debrief.
- Demo area set-up in public space, with tables, tablecloths, signage.
- Coffee, breakfast, lunch, refreshment items, depending on time of day. Water.
- Camera for documenting Practicum activities.
- Post-Survey Instruments (online or on paper).

*For info on NanoDays kits: http://www.nisenet.org/nanodays
As of November 2014, 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/NanoDays-2014-digital-kit

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Section Three: Sample Agendas

OPTION ONE
WORKSHOP & PRACTICUM *ON THE SAME DAY*

Note: *Hosting the* Sharing Science Workshop & Practicum *on the same day can be more efficient than spreading it over two days, especially if significant participant travel is involved, or if it's difficult to coordinate schedules for two separate sessions. In the single day version, you will be arranging logistics for two spaces – the workshop/debrief space and the museum floor or other public outreach space, where you can supervise participants as they practice with visitors. You'll want to time the Practicum to occur when visitor spaces are fairly busy, so there are lots of people for the trainees to work with. The day will be very full, and we recommend building in morning coffee, lunch, refreshments, and break times. Times below are approximate, depending on group variables. The PowerPoint slides and movies are in the Digital Appendix.*

Morning Workshop

9:30 Arrival Time and 'Meet & Greet' Role-Play

Preparation Notes: Instructions for the 'Meet & Greet" role-play will have been sent out to participants ahead of time. (See Section Two, "Preparing Participants for the Workshop & Practicum," and the "Sample Preparatory Email for SSW&P Participants in Section Five.) Greet participants as they arrive. (If needed, have a greeter in the lobby and/or instructions for where participants should proceed.) Ask everyone to turn off their smart phones. If using the Meet & Greet stand-up role-playing exercise, remind the participants to assume their conference role-playing mode the minute they walk into the room. It's nice to have walk-in music in the Workshop space, and coffee and refreshments if possible. Mingle with the participants, joining in on the role-play.

9:50 Sharing Science with Words: Introduction

(More detailed leader notes on this section are in Section Four.)

- Why are we here? Review Workshop goals.
- Role of communication in science.
- Critical importance of science education and outreach.
- The Science Communication Continuum.
- *(If there is time)* Exploring the essence of face-to-face communication:
    - Being there
    - Voice, body, gesture: Landing a point
    - Who is the audience? Language choice and emphasis adjustment
    - Why should I care? Context and meaning.
    - Using what's available – props, analogies, etc. Using a "hook."

10:00 Preparation for next activity: Introducing Oneself and One's Work to Younger Folks

- Take your professional intro and make it into an introduction you might use for a group of very polite twelve-year olds interested in science. Find a way to engage the 12-year

olds in the research that you do. You may begin any way you want. But the whole thing should be under a minute long.

- Hint: you may try to connect to your audience by sharing the motivation for your work – connecting it to something the audience might know and care about – or a phenomenon they might be familiar with in some way.

- **Give participants a minute or two to prepare this.**

10:10 Directions for the activity

- *Note: We typically pre-assign the participants to groups of 3, or groups of 4-5, sometimes with facilitators for the groups. If we can, we mix together people who work in different fields. (Nametags should be coded for pre-arranged groups)*
- Each participant will take 30-60 seconds to introduce themselves and their research to the group, as if speaking to a group of well-behaved 12-year olds. Their goal is to engage their interest. Depending on how much time you have for this activity, listeners may engage with the speaker for up to a minute beyond their introduction.
- After a minute or two, the listeners should provide up to a minute of feedback each to the speaker, if the speaker requests it. We counsel participants that they should be supportive and suggest any ideas they may have about how to improve their approach. (It could be that they should make more eye contact, or smile, or talk slower, or it could be that they used some words that were too technical, or it could be that they have a suggestion for how they might provide a better context to help the twelve-year-olds connect to or care about what they are working on.) Then, the group moves on the second speaker.
- *Note: Some people are shy about giving suggestions or feedback, however most participants would really rather receive constructive feedback in a relatively safe environment like this, then when they're on the spot in a higher stakes setting. So we encourage them to ask for permission to give feedback and then be very helpful.*
- Instruct participants how to find the code on their badge for the small group activity, and have them self-assemble. Let them know that if they when they finish this round, they can start working on a revision of their introduction, based on the feedback they received.

10:15 Activity: Introducing Oneself and One's Work to Younger Folks

- *Note: Participants really enjoy doing two rounds of this activity, and it gives them a chance to apply the feedback they receive and give it another shot. Timing can be tricky. You may want to cue the groups during each round when they should be on their second, third person, etc. In between rounds, give them a few minutes to revise their introduction. Mix up the groups for the second round by having each group send one (if groups of three) or two (if groups of four or more) on to the next group. That way there will be some "fresh ears" as well as others who will understand how it's changed since the last time. The length of this activity is entirely dependent on the number of people in each group, so you will need to adjust your agenda accordingly.*
- Round One, revisions, then Round Two, if there is time.
- Group Debrief

- Reinforce the characteristics of good introductions or "elevator speeches."
- Discuss how participants can continue working on these beyond this day, and how helpful it will be to have several different types of introductions suitable for use with several different audiences.

10:40 Break. Let participants know what's coming next. Set-up room for next activity.

10:50 Sharing Science with Hands-On Demonstrations: Introduction

- Why do hands-on demos? (Optional clip from "The Office" in PowerPoint)
- Topics to cover: Inquiry-based learning; elements of a successful hands-on demo; strategies for creating a positive visitor experience; what visitors bring to the experience. Let's start with a demo of a demo facilitiation…

11:00 The *Demo Demo* *(aka, how it should* not *be done)*

Straight-faced, the Workshop leader announces that he/she or another experienced museum educator is going to role-play the part of engaging a young visitor with a hands-on demo activity. Then he/she acts out a terrible hands-on demo 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 Section Four of this guide*** *– the skit can be easily be adapted for use with any of the NanoDays kit demos, or others. Mistakes that the presenter should try to highlight include: being distracted, texting or on the 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, making the visitor feel stupid, not providing a satisfying closure to the experience, etc. Be creative! The worse it is, the better it will be! Students catch on quickly and enjoy the spoof.*

11:10 *Demo Demo* Debrief

- Participants debrief in small groups or all together, identifying all the ways the *Demo Demo* demonstrator failed the visitors. Which were the worst? Ask members of the group to call out the errors, repeating them and adding context as needed.
- 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 a visitor?
- Participants watch the video clip "Lauren Tests Her Prototype" (in the PowerPoint slides) and discuss the strategies she used - what worked well? What could be improved? What role did the parent play in the interaction?
- Participants review the checklist provided – "The Nanoscience Demonstrator's Guide"

11:20 Hands-On Demonstrations - Independent 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). *(We often try to assign demos and participants based on their relevance to research group interests.)* Leader gives instructions to begin by reading the demo guide, reviewing materials, and then crafting an approach.

- Each group spends about 20-30 minutes exploring their assigned demo and coming up with ways to use it with visitors. The workshop facilitators check in with each group to offer guidance and discuss questions that arise.

11:50 Rotation – Presenting Demos, Experiencing Demos, Offering Feedback

- 11:50 – 12:10 – Rotation 1. Half the student participants act as demonstrators, while the other half rotate through the other demo stations acting as visitors, experiencing each demo and offering constructive feedback.
- 12:10 – 12:30 – Rotation 2. Demonstrators and visitors switch roles.

12:30 Lunch Break - Debrief and Discussion

Boxed lunches or lunch buffet is ideal, to save time, and so group can stay in the room.

- Lunch groups may be encouraged to discuss their experiences, and to speculate what might be different when they move into the demonstration space and begin working with family groups and youngsters.

Afternoon Practicum

1:15 Instructions and Orientation

- The group is briefed on what will happen during Practicum in thepublic location with actual visitors. Remind participants that they may have an opportunity to use their 30-second introductions if they get asked about their own research. Review any important policies/expectations for volunteers working with visitors and what to do in the event of an emergency. Pass out identifying t-shirts, lab coats and/or buttons if you have them.
- The group brings demo materials to set up in public area, and gets oriented to locations of entrance, exit, bathrooms, info desk, etc. (We assume here that tables and tablecloths and signage have already been set up for this purpose.)

1:30 Hands-on Demos with Visitors

- Two participants assigned to each demo station begin engaging with visitors; if there is a third participant, the three can rotate in and out every 20 minutes or so, observing what is happening around the entire demo area.
- Facilitators move around and observe each group at work, provide back-up support and guidance, and field any questions people may have about what is happening in this space.

3:00 or 3:30 Clean Up and Debrief

- Participants help organizers pack up demo materials and clear the area. Return to workshop room or staging area. Have refreshments handy! Five questions for reflection are written atop wide four columns on whiteboards or on four easels or large poster-size post-it notes:

- Q1 What did you like best about the experience of working with visitors? ☺
  - And, halfway down: What did you like least? ☹
- Q2 Did anything about this experience surprise you? If so, what?
- Q3 Which techniques/strategies did you find particularly effective?
- Q4 What suggestions do you have for improving your demo? (include demo name)

- Optional: advise participants to begin with a silent reflection on their Practicum experience. Consider the five questions on the board. Write one or more responses to each on post-it notes and place it under the associated topic question. (These comments can later be recorded by the facilitators to use in their evaluation and reflection efforts.)
- Workshop leader facilitates discussion of each question asking people to chime in with their thoughts/experiences. Prompts may include: 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 ideas did they come up with (if any) about making new hands-on demos related to their own research? (Sometimes we tack on a brainstorm session so participants can start to imaging designing hands-on demos about their own research areas.
- What's next? Hand out the resource lists, and discuss how participants can continue their practice and involvement.
- Congratulate them.
- Ask participants to fill out a paper Workshop Post-Survey, or to respond to one to which they'll soon receive an emailed link.

4:00 or 4:30 Adjourn.

OPTION TWO
WORKSHOP & PRACTICUM *ON TWO DIFFERENT DAYS*

Day 1 Agenda: SHARING SCIENCE WORKSHOP

THIS HALF-DAY WORKSHOP CAN BE HELD EITHER IN THE MORNING OF THE AFTERNOON. TIMES BELOW ARE FOR A MORNING EVENT. IF TRANSLATING TO AN AFTERNOON EVENT, SHIFT TIMES ACCORDINGLY (e.g. 12:30-4:30). YOU MAY BEGIN WITH A WORKSHOP LUNCH, AND, INSTEAD OF USING THE MEET & GREET ACTIVITY STAND-UP STYLE, ASSIGN PARTICIPANTS TO TABLES AND HAVE THEM DO IT SEATED, OVER LUNCH.

Morning Workshop

9:30 Follow the Morning Agenda for Option One – the one-day version of the Workshop & Practicum. Extend the lunchtime discussion as follows…

12:30 Lunch Break - Debrief and Discussion
Boxed lunches or a lunch buffet is ideal, so group can stay in the room debriefing over lunch.

- Lunch groups are advised to discuss further what they learned about engaging visitors in their demo and what they learned from visiting others, as well as ideas for improving the demos. What might be different when they move into the demonstration space and begin working with family groups and youngsters?

- Brief them on the logistics for the Practicum and what they can expect to happen during the Practicum in a museum exhibit hall or other public location with actual visitors.

- Remind participants that they may have an opportunity to use their 30-second introductions, and to continue working on various versions of those, suitable for various audiences.

- Suggest they think about ways that they might design a demo that introduces kids and adults to important aspects of their own research areas.

- (Optional) Ask participants to fill out paper feedback surveys or an online survey.

- (Optional) Invite them to enjoy some more time at the museum if they can…

1:30 Adjourn

Day 2 Agenda: SHARING SCIENCE PRACTICUM

THIS HALF-DAY PRACTICUM CAN BE HELD EITHER IN THE MORNING OF THE AFTERNOON. HAVE EVERYONE COME TO A MEETING ROOM OR STAGING PLACE, WHERE THEY CAN LEAVE THEIR THINGS, WARM UP, BE BRIEFED AND PREPARE TO MOVE OUT TO THE PUBLIC SPACE WITH THE DEMOS. TIMES BELOW ARE FOR AN AFTERNOON EVENT. IF TRANSLATING TO A MORNING EVENT, SHIFT TIMES ACCORDINGLY (e.g. 9:30-1:30). CONSIDER BEGINNING WITH MORNING COFFEE OR MIDDAY LUNCH, TO MAKE SURE EVERYONE IS FORTIFIED FOR THE EXPERIENCE, WHICH GENERALLY REQUIRES A LOT OF ENERGY!

Afternoon Workshop

Follow the Afternoon Agenda for Option One - the one-day version of the Workshop & Practicum. Modify the opening as follows…

12:30 Arrival Time and Lunch

Preparation Notes: Greet participants as they arrive. (If needed, have a greeter in the lobby and/or instructions for where participants should proceed.). It's nice to have walk-in music in the meeting room or staging area with coffee and lunch if possible. Ask them to turn off their smart phones.

12:45 Instructions and Orientation

- Welcome everyone and brief them on what will happen during the Practicum and what else is happening in that space. Review any important policies/expectations for volunteers working with visitors and what to do in the event of an emergency.
- Review with them some of the comments they made about what they learned during the Sharing Science Workshop (from the Post-It note exercise and/or the post-Workshop survey.
- Advise them to warm up by brushing up their 30-second introductions for 12-year-olds with each other.
- See if there are any questions.

1:15 Transition

- Pass out identifying t-shirts, lab coats and/or buttons, if you have them.
- Lead group in bringing demo materials to set up in the public area. (We assume here that tables and tablecloths and signage have already been set up for their use.)
- Orient the group to key locations, such as entrances, exits, bathrooms, info desk, etc.

1:30 Hands-on Demos with Visitors

…. Proceed with the rest of the Afternoon Agenda for the one-day version of the Workshop & Practicum.

SHARING SCIENCE WORKSHOP & PRACTICUM

Planning & Implementation Guide, v. 3.0

Section Four: Sample Workshop Leader Commentary

Sample Workshop Leader Introductory Talk on Sharing Science with Words

This is an edited transcript of the introductory parts of a Sharing Science Workshop led by Carol Lynn Alpert at the Museum of Science. 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. The 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

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?]

Sample Workshop Leader Introductory Talk on Sharing Science with Hands-On Demos

This is an edited transcript of the introductory parts of a Sharing Science Workshop led by Karine Thate at the Museum of Science. It is provided as a sample and as a rough guide to help other Sharing Science Workshop leaders prepare their own approaches. The optional digital slides are included in the PowerPoint on the Digital Appendix on the DVD or available online at http://www.nisenet.org/catalog/tools_guides/sharing_science_workshop_practicum .

This part of the workshop focuses 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 the (*really bad) DEMO DEMO*

This is based on the UW Madison MRSEC demo "Atomic Trampoline,"
but can be adapted to any well-designed demo.
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…

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Section Five: Supplemental Materials, Resources, Handouts

Coaching Advice for Facilitators & Mentors

Before the Workshop & Practicum, take some time with the staff, faculty or graduate students who will be helping with facilitation 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 in this aspect, with facilitators being the last to comment.

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 should have about 30 minutes to learn their demo. Give them a few minutes to Explore the materials on their own and see if they 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 engage visitors with their demo. Help them identify when they are using vocabulary that's too complex, or where an analogy could be helpful. Remind them to listen closely and catch cues from the visitors: it's not about getting across a lot of content; instead, it's about providing the opportunity to the visitor to explore and discover and experience an investigation of their own.

- After the 20-30 minutes, instruct half the group to stay at their demos and the other half to act as visitors circulating among the demos. After the first group of demonstrators get some practice and feedback, the two groups can switch roles. As Workshop Leader or Facilitator, try to hold your own 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.

Sample Sharing Science Workshop & Practicum Application

Learn how to engage public audiences with inquiry-based learning strategies and hands-on demos. This special "Sharing Science Workshop & Practicum" on [date] will give students and faculty an opportunity to develop skills for education & outreach, and practice them with members of the public. Please complete the application below by [date].

1. Your Name: _____

2. Your Institution: _____

3. Your Position:

- ○ **Undergraduate Student**
- ○ **Graduate Student**
- ○ **Post-Doc**
- ○ **Faculty**
- ○ **Staff**

4. Can you attend the full Workshop & Practicum?

	Yes	**No**
[*Date/Time*]	○	○

5. Can you attend the follow-up [outreach event]?

	Yes	**No**
[*Date/Time*]	○	○

6. Why do you want to participate in this Sharing Science Workshop & Practicum?

Thank you. We notify applicants by [*date*].

Sample Preparatory Email for SSW&P Participants

(send out about a week in advance)

Dear [*Name*],

This email is to prepare you for your upcoming Sharing Science Workshop & Practicum on [*date*]. This event is designed to give you a well-grounded experience using hands-on demos to stimulate informal science learning discussions with children and parents. We will also be providing you with lunch, and afternoon refreshments. Please let us know if you have any dietary restrictions.

Travel to [*Location of Workshop*]
The Sharing Science Workshop & Practicum will be held at [*address*]. Here is link to directions: [*link*]. [*Include any extra relevant detail on getting to your institution by public transit, where to park, etc.]*

Arrival
Please arrive by [time]. [*Include any extra relevant detail on where to meet upon arrival.]*

Morning Workshop
The workshop begins with a role-play the moment you walk into the workshop room. Wearing a nametag, you will circulate among the other participants, greet them, and introduce yourself with a 30-second "elevator speech" about your research, as if you are networking at an interdisciplinary research conference. We recommend you prepare your self-introduction in advance – target it for someone with a good understanding of science but no special experience in your area - and practice it aloud. That's all the preparation you need to do. After that we will delve into inquiry-based learning with hands-on demos.

Afternoon Practicum
We will break for lunch around midday (box lunches will be provided), and then we will move all our materials to the [*location of practicum*], and begin to work with families visiting the Museum. After about two hours working with visitors, we will pack up our materials and engage in a debriefing session with refreshments.

End of Day
We will wrap up by the workshop by [*time*].

Survey
Please use the link below to respond to a brief survey that will help us best tailor the workshop to the needs of the group. The survey should take 5-10 minutes and is due on [*date*].
[*Link to Pre-Workhshop survey*]

We look forward to seeing you!

Workshop Activity Guides and Handouts

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

Included:

- **Lunch Table Activity sign** (optional)
  This is to use if the opening Meet & Greet portion of the Workshop is to be held at tables rather than in a stand-up reception-style mingling. 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 Nanoscience Demonstrator's Guide"**
  You will hand this out when called for during the Workshop. You may want to distribute fresh copies of this to the participants if they return for a separate Practicum day, or to refresh them at a further education outreach event like NanoDays.

- **"Resources For Nanoscience Education and Outreach"** printed back-to-back with **"Resources about Learning in Free-Choice or Informal Settings"**
  Distribute at the end of the day.

- Evaluation forms are included in Section Six.

GROUP 1

Welcome! This Workshop begins with introductions of yourselves and your research, over lunch at your tables.

Instructions:

- Take turns introducing yourselves, including:
  - Name, year, grad school and department
  - The focus of your research within the overall context and motivation of your research area. (What larger societal challenge may it help to address?)
- Ask each other not-too-technical questions, but don't get bogged down focusing on just one or two people in the group. Make sure everyone gets a turn!
- When it's your turn, practice making eye contact with each person at your table as you speak.

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?**

- **NISE Network** - http://www.nisenet.org/ (click on Programs and Activities on the top menu)
  A searchable 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. Their companion site geared at public audiences also has resources - it can be found at http://www.whatisnano.org.

- **NISE Network Content Map**
  http://www.nisenet.org/catalog/tools_guides/engaging_public_nano
  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.

- **Exploring the NanoWorld Activities & Resources**
  http://education.mrsec.wisc.edu/index.htm
  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/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.

- **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.

Sharing Science Workshop & Practicum

Resources about Learning in "Free-Choice" or Informal Settings

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.

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Section Six: Evaluating the *Sharing Science Workshops & Practicum*

The SSW&P was initially developed over a six-year period, from 2005-2011, with ongoing formative evaluation and iterative 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 the workshop and practicum combined in a single day in 2011. Participants of both workshops 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. The findings for the two versions were not significantly different.

Beyond those two evaluation studies, we have continued to survey all participants of the Sharing Science Workshop & Practicum through 2014 to ensure further refinements to the model continue to support its effectiveness. We also survey participants after there experience volunteering at NanoDays events. Overall impressions of the Workshop & Practicum have been and continue to be 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.

<u>From the 2009 two-day Workshop and Practicum post-survey:</u>

- 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 to 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.

<u>From the 2011 single day Workshop and Practicum post-survey:</u>

- 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 & Practicum had prepared them very well for doing outreach with museum visitors at the event.

Of the 76 additional Sharing Science Workshop & Practicum participants we have surveyed between 2012-2014:

- 87% rated the workshop session as "very useful."
- 93% reported increased confidence in engaging public audiences in conversations and science demonstrations.

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 & Practicum. 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.

On the following pages, we are providing generic sample copies of survey instruments we have used. You may adapt 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. 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 the rights of those human subjects involved in research and evaluation. (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 the Digital Appendix accompanying this guide.)

- Pre-Survey for a Workshop + Practicum combo day
- Post-Survey for a Workshop + Practicum combo day
- Post-Survey for volunteer participants at a follow-up outreach event (NanoDays)

Sharing Science Workshop & Practicum
Pre-Workshop Survey

Hello. We are looking forward to working with you at the upcoming Sharing Science Workshop & Practicum. Please take 5-10 minutes to respond to a few survey questions, so that we can be attentive to the needs of the group. (There are no right or wrong answers.) Your individual responses will remain confidential.

1. **What is your institutional affiliation?** _____

2. **Have you previously participated in volunteer science education and outreach activities?**

No	Yes, once	Yes, 2-3 times	Yes, more than 3 times
❑	❑	❑	❑

2a) If yes, please briefly describe the nature of these activities.
If no, please skip to #3.

2b) What have you found most rewarding about participating in these activities?

2c) What have you found most difficult or frustrating about participating in these activities?

3. What do you most want to get out of the Sharing Science Workshop & Practicum?

4. Please rate your level of interest in:	**Not likely**	**Slight interest**	**Moderate interest**	**High interest**	**Definitely doing it**
Participating in volunteer science education and outreach activities during the next year or two.	❑	❑	❑	❑	❑
Developing a hands-on demonstration for education and outreach related to your own area of research.	❑	❑	❑	❑	❑

Thank you. We look forward to seeing you.

Sharing Science Workshop & Practicum
Post-Workshop Survey

Thank you for participating in the Sharing Science Workshop & Practicum. Please take 5-10 minutes to respond to a few survey questions, so that we can get a sense of your thoughts about the experience. There are no right or wrong answers. Your individual responses will remain confidential.

1. What is your institutional affiliation? _____

2. What did you like best about the Sharing Science experience?

3. What did you find most surprising about working with Museum visitors?

4. What were the big "take-home" lessons of the day for you?

5. Please rate your level of interest in:	**Not likely**	**Slight interest**	**Moderate interest**	**High interest**	**Definitely doing it**
Participating in volunteer science education and outreach activities during the next year or two.	❑	❑	❑	❑	❑
Developing a hands-on demonstration for education and outreach related to your own area of research.	❑	❑	❑	❑	❑

6. Please rate your level of agreement with the following statements:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I enjoyed engaging Museum visitors with hands-on demos and discussions about science.	❑	❑	❑	❑	❑
Working with visitors was personally rewarding.	❑	❑	❑	❑	❑
Adult visitors showed interest in me and my research.	❑	❑	❑	❑	❑
I felt prepared to answer questions about my research in a way visitors could understand.	❑	❑	❑	❑	❑
As a result of this workshop, I have more confidence speaking about my research with non-scientists.	❑	❑	❑	❑	❑
I came up with a good idea about how I might design a demo related to my own research.	❑	❑	❑	❑	❑
I'd recommend this workshop to my peers.	❑	❑	❑	❑	❑

7. What modifications would you suggest for future versions of this workshop?

8. Please feel free to share any other comments you may have.

Thank you. We look forward to working with you again.

NanoDays Volunteer Survey

Thank you for participating in our NanoDays event. Please help us improve future events by providing some feedback. Your individual responses will remain confidential.

1. What is your institutional affiliation? _____

2. Have you previously participated in any…?	**No**	**Yes, Once**	**Yes, 2+ times**
"NanoDays" event	❑	❑	❑
"Sharing Science" Workshop & Practicum	❑	❑	❑
Other professional development on engaging broader audiences	❑	❑	❑

3. Please rate your level of agreement with the following statements:	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I had a good time at NanoDays today.	❑	❑	❑	❑	❑
I enjoyed engaging people with hands-on demos and discussions about science.	❑	❑	❑	❑	❑
NanoDays organizers did a good job coordinating my participation in this event.	❑	❑	❑	❑	❑
The expectations of my role were clear.	❑	❑	❑	❑	❑
This event has helped increase my interest in further involvement in education & outreach.	❑	❑	❑	❑	❑
I am interested in developing a new hands-on demo related to my area of research.	❑	❑	❑	❑	❑

3. (cont'd) Please rate your level of agreement with the following statements:	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
As a result of participation in the NanoDays events (and/or Sharing Science workshops), I have more confidence in speaking about my research to broader audiences.	❑	❑	❑	❑	❑
Participation in the NanoDays events (and/or Sharing Science Workshops) have helped me develop communication skills that will be useful in my career.	❑	❑	❑	❑	❑

4. What did you like best about today's experience?

5. Do you have suggestions for improving the activity you participated in? (If so, please describe).

6. Other comments or suggestions for improving the NanoDays event or your participation in it?

Thank you. We look forward to working with you again.

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Afterward: Beyond the SSW&P

We wish you every success in your future implementations of the SSW&P, and we encourage you to continue to adapt and improvise on the design and content to best suit your needs and those of your organization, partners, and community.

It serves all of us to bring together scientists and engineers, community members, educators, families, and children in sharing science, knowledge, still-unanswered questions, and the spirit of research and innovation.

As your collaborations with the science and engineering research community grow and deepen, you will undoubtedly find new ways of expanding your education and outreach efforts. Like us, you may find yourselves helping researchers communicate to their own broader audiences – colleagues in other fields who are less familiar with their areas of research. If so, you may be interested in the ***REU Science Communication Workshops Planning & Implementation Guide*** which provides step-by-step guidance for implementing a set of 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/tools_guides/reu_science_communication_workshop

We also suggest ***A Guide to Building Partnerships Between Science Museums and University-Based Research Centers***, which is available as a pdf or a glossy booklet at http://www.nisenet.org/partner_guide. This resource provides insight and step-by-step guidance in developing effective, productive, and funded education outreach partnerships with university-based research centers.

A few additional helpful resources are listed on the next page.

With all good wishes,
Carol Lynn Alpert & Karine Thate

Questions, comments, and suggestions for improvements to this Planning & Implementation Guide and to the Sharing Science Workshop & Practicum are encouraged and welcome. Please contact us at nano@mos.org. We also welcome inquiries about our consulting services.

Sharing Science Workshop & Practicum

Additional Resources for Sharing Science Workshop & Practicum Providers

The following NISE Network professional development resources for preparing volunteers to work with public audiences have been distributed in NanoDays kits and/or shared at Regional Meetings. There is some overlap and redundancy with the Sharing Science Workshop & Practicum – however, the SSW&P outlined in this guide focuses on preparing graduate students and early-career researchers (who already have a strong science background) for interactions with broader audiences, while the NISE Network resources outlined below are meant to be more generic for preparing any volunteer (of any age/with or without a background in science) for engaging public audiences with nanoscale science & engineering.

- **NanoDays Training Materials** - http://nisenet.org/catalog/tools_guides/nanodays_training_materials A suite of materials distributed with NanoDays kits to prepare volunteers and staff for a NanoDays event. Includes:
  - A generic slideshow to introduce volunteers to NanoDays
  - Tips for Engaging Visitors with hands-on demos (similar to *The Nanoscience Demonstrator's Guide*)
  - Tips for Visitor Conversations (about nano and society)
  - Videos and a Discussion guide on How TO and How NOT TO interact with visitors (similar to using the "Demo Demo" activity and the video of "Lauren Testing her Prototype Activity")

- **NanoDays Training Videos** - http://vimeo.com/album/2292889
  These videos give a brief orientation and explanation for all of the hands-on activities distributed in the NanoDays kits. These videos can be useful in preparing workshop facilitators by getting them familiar with how the demos work. If you assign students to particular hands-on demos in advance, you can give them a sneak peak at the demo and materials with this video (however, remind them they can/should explore their own ideas about how to lead the activity with visitors). We also use these as "refreshers" before a big event, like NanoDays, to remind students about the key components of their assigned activity.

- **Intro to Nano Training Materials** - http://nisenet.org/search/product_category/intro-to-nano-28
  For volunteers without a background in nanoscale science & engineering, the Intro to Nano video, the Nano 101 for Staff, and Engaging the Public in Nano: Key Concepts are helpful for providing a brief background on the subject at a level of detail that is appropriate for engaging public audiences.

- **Other Relevant Tools/Guides** – If you choose to expand your work with graduate students/early-career researchers to support them in developing their own hands-on demonstrations and activities, these tools/guides can be helpful:
  - Team-Based Inquiry Guide – to incorporate an element of evaluation (question/investigate/reflection/improve) into the process of designing a new activity.
  - Universal Design Guidelines – to create accessible programming.
  - Nanotechnology and Society Guide – to incorporate open-ended conversations with visitors about how new nanotechnologies can affect society into the learning process.

- **Portal to the Public** – http://www.pacificsciencecenter.org/Portal-to-the-Public/portal
  This program includes many professional development elements that help prepare scientists for face-to-face interactions with public audiences to promote an appreciation and understanding of current scientific research and its application.