SHARING SCIENCE:

Workshop & Practicum for Early-Career Researchers

Planning & Implementation Guide, v. 4.0

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Designed and produced at the Museum of Science, Boston

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NANOSCALE INFORMAL SCIENCE EDUCATION

Background & Acknowledgements Version 4.0

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SHARING SCIENCE WORKSHOP & PRACTICUM

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Digital Appendix (Available on accompanying flash drive or from nano@mos.org)

- E-version of this Guide, customizable agendas, invites, handouts, and surveys.
- PowerPoint slides and movies.

SHARING SCIENCE WORKSHOP & PRACTICUM

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Executive Summary

This guide provides information and resources for planning and hosting a *Sharing Science Workshop & Practicum* (SSW&P) 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 SSW&P 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 especially benefit from these face-to-face encounters with energetic and enthusiastic early-career researchers and graduate students from diverse backgrounds. Museums and other science outreach organizations benefit greatly from their skilled participation. Participating in the SSW&P can launch scientists and engineers into life-long engagement in education and outreach - 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, and funding for materials and staff time can be 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 flash drive with electronic versions of all these, plus the PowerPoint slides and movies. You may check for updates to Version 4.0 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."

Comments from Sharing Science Workshop & Practicum *Providers:*

"I received only positive feedback from the trainees on this experience. Many of them said the training was really helpful… a few expressed interest in coming back to the museum to deliver programming based on their research."

"They were more conscious of what the guest was getting out of the experience. I saw them adapt the demo to the guests they had in front of them and try out new things to expand the experience."

"I believe the training really enhanced the guest experience. The scientists seemed more invested in creating a good experience for the guest."

"The SSW&P Implementation Guide did a thorough job of laying everything out and providing resources and tips for making implementation straightforward!"

"Some of them had volunteered before, and there was a marked difference in their confidence level and abilities after the workshop."

"The workshop participants really enjoy the experience of working with the public and are invested in doing it well - they appreciate feedback, guidance and support."

"I had many comments from visitors that it was great to talk to real scientists."

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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 authentic face-to-face engagement with broader audiences. However, science and engineering expertise doesn't always translate to successful engagement in "free-choice" learning environments such as science museums, science festivals, and after-school enrichment programs. How can we better prepare scientists and engineers for effective and rewarding outreach experiences 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 and graduate students for successful interactions with youth and community audiences. The experience is streamlined so that participants can get 'up and running' after just one full day or two half-day sessions.

The SSW&P focuses on two skill areas:

- Sharing Science through Conversation – Introducing oneself and one's research using using simple terms and easy-to-understand language; focusing on motivation and relevance to solving mysteries and meeting challenges; encouraging questions and concerns. These skills also translate to networking with other scientists outside one's area of specialty.

- Sharing Science with Hands-on Activities – Exploring inquiry-based learning goals and techniques; engaging people of all ages to think creatively, ask questions, make hypotheses, test them, reason about results, and design further investigations. We use already well-vetted demo activities, so participants focus first on interaction and engagement; later, some choose to apply these lessons to designing new hands-on activities focused on their own research.

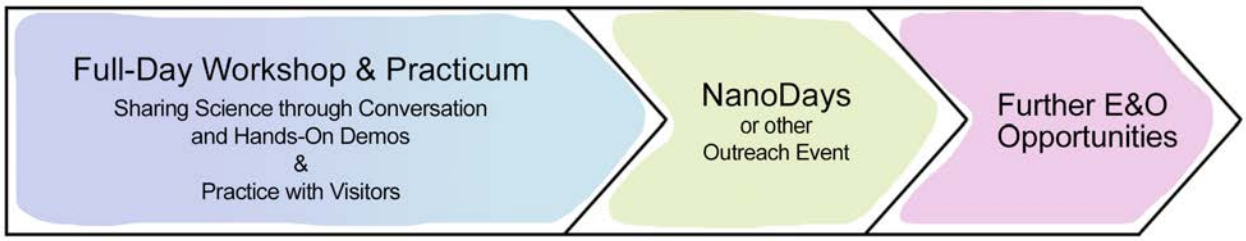
Evaluation results over several years of program research and iterative development show that participants find the SSW&P useful and enjoyable; they report increased skills and confidence engaging in conversations about science with broader audiences and increased interest in participating in education and outreach. The audiences engaged through these interactions reap many benefits as well.

Scheduling Options

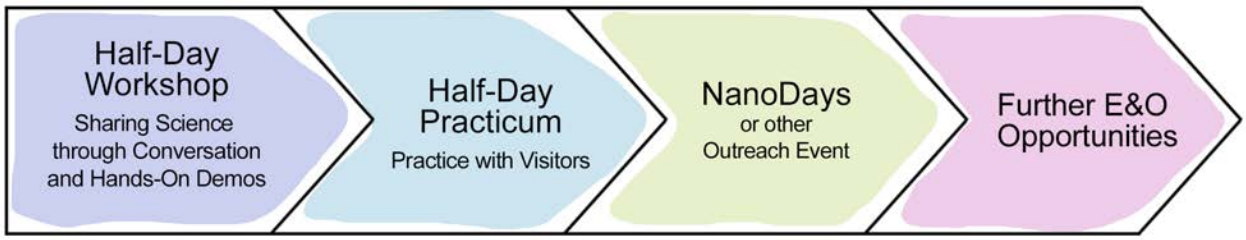
The half-day *Sharing Science Workshop* is lively, interactive, and hands-on, and takes place in a meeting room with flexible workspace. The half-day *Sharing Science Practicum* takes place in a science museum exhibit hall or other informal learning setting, where participants can practice

their skills with youth and adult audiences, with coaching from the workshop providers. We normally schedule the *Workshop* for the morning and the *Practicum* for the afternoon of a single day, typically a Saturday; however, the two parts can also be split into two or more separate sessions. Either way, it works well to cap the experience by inviting the SSW&P graduates back as volunteers at a special Education & Outreach event like NanoDays or a community science festival. We then periodically offer them further opportunities to contribute their skills at school and public outreach events; and, if they like, to become further involved developing new public engagement activities based on their own fields of study. These partnerships can sometimes lead to exciting new grant-funded collaborations.

Scheduling Option One



Scheduling Option Two



Hosting the *Sharing Science Workshop & Practicum* on a single day can be more efficient than spreading it over two days, especially if significant participant travel is involved or if coordinating schedules for two separate sessions proves difficult. In the single day version, you will be arranging logistics for two spaces – the private workshop room and the public outreach space or museum exhibit halls, where you can coach the trainees as they practice with visitors. The day will be very full; we recommend scheduling about 6 hours and building in morning coffee, lunch, refreshments, and break times.

When the *Workshop & Practicum* occur on separate days, it's best to schedule 3 - 4 hour blocks for each. If necessary, these can be shortened to 2 - 3 hour blocks by removing some of the activities, but try not to shorten the hands-on demo activity practice and rotations. The *Workshop* portion can also be provided on campus or close to where trainees work, although the demo materials will need to be transported there. Schedule the *Practicum* for 90 minutes or two hours at a time and place where there will be plenty of eager 'customers' with whom your trainees can engage before debriefing and solidifying what they have learned. While the *Practicum* can be merged with the follow-up outreach event, it's preferable to do it ahead of time, when you can provide more personalized coaching, reinforcing your trainees' skills and confidence. See a sample agenda for both *Workshop & Practicum* on page 9.

SHARING SCIENCE WORKSHOP & PRACTICUM
Goals & Learning Objectives

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

- Enjoy the rewards of becoming adept at sharing science with broader audiences.
- Realize the significant contributions one can make through science and engineering outreach.
- Explore 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.

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.

SHARING SCIENCE WORKSHOP & PRACTICUM

Sample Agenda

Morning Workshop

9:30 Welcome! 'Meet & Greet' Role-Play
Introducing yourself and your work

9:50 Introduction to the *Sharing Science Workshop & Practicum*
Theme One: Sharing Science through Conversation

10:00 Introducing Yourself and Your Work to Broader Audiences
Rapid Prototyping - Two Rounds

10:40 Brief Break
Transition to Theme Two

10:50 Introduction to *Sharing Science with Hands-On Activities*

The *(Really Bad)* Demo Demonstration
(*How NOT to do it)*

Debrief: What Went Wrong and Doing it Right

Lauren Tests her Prototype

The Hands-On Activity Facilitator's Guide

11:30 Exploring Hands-On Activities
Investigating materials and approaches

11:50 1st Rotation
Taking turns leading and experiencing

12:10 2nd Rotation
Switch!

12:30 Lunch Break

Afternoon Practicum THIS PORTION CAN ALSO BE HELD ON A SEPARATE DAY

1:15 Instructions and Orientation *Transition to visitor engagement space.*

1:30 Leading Hands-On Activities with Visitors

3:00 Debrief & Discussion

3:45 Wrap Up (Congratulations!) and Next Steps

4:00 Adjourn

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

Participants

The *Sharing Science Workshop & Practicum* (SSW&P) was developed primarily for early-career researchers (graduate students, post-doctoral fellows, junior faculty) interested in improving their science communication and education outreach skills. It also works well with scientists and engineers at other stages of their careers. 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 eight or less if there is a single workshop leader/facilitator, or up to 24 if there are a couple of other mentors/facilitators available to help. This helps ensure that participants get an adequate amount of individual practice and feedback during the very essential small group activities, and adequate supervision during the *Practicum.* If demand is high, try breaking groups into two or more cohorts and offering the *Workshop & Practicum* multiple times.

Recruitment

SSW&P experiences are fun and valuable - and they can get oversubscribed. We typically offer the SSW&P in collaboration with university partners or a research center, but sometimes mixing up participants from different organizations can be a lot of fun for everyone. If the SSW&P is being offered to a large pool of people, consider making an online application form using simple survey software to help select participants for the upcoming program, and to learn more about them. (Sample recruitment emails, flyers, and application forms can be found in Section Four: Supplementary Materials). Ask applicants to indicate whether they can commit to attending both *Workshop & Practicum* sessions and the follow-up outreach event. Ask what motivated their interest and what prior experience they may have in education and outreach. In fact, the application form and the Pre-Workshop survey (Section Five: Evaluation) can be merged and you will better understand the needs and interests of your group. When they arrive for the *Workshop,* they may be interested in finding out the range of experience in the room.

Location

Host the *Workshop* portion in a spacious meeting room or classroom with worktables around which participants can circulate and gather for the small group activities and hands-on demo work. You'll need a projector, screen, and audio for the slides and videos, places to stash personal belongings, and areas for food, refreshments and trash, with bathrooms nearby. The *Workshop* can be held after hours if it is more convenient for participants, or offsite - such as at a partnering university, though you will need to transport the hands-on activity materials there.

Host the *Practicum* when and where you'll get plenty of 'customers' with whom your trainees can exercise their newly developing skills, but not in a situation where they might find themselves deluged or overwhelmed. (In a science or children's museum, you can set up in an exhibit hall or a space dedicated to cart demos or hands-on activities.) The idea is to give them a 90-minute or two-hour period to work face-to-face with visitors, putting what they've learned to practice; and then, invite them all back to the workshop room to debrief together on their experiences. Later, you will invite them all to return as SSW&P graduates to volunteer at a larger outreach event, like NanoDays, or a university open house, library, or science festival – anyplace where families with time on their hands can be found.

Hands-on Demo Supplies

You will need a set of well-designed hands-on demo activities for your SSW&P participants to work with and all the associated supplies. The NISE Network's NanoDays kits (http://www.nisenet.org/nanodays) are ideal for this purpose, but you can also use any other set of good hands-on activities for which you have the materials and experience. While in later workshops, participants who have already mastered *Sharing Science* can explore with you the design and development of new hands-on activities related to their own research, for this introductory workshop, make sure the demonstrations and materials you plan to use are already tested and proven. Participants therefore will need only to concentrate on their mastery of the engagement process with visitors. Be well stocked with the necessary supplies and accessories for each activity, including written instructions and background materials, so that participants can explore them in pairs or small groups during the *Workshop*. If the activities require significant set-up or preparation ahead of time, do this before the *Workshop* or you will have your participants twiddling their thumbs while you rush around making last-minute preparations! The same holds true when it comes to organizing the *Practicum*.

Other Materials and Amenities

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 volunteer and part of a team. We often use our NanoDays t-shirts, but you could also encourage them to wear t-shirts representing their institution. We give the trainees "Hi, I'm an engineer" and "Hi, I'm a scientist" buttons to wear (see samples in Section Four: Supplemental Materials), which can encourage visitors to ask them questions about their research. Assign pairs or trios of volunteers to each demo; besides allowing for break times and clean-up, partners can cover for each other while these discussions take place. Prepare signage that identifies the theme of the offerings and lists the university, research center, or company the volunteers represent.

Give each participant their nametag upon their arrival. The nametag can be pre-marked with a color, number and/or letter code that discretely indicates work group assignments. We try to mix the work groups so that participants are likely to meet people 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, and so, if the resources are available, we typically begin a *Workshop*

with refreshments, a continental breakfast or lunch buffet; or we provide a voucher so participants can stop at the cafeteria on their way in. You can serve a box lunch as a mid-day break if you are offering the *Workshop & Practicum* in a single day. Have walk-in music playing when participants arrive to set a friendly tone and project the introductory Welcome slide providing instructions for the Meet and Greet activity. Have plenty of fresh water available during both *Workshop & Practicum*; facilitating hands-on activities and talking with visitors for extended periods of time requires frequent hydration!

Visual Documentation

Take photos of the participants and children engaged in activities during both *Workshop & Practicum,* especially close-ups at eye-level showing the kids actively engaged. Share the best photos with the participants and your organizational partners and use them to document the event for grant-reporting and further 'marketing.' Have the appropriate institutional photo releases handy, and always ask parents or guardians permission before photographing children.

Budgeting

The biggest expense is your time and that of other staff and volunteers. Food and drink for participants is the second biggest cost concern, followed by hands-on activity materials and amenities like t-shirts or buttons if you are providing these. Consider nametags, signage, photocopies of workshop materials, and photo releases. Expenses can sometimes be covered through an organization's volunteer or education outreach budget or through grant-funded partnerships supplemented with existing resources. If participants are in training to help at a special event, *Workshop & Practicum* costs might be included in the event budget.

Evaluation *(See Section Five for further guidance and sample survey forms)*

The SSW&P works well for its target audience. It's been through years of formative evaluation and iterative development, and it has been validated in multiple settings at various sites. However, through simple surveying efforts, you may gain invaluable insight into the particular experiences *your* participants are having, and make simple modifications to better serve them the next time around. The short Pre-Workshop Survey will give you a sense of your participants' prior experience, their motivations, and any particular goals they are pursuing. The Digital Appendix includes editable versions of evaluation instruments we use. We've found it easiest to administer our surveys using online programs like FluidSurveys or Survey Monkey.

Preparing Participants for the Workshop & Practicum

About a week before the *Sharing Science Workshop*, send participants a welcoming email letting them know what to expect, with specific information about start and end times, travel, parking, food, and other logistics. Include contact information for their day of arrival and a link to the online “Pre-Workshop Survey,” with instructions to complete it by a specific time. Give them specific instructions for the Meet & Greet role-playing activity that begins the moment they walk into the *Workshop* space. (See a sample "Preparatory Email” in Section Four.)

Sharing Science Workshop & Practicum Planning Timeline

DATE / PHASE	ACTIVITIES	OUTCOMES
2 -3 months prior **Strategic Planning** Sponsoring partners coordinate plans, goals, locations, and schedules.	• Confirm with partners decision to implement *SSW&P* and decide between one-day or two half-day formats. • Determine optimal scheduling (e.g., preparing participants for a particular outreach event, working around holidays and academic calendars, etc.) • Determine availability of facilitators; size of budget; number of participants. • Adjust agenda and start/end times as appropriate. • Book *Workshop & Practicum* locations.	Partners have agreed on goals, structure, budget, and schedule, and have booked appropriate spaces.
5-6 weeks prior **Advance Preparation & Recruitment**	• Choose hands-on activities and order supplies. • Order t-shirts/buttons (optional). • Email and/or post participant recruitment fliers with links to an online application/survey form (unless it's a pre-determined group). • Recruit extra facilitators, if needed for larger group. • Take care of advance logistics (space, equipment, food/refreshments, floor plans, signage, permissions).	Everything requiring third-party resources and commitments and resources is put in place ahead of time.
2-4 weeks prior **Preliminary Preparations**	• If combined online application/pre-survey forms were used, notify selected participants at least three weeks in advance. If not, send link to pre-survey one to two weeks in advance. • Finalize *Workshop* agenda and *Practicum* logistics. • Check on supply orders. • Finalize the agenda, the presentation materials, slides, signage, and hand-outs, (including photo releases). • Prepare the "*(Really Bad)* Demo" skit with your choice of hands-on activity, or choose video option. • Draft welcome email for participants with the scheduling and logistics for the day (e.g., directions, parking, meals), and instructions for the Meet & Greet role-play.	Nailing these preliminary preparations prevents last-minute stress.
1 week prior **Final Preparations**	• Send welcome email. Order food. • Check pre-survey results to better understand needs/prior experience of your group. If group is large, prepare to share some of the aggregated results with participants and pre-assign participants to working groups and demos. • Make nametags, coded with group assignments. • Finalize Post-Workshop surveys online or make paper copies. • Make photocopies of handouts and photo releases. • Practice delivering the Workshop with slides and videos, using the facilitation notes, and practice the "*(Really Bad)* Demo" skit with helpers. Ensure the videos play as planned.	Everything is ready to go.

Day of Workshop & Practicum	• Your participants arrive! • See the Agendas and notes on making this a great day. • Take some great photos. • Ask them to fill out the post-survey unless you will be sending them a link to it online.	Participants have gained practical communication and outreach skills working with visitors.
In the days following... **Post-Workshop Assessment**	• Debrief the event. Note what worked and what might have worked better and jot down ideas for the next iteration. • Send participants a follow-up note with appreciation for their efforts, advice on next steps, opportunities for outreach, and a link to the post-Workshop survey if administering it online. OR remind students of the schedule for their upcoming Practicum session if it is occurring on a separate day. • Examine survey data and add notes to the debrief document.	Outcomes and ideas for improving future iterations have been gathered and analyzed.
Alternative two-session schedule: 1-4 weeks later ***A separate* half-day *Practicum* or outreach event and post-Practicum Assessment**	Adapt the agenda and adjust pre- and post -planning accordingly.	Participants have had the opportunity to hone their skills with real visitors.
Next few weeks... **NanoDays or other Education Outreach Event...**	• Invite SSW&P "graduates" to share their new skills. • Provide instructions and logistical information. Ask them to wear their t-shirts and buttons if they have them. Credit your volunteers in printed materials associated with the event. • Prepare signage, nametags. Have plenty of supplies and refreshments for the volunteers. • Afterwards, debrief with volunteers about their experiences and their sense of preparedness and confidence. Let them know about other opportunities to volunteer. Keep in touch. • Debrief the event. Note what worked and what might have worked better and jot down ideas for the next iteration.	SSW&P graduates successfully engage audiences with hands-on demos and discussion. Some will be interested in participating in other outreach activities in the future.
Follow up... **Further Partnership Activities**	• Brief your partners and co-sponsors on the success of the event and the contributions of the volunteers. Provide photos and other documentation and visitor numbers for reporting purposes. • Be open to discussing further opportunities for collaboration. Build on your success.	. Successful outcomes for stakeholders often lead to other exciting opportunities.

Materials Lists for the *Sharing Science Workshop & Practicum*

Note: All written materials and hand-outs are included in Section Four: Supplemental Materials. Customizable electronic versions and the PowerPoint slides and movies are in the Digital Appendix. All are also available for download from http://www.nisenet.org/catalog/tools_guides/sharing_science_workshop_practicum (or by request from nano@mos.org).

For the Workshop

- Hands-on activity kits, boxed or packaged with all necessary materials and instructions. (From NanoDays kit* or other similarly vetted demo kits)
- Nametags (optionally marked with small-group assignments)
- Large workshop room with tables and chairs, trash cans
- MP3 or CD player and walk-in music (optional)
- Laptop, projector, audio speaker connection, and screen for the PowerPoint slides and video.
- Whiteboard(s) and markers or easel stands and large format pads for recording ideas during group discussions and debrief; sticky notes for collecting ideas to post.
- Photocopies of "Coaching Advice for Workshop facilitators" if needed
- Pre- and Post-Surveys (if administering on paper)
- Participant handouts:
    - "The Hands-On Activity Facilitator's Guide"
    - "Resources on Learning in Free-Choice or Informal Settings," *back to back with* "Resources for Nanoscience Education & Outreach"
- Pens, pads.
- A hands-on activity to use with the "(*Really Bad)* Demo Demonstration*"* skit OR download the NISE Net's pair of videos "How NOT to Interact with Visitors" and "How To Interact with Visitors" (https://vimeo.com/32933894; https://vimeo.com/32933974). (Also accessible from the NanoDays Kit Staff & Volunteer Training DVD.)
- Coffee, breakfast, or lunch, refreshment items; water.
- Camera, smart phone, or tablet for documenting *Workshop* activities; photo releases and pens.
- A watch or clock and a set of chimes or a bell, or a smart phone timer.

For the Practicum

- Hands-on activity kits, boxed or packaged with all necessary materials and instructions (such as a NanoDays kit* or other well-vetted activity kits)
- Nametags (optionally marked with small-group assignments)
- Identifying t-shirts, aprons, buttons, or lab coats (if available)
- Staging area behind the scenes for pre- and post- discussion, and where participants can leave their belongings. Post-it notes, whiteboards, or easel stands and pads for recording ideas during group discussions and debrief.
- Coffee, breakfast, lunch, refreshment items, depending on time of day; bottled water
- Hands-on activity area set-up in public space, with tables, tablecloths, signage, trash cans
- Camera, smart phone, or tablet for documenting *Practicum* activities; photo releases and pens
- Post-Surveys (if administering on paper)

* For info on NanoDays kits: http://www.nisenet.org/nanodays The link for downloading the materials for the latest NanoDays kit (2015): http://www.nisenet.org/nanodays/NanoDays-2015-digital-kit. An archive of NanoDays materials from prior years is available: http://www.nisenet.org/nanodays/archive

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Section Three: Detailed Agenda with Facilitator's Notes & Narrative

Adapt and adjust the *Workshop & Practicum* for your particular set of participants, environment, schedule, and outreach venue. With 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. The day will be very full, and we recommend building in morning coffee, lunch, refreshments, and breaks. Times below are approximate, depending on group and scheduling variables. For the two day version, break at the appropriate point. [Commentary in brackets is intended for appropriate customization.] The PowerPoint slides and movies are in the Digital Appendix and can also be downloaded from http://www.nisenet.org/catalog/tools_guides/sharing_science_workshop_practicum. The slide notes contain key parts of the narrative. Contact nano@mos.org for further assistance.

Morning Workshop

Theme One: Sharing Science through Conversation

9:30 [Slide 1] Welcome: 'Meet & Greet' Role-Play

Preparation Notes: Prepare the Workshop room with all the necessary materials, the projector, audio speakers, and screen, refreshments, walk-in music, and introductory slide. Greet participants warmly as they arrive. Give them their nametags and remind them that the Meet & Greet role-playing activity begins the moment they walk into the Workshop room. Ask them to mute and stow away their phones.

Activity: *Introducing Yourself and Your Work*

Participants were instructed to prepare ahead of time and practice aloud a 15-30 second introduction, suitable for use at an interdisciplinary conference where they might be meeting other scientists or students with no particular experience in their particular area of research. Participate in the role-play as if you too are attending the conference, meeting and greeting, learning about your guests, and introducing yourself. Encourage the participants to mingle, meeting a good portion of the others in the time available.

9:50 [Slide 2] Introduction to the Sharing Science Workshop & Practicum

Use a gentle bell or chime to invite the group to have a seat. Have a white board or easel and pad handy for the interactive part of the discussion.

Facilitator Narrative:

Hello again and welcome. We're delighted to have you here today, and we think you'll have a pretty good time. *Sharing Science* turns out to be a rewarding activity. You seemed pretty at ease with these conversations and indeed, many of you noted in your pre-Workshop survey that [you have more confidence speaking about your research to other scientists than you do to non-scientists]. Today we're going to work together on stretching your capacity to have good conversations about science with people who may be less comfortable and familiar with the world of research. Then we're going to give you an opportunity to engage [families, young people, museum visitors] in science with conversation and hands-on activities here at the [Museum, school, festival, etc.].

[Slide 3] So, what's different about sharing science with broader audiences, like [museum visitors, science cafe participants, kids]? All of you have had some experience talking about science or about your own research with family members or with friends who don't necessarily have the same science background that you do. What are some of the common problems you typically encounter?

Facilitation Note: Encourage the group to respond - you can jot down key issues on a white board or easel pad. You also have the option here to share (anonymously) any relevant comments that emerged from the pre-workshop survey. Common issues that typically arise:

- *Too much to explain.*
- *Hard to know what they do and don't know.*
- *Slipping into jargon.*
- *Making the TMI (too much information) mistake.*
- *Trouble finding analogies.*
- *Being afraid of boring them.*
- *Not wanting to seem too 'nerdy.'*

Now, what are some of the strategies you have already come up with to deal with some of these issues?

Again, encourage the group to respond and share ideas with each other. Jot some of these down on the whiteboard.

[Slide 4] One way to think about this is to that you are trying to take your audience on a journey from a place they already are... to a new place they may have never been. You can't drag them there; you can't force them to want to go. You'd be better off enticing them there. Or giving them an incentive to go ahead and explore the place on their own, providing a little signposting along the way.

[Slide 5] It may help to spend a moment reflecting on the following questions:

Who are they?
What prior experience might they have?
What might they find intriguing?
What might they care about?
And, how much time and attention are they likely to have to spend with you at this particular moment?

The answers to these questions will provide you with clues as to how you might best scaffold your interaction with this particular audience based on their needs, more than your own. And, as a result, the experience is likely to prove more rewarding for you both.

Once you figure out who your audience is, you can figure out what it might take to begin to engage their interest in the topic. You might ask an intriguing question. You might give them a hands-on opportunity to explore an interesting phenomenon. You might adjust your use of language and the kinds of explanations you provide. Remember that there is always a little lingering question in the mind of every listener: "why should I care?" In other words, "why should I expend time and energy to try to stay with you and follow where you're going?" It helps for there to be a reward, an 'aha' moment, an intriguing insight that helps capture the imagination and cast the world around us in new perspective.

[Slide 6] One of the most powerful things you can do, in talking about your research with teen and adult audiences, is to address the significance of the work - the 'So What?' of it. For an engineer it might be about a solution to a problem or an important challenge you are trying to overcome. For a scientist it might be about an intriguing mystery are you hoping to solve. Quite likely, there's a little of both involved. The key thing is to address "why will it matter?" in a way your audience will find relevant. Next, I'm going to play for you a couple of examples where researchers take this approach in speaking to broader audiences.

[Slide 7] First we'll hear a one-minute excerpt from chemist and Harvard professor George Whitesides, as he begins one of his TED Talks. He starts with a very grand idea.

[Slide 8] ***Video plays automatically.***

[Slide 9] Now, let's listen to a one-minute excerpt from Professor Pamela Silver, a bioengineer at Harvard Medical School, speaking to an audience at the Museum of Science, Boston. Like George Whitesides, she begins with a challenge bioengineers would like to solve. Notice also how she makes frequent eye contact with her audience and connects the biological tools and chemical compounds with pictures of things familiar to her audience.

[Slide 10] ***Video plays automatically.***

10:00 [Slide 11] Introducing Yourself and Your Work to Broader Audiences

Facilitator Narrative: One thing you might have noticed about the two video excerpts we just saw is that they would probably both work well with a high school audience, and maybe even a middle school audience. And that is something we want to aim for here. If a smart 12-year old can grasp what you're saying, then probably so can adults who haven't attended a science or math class for perhaps decades. Let's focus on that next.

Activity: ***Introducing Yourself and Your Work to Broader Audiences***
Facilitation Notes: Ideally, include two complete rounds of this activity, giving slightly less time for the second round. Typically everyone enjoys it and many even want a third go-round. Begin by giving participants a couple of minutes to prepare their new introductions. Provide pads and writing instruments for those who need them. Alert them about a minute before and ring a chime or bell when the time is up, and then give them instructions for breaking into small groups of 3-5. If some of the participants already know each other or come from the same lab, mix them up. (Nametags can be coded by pre-arranged groupings). You may adjust the size of the small groups for the amount of time you have. Smaller groups finish quicker, but get less exposure to different approaches and fewer opportunities to provide feedback. You and any helpers you have can circulate among the groups and assist with process and feedback.

Facilitator Narrative: We're going to do a rapid prototyping exercise now. We'd like each of you to take a few minutes to work out how you will take the professional networking introduction you used this morning, and transform it into the kind of introduction that might engage a bunch of smart (and polite) 12-year olds in the research that you do. Think back to when YOU were around that age, and what you might have found interesting - and what content and vocabulary you might have been familiar with. You may begin any way you want - with an appeal to the imagination, a description of an important problem that

should be solved, a '*suppose'* kind of question, or a story. But the whole thing should take less than a minute, and your goal is to get it to the point where your listeners want to ask you *more* about the work you are doing or the scientific questions involved. After you have had a chance to work on a first draft of this for a couple of minutes, we're going to get into small groups and try it out. Then, if there's time, we'll give you a chance to revise these drafts and try them again.

[Slide 12] Here are your drafting instructions. I'll let you know when it's time to form into groups.

> **Rapid Prototyping**
> Introducing yourself and your work to smart twelve-year-olds. (1st draft)
> Length: Up to one minute long.
> Engagement: How will you grab their attention or capture their imagination?
> What analogies can you make?
> Relevance: How can you relate the topic to something they already know or care about?
> Language: What words and concepts can you use?
> Open ending: How can you encourage their curiosity?

[Slide 13] *Facilitation Notes: Facilitator gives instructions for small group work, as summarized on the slide.* Have each group assign a timer, to ensure that everyone gets their turn. (Countdown timers on smartphones are readily available and work well for this.) It helps keep the energy flowing if people stand in their small groups in different areas of the room.*

> ****Rapid Prototyping: Try out the 1st Draft!***
> - *Structure: Groups of 3-5, rotate speaker and smart 12-year-old roles.*
> - *Timing: Appoint a timer. Each speaker has up to one minute, and then may engage in up to two minutes of questions and discussion with listeners.*
> - *Feedback/Suggestions: Each listener provides up to 1 minute of helpful feedback to each speaker, if the speaker requests feedback.*
> - *Rotate: Switch roles. About 5-6 minutes total for each person.*
> - *When finished: Begin work on Draft Two.*

Facilitator Narrative: Before you begin, I'd like to encourage you to listen carefully to each other and do your best to help by offering constructive feedback. What is constructive feedback? Think about content, style, approach, presence. Is the speaker's strategy working? Why or why not? Should they make more eye contact, slow down, or smile more? Are they using words that were too technical or concepts too advanced? Are they trying to cram too much in? Do you have an idea for an analogy they might use or a thought-provoking question they could ask? Many people are shy about giving feedback, or they only want to mention what was good and not what could be improved. And yet, we find most participants in these workshops would really rather receive constructive feedback in an environment like this, before they're put on the spot in a much higher stakes setting. So I encourage each of you to give your colleagues permission to give you their valuable feedback and to provide thoughtful feedback to them as well. Then, when everyone in your small group has had their turn, sit down and begin your second draft. Go ahead and begin.

Facilitation Notes: Continue to monitor the time, and give cues when the groups should have reached their second, third speakers, etc. Stop by each group to see if they have any questions. Participants always enjoy doing two rounds of this activity, and it gives them a chance to apply the feedback they receive. 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 in groups of three) or two (if in groups of four or more) on to the next group (you may also code these rotations on their nametags in advance). That way there will be some "fresh ears" as well as others who will understand how the introductions have improved since the prior draft. The length of this activity is entirely dependent on the number of people in each group and the size of the groups. You may accelerate draft two by giving them less time to revise, and less time in small groups for feedback.

[Slide 14] (*Round 2 - 2nd Draft)*

[Slide 15] (*Round 2 - Sharing and feedback)*

[Slide 16] What did you learn from the Rapid Prototyping Exercise?
Now, let's discuss what we learned from the rapid prototyping exercise.
Facilitation Notes: Take a few moments to prompt the group to reflect on their experiences and what they learned during this rapid prototyping exercise. Reinforce the characteristics of effective introductions and the value of drafting different versions and trying them on various people until they have versions that work well in situations. Encourage them to develop several different types of introductions suitable for use in a variety of social and professional situations. Above all, tell, them, none of this comes easily, and ***the best idea to take away from this exercise is that...***

[Slide 17] It takes practice. But with practice, especially practice aloud and with others, these types of introductions will soon just roll off the tongue. You can prepare a few different varieties, for use in different types of situations, and be prepared no matter where you are. We're going to take a ten-minute break now, and when we resume, we're going to stretch you even further...

[Slide 18] Next, something completely different... engaging kids, and their accompanying adults.

10:40 [Slide 19] Time for a brief break! *[Set up the room for hands-on activities.]*
This is also a good time to recruit and brief the two volunteers you will need to help you in the next role-play activity, a 5-minute skit.

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Theme Two: Sharing Science with Hands-On Activities

10:50 [Slide 20] Introduction to Sharing Science with Hands-On Activities

Preparation Notes: Our philosophy is "learning by doing," and in this introductory activity you introduce a bit of humor and surprise with a skit involving two of your participants. (It's actually a spoof that demonstrates how NOT to facilitate a hands-on activities with visitors, but no one will know that at the start, except your volunteers.) Afterwards you debrief the experience together and build from the ground up a set of good practices to use in hands-on activity facilitation. An alternative to acting out the skit with your participants is to screen a NISE Net video "How NOT to Interact with Visitors" which can be downloaded from https://vimeo.com/32933894 and is

also on the NanoDays Kit Staff & Volunteer Training DVD**.** We highly recommend the skit because it is lively, funny, and interactive. First there is this little intro....

Facilitator narrative: Today, we're going to explore hands-on demo activities where visitors get to interact one-on-one with a person – YOU – as they explore a new idea or phenomenon. We'll discuss inquiry-based learning and strategies for creating a really positive visitor experience. Now, most kids will engage with you if you are friendly and welcoming and have something interesting to show them, or better yet, something interesting and fun for them to do.

[Slide 21] So, in science museums and other informal learning environments, we like to provide hands-on activities that get our guests acting like scientists and investigators themselves. A well-designed hands-on activity will give them a *wow!* moment and stimulate their curiosity. So...

[Slide 22] What makes for a good hands-on activity experience? Well, let's try one, and see what you think. We'll call it a "demo demonstration" or "demo demo." I'll show you one way of facilitating a hands-on activity with a pair of visitors and then we can share our thoughts about it. First I'll need a couple of volunteers...

10:55 Activity: The *(Really Bad)* Demo Demonstration [still Slide 22]

Facilitation Notes: In the pages following this Annotated Agenda is the sample script and instructions for this activity. The secret you don't want to divulge ahead of time is that *this is a spoof* - in fact, you are going to be demonstrating a *terrible* way of facilitating a hands-on activity, and then you will use the experience to stimulate their thinking about the qualities that make for good hands-on activity experiences. Ham it up, and your audience will soon begin to catch on. Practice the skit ahead of time. (You may also invite a willing colleague to come in to do play the role of Facilitator, introducing them as one of the best hands-on demo facilitators on ever!) During the break before this part of the *Workshop,* recruit a pair of volunteers from your group to act as a child/parent pair coming to the activity table, and brief them in advance. *Advise them to be curious, ask questions, and act like a typical parent-child pair. Don't give away the surprise but encourage them to be patient and play along.* As scripted, the skit uses a demo called the "Atomic Trampoline;" however you can easily substitute in other activities from the NanoDays kit or elsewhere, and adjust the script accordingly. Your goal is to do the opposite of what a good facilitator would do: you could act grumpy or distracted, text or talk on a phone when visitors approach; fail to use any opening engagement or "hook;" discourage the child from touching any of the materials, do the demo yourself instead of letting them do it; give away the "aha" moment of discovery by explaining what will happen. You might use overly technical and complex vocabulary, read from a background sheet, fail to reward the child for asking questions, fail to provide a satisfying closure, etc. Afterwards, everyone has a laugh and debriefs on all that went badly, while building up a new model for principles of *good* practice.

11:00 Activity: Debrief: What Went Wrong [still Slide 22]

Facilitation Notes: Draw out from your group a list of the unfortunate facilitation behaviors that made the (Really Bad) Demo such a very bad experience for the guests. If your group is large, you can have the participants pair off with a neighbor or debrief in small groups and then bring them together to share what they found. As the missteps are called out, the Workshop leader can repeat them and amplify them, adding context as needed. You may jot them down on a white board or large pad side-by-side with a list of alternate behaviors that would have made for a much more fun and satisfying interaction. In this way, the group constructs a list of good hands-on demo facilitation behaviors, which will then get further reinforced.

Facilitator Narrative: Well that was pretty bad, wasn't it? But what's important here is to tease out exactly what were the elements that made it so very bad? Because therein lie all the clues as to what can makes a hands-on activity facilitation very *good.* [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.]
So, what made this experience so terrible? Perhaps we should hear from our brave volunteers first...
[Take comments from the audience and underscore the critical points. If comments peter out, remind the group of any important faux pas not yet mentioned.]
OK, we've identified what was bad. Now let's see if we can identify – by contrast – some good ways to facilitating a hands-on learning experience.

Additional Facilitator Guidance: Here are some concepts about out-of-classroom learning that could be introduced during this guided conversation, and you may want to flash back to **Slide 21.**

- In a "free choice" learning environment, people need to be engaged or they will walk away. They need to see that there is something cool happening that they can participate in, and they want to feel welcomed and respected.
- In "inquiry-based learning," the learners drive the process. They're invited to ask questions, experiment, and explore using both hands and minds.
- "Constructivist learning theory" predicts that most people will gain deeper understanding of a concept by taking through their own paths of inquiry through experiment and observation. Reinforcing curiosity and a scientific mindset is more important than teaching particular facts.
- People bring prior knowledge, experience and assumptions to any learning experience. Facilitation can involve gentle prompting to help them question embedded assumptions. Facilitators should also be aware of their own assumptions and expectations - and listen carefully to what visitors are saying. Meet them were they are and explore from there.
- Personal connection and engagement: A child will light up when receiving kind eye-level attention and encouragement to share their thoughts and ideas. (Their adult guardians will be grateful too, and some may end up adopting the inquiry-based learning approach in further interactions with the child.)
- Situational factors can affect such interactions in a way that can't be helped - visitors may be tired, hungry, or in a hurry. (Don't take it personally!)

11:10 Activity: Doing it Right

Facilitation Notes: At this point, the Workshop leader can model facilitating the same demonstration anew, this time incorporating the list of good practices the group has generated, and inviting the same of new volunteers to role-play the visitors. Alternatively, you can screen the NISE Net "How TO Interact with Visitors" video, which can be downloaded from Vimeo (https://vimeo.com/channels/nisenet/32933974) and is also on the NanoDays Kit Staff & Volunteer Training DVD. Briefly discuss what practices worked better this time.

11:10 [Slide 23] Activity: Lauren Tests her Prototype

Facilitation Notes: There are nice moments of humor in this little video, and it shows the process of an early career researcher testing out how to facilitate a hands-on activity of her own design. It's a good hands-on activity, and Lauren does a good job facilitating; although, are there a few moments when she seems not to be listening carefully enough to what the little boy is saying? Could she have taken more time to let him explore his ideas? Discuss with your group after the screening.

Facilitator Narrative: Now, let's see what you think of this interaction. Lauren Zarzar was a Harvard graduate student researching hydrogels when she devised a hands-on activity that

would allow museum visitors to explore their amazing capacity to absorb liquids. This little two-and-a-half minute hand-held video catches Lauren testing her demo prototype activity with a mother and child pair during her internship at the Museum of Science in Boston. See if you can pick out what's working well and what might be improved the next time she tries it. And, notice how the boy's mother is able to provide additional context and meaning for him. Often you will find yourself being assisted by the adult companions of children.

[Slide 24] ***Video will roll automatically.***

Debrief Questions: What strategies did Lauren use to engage her young visitor? What worked well? What might be improved next time? What role did the parent play in the interaction?

Facilitator Narrative: By the way, after more prototyping, Lauren's activity proved so successful that it was adopted into the catalog of demos maintained online by the Nanoscale Informal Science Education Network, at nisenet.org.

11:25 [slide 25] The Hands-On Activity Facilitator's Guide

Facilitation Note: This single-page handout is in Section Four. Go through it in a lively step-by-step with your group.

Facilitator Narrative: In just a minute, you're going to get your hands on some hands-on activities. But first, I'm handing out a 10-point "Hands-On Activity Facilitator's Guide that will prompt you to think about key elements of successful hands-on activities and facilitation styles. These 10 queries will remind you that our goal is not to cram people's brains with facts, but to guide them in exploring and questioning for themselves. And now, it's time to get our own hands on...

11:30 [Slide 26] Exploring Hands-On Activities: Investigating Materials and Approaches

Facilitation Notes: Participants assemble into pre-designated groups of 2-3. Each group is provided with a hands-on activity kit. (You may try to assign activities and participants based on their relevance to research group interests.) Each group spends 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 answer questions.

Facilitator Narrative: When you get to your station, you will find a box. Inside the box you will find all the materials you need to run one [NanoDays or other] hands-on activity. Each activity has a "guide" with information you need about the activity. This is for you, not the visitor to read.

[The following is true for NanoDays activity guides:

- The front of the guide is divided into three sections:
  - **"Try This!"** which gives the instructions for doing the activity.
  - "**What's going on?"** which explains what the visitor observed.
  - **"How is this nano?"** which explains the nanoscale science and/or technology background for the activity
- Many guides also have a back side, including:
  - **Learning objectives** – tells you what visitors will hopefully learn from participating in the activity.

- **Materials** – Check that you have all the materials needed for the activity.
- **Notes to the presenter** – These may help give you some helpful hints to make the activity more successful.

• Some of the activities also include **Extensions** – which are extra activities that can be added on.]

Read over the guide, review the other materials in your box, and then craft an approach for facilitating this activity with visitors. Refer to the Hands-On Activity Facilitator's Guide for coaching. Practice it with your partners, and figure out how to improve it.

[Slide 27] We have about 20 minutes.

11:50 [Slide 28] 1st Rotation - Taking Turns Leading and Experiencing

Facilitation Notes: Instruct half the pairs (or trios) to leave their demos and go to visit one of the other demo stations, role-playing being 'visitors.' In 20 minutes, they should make it to at least two demo stations. You may want to sound a chime after 10 minutes, when the group should rotate stations. Advise the facilitators to try testing out two different strategies. Advise the role-playing visitors to offer some feedback after the interaction. If you have more time, for instance, if you are holding the practicum on a separate day, you may want to extend these 20-minute rounds to 30 minutes each.

12:10 [Slide 29] Switch!

[Slide 30] 2nd Rotation - Taking Turns Leading and Experiencing

Facilitation Notes: Facilitators and visitors switch roles.

12:30 [Slide 31] Lunch Break - Debrief and Discussion

Facilitation Notes: Boxed lunches or a lunch buffet will help save time. The group can stay in the room and continue to discuss what they learned from the practice rotations and brainstorm new approaches. If you are breaking the training into two separate days, this would be the conclusion of the Workshop portion.

The Afternoon Practicum continues on the next page....

Afternoon Practicum: Putting it all to Practice

1:15 [Slide 32] Instructions and Orientation

Facilitation Notes: *Brief the group on what will happen during the Practicum with actual visitors. Advise them that they may have an opportunity to use the 30-second introductions they worked on earlier in the day if they get asked about their research. Review any important policies/expectations for volunteers working with visitors, and what to do in the event of an emergency.*

Some last minute advice:

- Kids will probably approach you right away, even before you're all set up. Just smile and tell them you're setting up and invite them to return in a few minutes.
- Once you're set up, be very welcoming and attentive. You may want to introduce yourself and ask your young visitors their names. Welcome their adults too!
- Say little; instead encourage activity, thinking, exploration, and conversation.
- Have a closing ready – thank them for doing a great job and suggest another activity.
- Keep track of your materials. It helps to keep a clean demo space – just the sign and the materials you need to do the demo. Stash extra materials behind you and make sure a trashcan is handy.

1:30 Leading Hands-On Activities with Visitors

Facilitation Notes: Pass out identifying t-shirts, lab coats and/or buttons if you have them. Bring the materials and signage identifying the group and the theme into the public area, and get set up. Help them get their bearings for entrance, exit, bathrooms, info desk locations, etc. You may be using the carts or tables that have already been set up in the area, with accompanying signage. Arrange two participants to each demo station. If there was a third participant in that group, the three can rotate in and out every 20 minutes or so, observing what is happening around the entire demo area. Meanwhile, the Practicum facilitators move around and observe each group at work, providing back-up support and guidance, and fielding any questions people may have about what is happening in the space. After about 90 minutes, clean up and return to the Workshop space to debrief..

3:00 [Slide 33] Debrief & Discussion

Facilitation Notes: Facilitating hands-on activities can be exhausting! Hopefully you'll have some refreshments handy for your participants. You may want to write the five questions for reflection as headings atop five columns on a whiteboard or easels or on large poster-size post-it notes stuck to a wall:

Q1 What did you like best about working with visitors?
Q2 What proved more difficult than expected?
Q3 What strategies worked best?
Q4 Any surprises or 'aha' moments?
Q5 Any ideas for improvements? (activity or approach)

Congratulate your Practicum participants on a job well done. Facilitate a discussion soliciting comments under each of these topic headings and encourage the group to share their experiences, and scribe them on the walls. You can also suggest a quiet reflection time before the discussion begins, so that people can collect their thoughts and jot them down on post-it notes to place under each of these headings. You might also follow this exercise

by inviting group members to brainstorm and discuss new hands-on activities they could design in relation to their own research areas.

3:45 [Slide 34] Wrap Up (Congratulations!)
You are now graduates of the Sharing Science Workshop & Practicum.

Facilitator Notes: Hand out the resource list if you have photocopied it. Hand out the post-session surveys if you are administering them on paper; or, ask your participants to respond to the survey link they will soon receive by email.

***[Sample: Slide 35]** If you are inviting the participants to help out at an upcoming outreach event, like NanoDays, brief them on the date, time, and logistics**]**. Otherwise, discuss other ways participants can continue their practice and involvement.*

4:00 Adjourn

Sample Script for the (*Really Bad) DEMO DEMONSTRATION*

"The worst hands-on demo facilitation ever!"

This spoof is designed to surprise, then entertain and enlighten your participants, stimulating a lively discussion on the qualities of an authentic and effective inquiry-based learning experience. The script provided below is based on the University of Wisconsin-Madison Materials Research Science and Engineering Center's demo "Atomic Trampoline,"* but can be easily adapted for use with any well-designed demo activity.

*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 for this Demo: http://mrsec.wisc.edu/Edetc/IPSE/educators/amMetal.html

Facilitator Guidance: The secret you don't want to divulge to your participants ahead of time is that *this is a spoof* - in fact, you are going to be demonstrating a *terrible* way of facilitating a hands-on activity, and then you will use the experience to stimulate their thinking about the qualities that make for good hands-on activity experiences. Ham it up, and your audience will soon begin to catch on. Practice the skit ahead of time. (You may also invite a willing colleague to come in to do play the role of Facilitator, introducing them as one of the best hands-on demo facilitators ever!) During the break before this part of the *Workshop,* recruit a pair of volunteers from your group to act as a child/parent pair coming to the activity table, and brief them in advance. *Advise them to be curious, ask questions, and act like a typical parent-child pair. Don't give away the surprise but encourage them to be patient and play along.* As scripted, the skit uses a demo called the "Atomic Trampoline;" however you can easily substitute in other demos from the NanoDays kit or elsewhere, and adjust the script accordingly. Your goal is to do the opposite of what a good facilitator would do: you could act grumpy or distracted, text or talk on a phone when visitors approach; fail to use any opening engagement or "hook;" discourage the child from touching any of the materials, do the demo yourself instead of letting them do it; give away the "aha" moment of discovery by explaining what will happen. You might use overly technical and complex vocabulary, read from a background sheet, fail to reward the child for asking questions, fail to provide a satisfying closure, etc. Afterwards, everyone has a laugh and debriefs on all that went badly, while building up a new model for principles of *good* practice.

Role players for this spoof:

- Hands-On Activity Facilitator (*Workshop* leader or other staff member)
- Child of about 10 (staff member or audience volunteer)
- Parent (audience volunteer – no written script – but will chime in as appropriate)

Scene opens with Hands-On Activity Facilitator *sitting behind the table texting on his/her phone. Child and Parent walk up to table, curious about what's happening.*

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

Facilitator: *(Looks up irritated, grabs the ball back)*
Who said you could touch that? Settle down; I'll be with you in a minute.

(He/she finishes texting)
Thanks for waiting… you shouldn't just walk up and start touching this stuff – it might be dangerous… *(Pedantically)* 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…)*

Facilitator: *(Annoyed)* 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…

Facilitator: 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?

Facilitator: Well that's not a very smart idea…. why would you want to try that? Haven't you been listening to what I've said? For a proper scientific investigation, you need to keep the same steel ball for both trials.

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

(Child and Parent walk away)

Facilitator: *(Calls after them…)* I'm not really finished yet. You should come back. And, you know, 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 that [Mom/Dad]… no control over the [him/her]. But I think I did a pretty good job getting all the information in.

The End

SHARING SCIENCE WORKSHOP & PRACTICUM

Planning & Implementation Guide, v. 4.0

Section Four: Supplemental Materials, Resources, Handouts

Most of these resources are also included as Microsoft Word electronic documents in the Digital Appendix, to make it easier for you to customize and print copies.

Coaching Advice for Workshop Facilitators and Mentors.....37
This customizable one-pager can be sent ahead of time to those helping with SSW&P Workshop Facilitation or reviewed with them before the Workshop begins.

Recruitment Email (sample) 39
This draft can be customized to invite your target audience to apply to the SSW&P.

Recruitment Flyers (samples) 40
Two pdf examples.

SSW&P Participant Application (sample) 43
Customizable. May also be combined with the Pre-Workshop Survey in Section Five.

Preparatory Email for SSW&P Participants (sample) 45
Customizable.

Sample Button Designs 47

Workshop Handouts 49

- **The Hands-On Activity Facilitator's Guide**
- **Resources on Learning in Free-Choice or Informal Settings**
  Can be printed back-to-back with...
- **Resources for Nanoscience Education and Outreach**

(Evaluation survey forms are in Section Five)

Coaching Advice for Facilitators & Mentors

[Before the *Workshop & Practicum,* take some time to brief staff, faculty or graduate students who may be helping out. Share with them the goals of the *Workshop & Practicum,* the day's schedule, and the protocols for small group activities.]

Facilitating the Small Group Activity on Introductions for Broader Audiences

- There will be 3-5 participants assigned to each small practice group.
- Each group should designate a timer to ensure that everyone gets a turn.
- Remind the groups to listen well and be prepared to offer constructive feedback.
- Each speaker can decide whether to give the group permission to provide feedback.
- If permission is given, the idea is that everyone in the group participates. It is important that they all practice thinking about and providing helpful advice.
- Constructive feedback includes validation of what worked well as well as ideas for how the introduction might be improved.
- If you are participating in the feedback, go last, so that the participants will not be swayed by your opinion.
- Feedback is opinion, of course, and the participants should be advised to decide for themselves how to use it or apply it.

Facilitating the Small Group Hands-On Activity Exploration and Rotations

- 2-3 participants will be assigned to each of the hands-on activity kits.
- Each group should have about 30 minutes to learn their activities. Give them a few minutes to explore the materials on their own. Be available for guidance or to respond to questions.
- Encourage the groups to use 'The Hands-On Activity Facilitator'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 pursue an investigation and line of inquiry.
- When the rotations begin, roam among the groups and monitor what is happening. Provide guidance if issues arise. Make sure the participants playing the visitor role don't get too bogged-down; they should have time to visit two demo activities during each rotation.

Sample Recruitment Email

Subject Line: New Sharing Science Workshop Opportunity!

Dear Science & Engineering Enthusiast,

[Our organization] is partnering with [your organization] to provide volunteer opportunities for sharing science with broader audiences. Are you interested in sharing your enthusiasm about science and engineering, but not sure how to do it? Would you like to 'give back' to your community, and perhaps help inspire young people to explore STEM fields? Could you use some pointers on sharing your own research with broader audiences?

We invite you to attend our upcoming "Sharing Science Workshop & Practicum" on [date/time] from [time] to [time] at [location]. This lively and interactive program will give you a sound introduction to public engagement through inquiry-based learning and hands-on activities, and also provide professional practice discussing research with people outside your field. Graduates of this [one-day] program will be invited back to join our science outreach team at [event] on [date], and will have other such opportunities in the future.

[Include any other relevant details about the workshop – if it includes food/snacks, free admission to your museum or a special venue, a t-shirt, parking, etc.]

As spaces in the upcoming Workshop are limited, please fill out the brief application [attached? below? at this link?] and we will notify you of your acceptance by [date].

For more information, contact [name / email / phone].

We look forward to hearing from you.

[signature]

<u>Some comments about the Sharing Science Workshop & Practicum from past attendees</u>:

"I really liked interacting with museum visitors;
the best part was that even the adults were as excited
to find out about nanotechnology as the children were."

"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."

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

Sample Recruitment Flyer #1

This flyer was posted around laboratory facilities and classrooms at our partnering research center universities, advertising a one-day SSW&P.

CIQM CENTER for INTEGRATED QUANTUM MATERIALS

Gain valuable experience in science education & outreach...

Sharing Science Workshop & Practicum

for CIQM students and faculty

at the Museum of Science, Boston

Museum of Science

Saturday, November 15, 10 am - 4 pm

Lunch vouchers and free parking provided

Online applications due October 24

http://bit.ly/1Cisozq

Questions? ciqm@mos.org

HOWARD UNIVERSITY

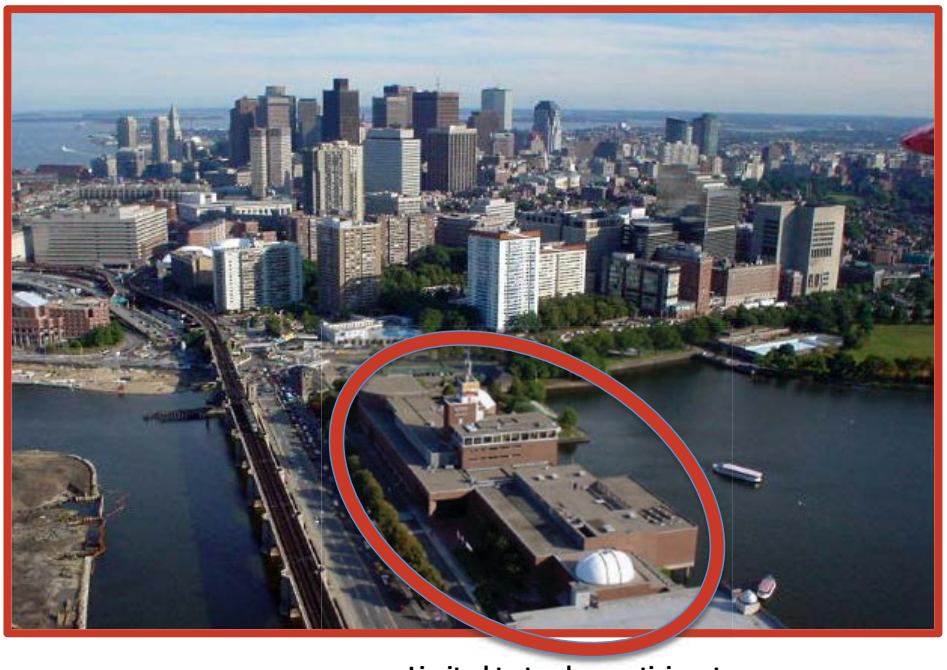
DMR-1231319

Sample Recruitment Flyer #2

This flyer was posted around the laboratory facilities and classrooms at our partnering research center universities, advertising a one-day SSW&P combined with a NanoDays outreach volunteering opportunity.

CIQM CENTER for INTEGRATED QUANTUM MATERIALS

Two-Day Education and Outreach Training Opportunity for CIQM Students and Faculty at the Museum of Science, Boston



NanoDays The Biggest Event for the Smallest Science!

Museum of Science

Limited to twelve participants.
Online applications due March 11.
Apply at http://bit.ly/1egVzsS
Questions? nano@mos.org

Saturday, March 29, 10 am - 4 pm:
Sharing Science Workshop & Practicum

Saturday, April 5, 10:30 am – 3:30 pm:
NanoDays

Participants must attend both sessions.
Lunch vouchers and parking will be provided both days.

CIQM CENTER for INTEGRATED QUANTUM MATERIALS

Sharing Science Workshop & Practicum Application (sample)

[Note: This application could also be combined with the Workshop Pre-Survey and posted using online survey software, with links sent to individuals in the group being invited.]

Thank you for your interest in the *Sharing Science Workshop & Practicum*. This lively, interactive event will be held at [location] on [date] from [start time] to [end time]. [Free parking and lunch] will be provided. Graduates of this [one-day] program will be invited back to join our science outreach team at [event] on [date], and will have other such opportunities in the future. Please complete the application below by [date] and return it to [person/address], as spaces are limited.

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? *[list separately if scheduled on different days]*

	Yes	**No**
[*Date/Time*]	○	○

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

	Yes	**No**
[*Date/Time*]	○	○

6. Please describe your motivation for participating in the *Sharing Science Workshop & Practicum*.

Thank you. Please save the dates. We will notify all applicants by [date].

Sample Preparatory Email for SSW&P Participants

(send to participants about a week in advance of the Workshop)

Subject: Your Upcoming Sharing Science Workshop...

Dear [*Name*],

We're looking forward to seeing you [this coming] [day of week], [date], at [location], from [time] to [time] for the *Sharing Science Workshop & Practicum*. This email contains important logistical information and some advice on how to prepare.

The SSW&P is designed to give you a well-grounded experience using hands-on activities to stimulate informal science learning discussions with children and adults, and also give you professional practice conversing about research with broader audiences. During the *Workshop* portion you will pick up new skills; in the afternoon you will practice them with [Museum visitors or families attending ____]. Expect to have a good time. We will provide [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.]*

Preparation: The *Workshop* begins with a 'Meet and Greet' role-play, the moment you walk into the room. Wearing a nametag, you will circulate among the other guests as if you are among strangers at an interdisciplinary research conference, introducing yourself and giving these new acquaintances a brief (under a minute) insight into what's interesting or exciting about your current research, but assuming they know little about your field. We recommend you prepare this brief introduction in advance – target it for someone with a good understanding of science but no special experience in your area - and practice it aloud. Don't worry about cramming a lot of information in. Your goal is to arouse their interest in learning more.

Afternoon Practicum: [We will break for lunch around midday] [box lunches will be provided], and then we will move to the [location of *Practicum*], and begin to work with children and adults visiting [the Museum]. After about 90 minutes of working with visitors and coaching, we will return behind the scenes to debrief about our experiences.

End of Day: We will wrap up by [time].

Please use [this link] to respond by [day] to a few brief questions that will help us tailor the workshop to the needs of the group.

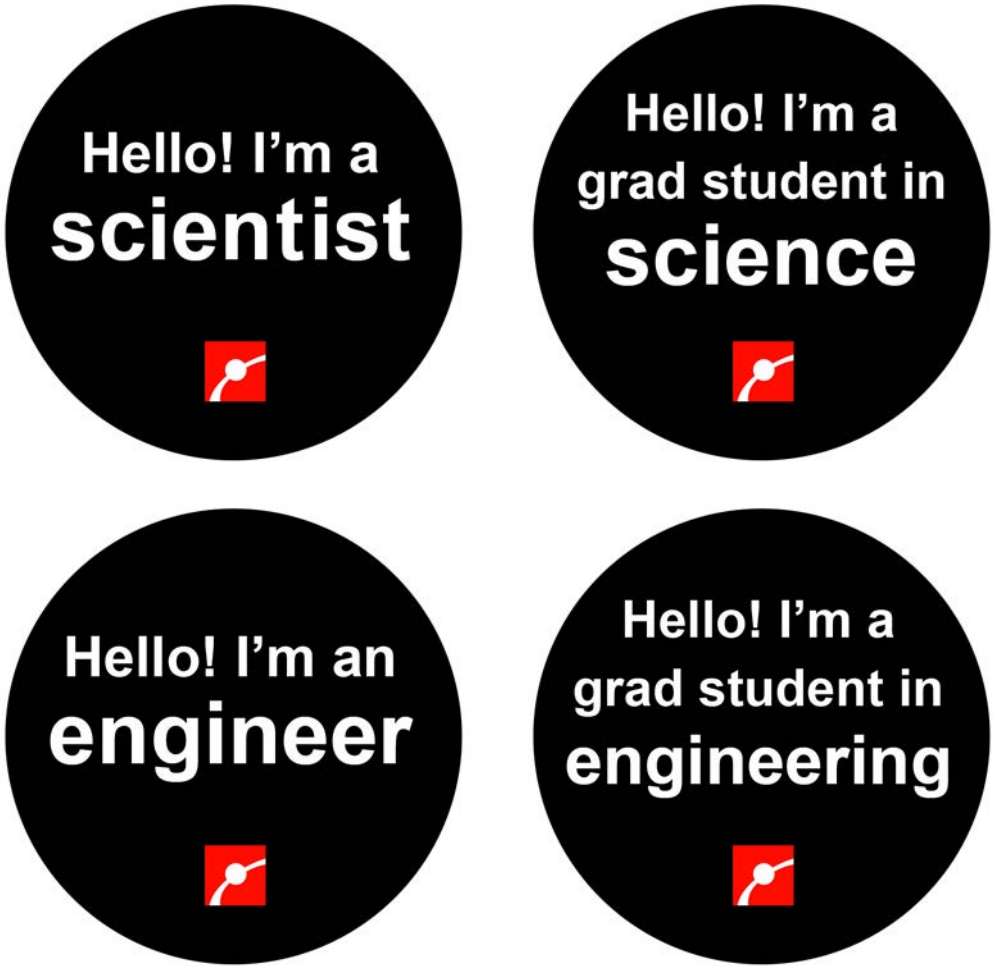
If you have questions, please contact us at [ ].

We look forward to seeing you [day].

[signature]

Sample Button Designs

Buttons with designs like these can be provided to *Sharing Science Practicum* participants as well as to other scientists and engineers and graduate students who participate in education outreach in informal settings. They underscore the authenticity of these face-to-face interactions and the diversity of people who work in STEM fields. Young people are particularly encouraged when they find themselves speaking with graduate students who are so much closer to them in age and demeanor than more stereotypical role models often encountered in media and classroom. The buttons also encourage teen and adult visitors to ask the volunteers about their work and about the research they may be pursuing, stimulating further informal learning conversations. The volunteers get a chance to put to use the broader audience conversational skills they practiced in the *Workshop.*



Workshop Handouts

The handouts on the following pages are also included as e-documents in the Digital Appendix, to make it easier for you to customize and print for your participants.

Included:

- **The Hands-On Activity Facilitator's Guide**
  Distributed during the *Workshop* session just before participants begin exploring their hands-on activities. You may want to distribute fresh copies of this to the participants if they return for the *Practicum* on a separate day, or at a further outreach event.

- **Resources on Learning in Free-Choice or Informal Settings &**
  Resources for Nanoscience Education and Outreach
  You may print these two back-to-back and distribute them at the end of the day.

(Evaluation forms are in Section Five)

The Hands-On Activity Facilitator's Guide

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

2. **How can I pique their *curiosity* and *draw them in?***

3. **What challenge can I offer them?**

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

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

6. **How can I help them *guess or reason toward* possible explanations and think of ways *to test* them?**

7. **What does the demo reveal about *underlying principles or properties?* How can I respond to questions using *simple* language and familiar *analogies*?**

8. **How can I lead them in the direction of *imagining* useful *applications?***

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

10. **How will I know if it was a *successful* interaction?**

Sharing Science Workshop & Practicum

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

Science learning often occurs outside of formal classrooms - in museums, zoos, and arboretums, at national parks; through hobbies, clubs and after-school activities; at science festivals; on the web; and through television, radio and podcasts. "Free-choice" or "informal science learning" as it is often called, relies on attracting and engaging people through their own interest and curiosity, and is often designed to entertain as well as to inform. The following resources provide additional background and context about learning in informal settings and inquiry-based pedagogy.

- **What is Inquiry?** http://www.exploratorium.edu/education/ifi/inquiry
  An introduction to inquiry-based learning. From this page, you can also access *Pathways to Learning*, which delves deeper into teaching and learning through inquiry, and *Inquiry Structure*, which maps an approach to inquiry that can guide your activities. You can also learn how inquiry can be applied successfully in formal settings in *Inquiry: Thoughts, Views, and Strategies for the K-5 Classroom (*http://www.nsf.gov/pubs/2000/nsf99148/htmstart.htm).

- **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.

- **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.

- **Learning Science in Informal Environments**
  http://www.nap.edu/catalog/12190/learning-science-in-informal-environments-people-places-and-pursuits
  This 2009 report from the National Research Council draws together contributions from experts in the field to explain how informal settings can boost science learning and provides guidance for improving these experiences.

- **Center for Advancement of Informal Science Education** http://www.informalscience.org
  This is a growing repository for research and evaluation, project reports, and professional resources.

- **NISE Net Resources** –
  Team-Based Inquiry Guide – how to incorporate an element of evaluation (question/investigate/reflection/improve) into the process of designing a new activity.
  Universal Design Guidelines – how to create accessible programming.

Sharing Science Workshop & Practicum

Resources for Nanoscience Education & Outreach

Although the SSW&P can be applied with scientists and engineers from any field of research, we maintain this list of resources focused on nanoscale informal science education, reflecting the fact that the SSW&P was first developed in collaboration with university-based nanoscale science and engineering research centers, and dissemination of this Guide was supported by the Nanoscale Informal Science Education Network.

- **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. NISE Net also offers many professional resources. Their companion site geared to 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.

- ***NanoNerds* YouTube Channel** - http://www.youtube.com/NanoNerds
  This much trafficked channel produced by the Strategic Projects Group at the Museum of Science, Boston, is full of short videos, researcher talks for public audiences, news stories and podcasts, and examples of hands-on demos and animations created by early career researchers who are graduates of the *Sharing Science Workshop & Practicum* and Museum of Science internship programs. Videos from the popular *Talking Nano* DVD set (www.talkingnano.net) are also posted here.

- **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. They have a comprehensive "Education" section with links to additional resources (http://www.nano.gov/education-training). You can also download/print their brochures for the public – "Nanotechnology: Big Things from a Tiny World" (http://www.nano.gov/node/240) and "Nanotechnology and Energy: Powerful Things from a Tiny World" (http://www.nano.gov/node/734)

- **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.

- **The Amazing Nano Brothers Juggling Show**
  https://www.facebook.com/TheAmazingNanoBrothersJugglingShow
  This hilarious 40 minute romp through physics, chemistry, and nanoscale forces delights family and school audiences and is available as a travelling show for theaters, schools, museums, and science festivals. For more information, contact mailto:nano@mos.org

- **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.

SHARING SCIENCE WORKSHOP & PRACTICUM

Planning & Implementation Guide, v. 4.0

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

The SSW&P has undergone almost constant evaluation and iterative development, beginning in 2005 and continuing through the present day. This edition of the Guide, version 4.0, reflects our most recent (December 2015) adjustments and updates based on the evolving needs of our participants as well as the experiences of new SSW&P providers (see the Acknowledgements page up front). The SSW&P works in an impressive variety of circumstances, in science museums and in university settings, whether offered in the one-day or two-day format.

We also survey participants after their experience volunteering at NanoDays and other outreach events. Overall impressions of the *Workshop & Practicum* have been and continue to be very positive. Participants find the workshops useful and enjoyable; they reported increased confidence and skill engaging visitors with hands-on demonstrations and conversations about science, and they report increased interest in science and engineering education outreach. Highlights from the evaluation reports, some of which are posted in the NISE Net catalog, follow.

From a 2009 evaluation study of the two-day version of the SSW&P conducted by the University of Massachusetts Donahue Institute for Research and Evaluation:

- 89% of participants rated the *Workshop* as very or extremely useful. (n=52)
- The vast majority of participants agreed that as a result of the workshops:
    - 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%).
    - Improving their science communication skills became a greater priority (89%).
- 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 *Practicum* participants reported that they had a good time and enjoyed working with visitors.

From a 2011 study of the single day version of the SSW&P conducted by the Donahue Institute:

- All the participants enjoyed engaging with museum visitors.
- All participants reported an increase in confidence in engaging public audiences with science demos, and more than three-quarters were more motivated to get more involved with education and outreach.
- 85% agreed that they'd learned "a lot" about how to engage public audiences with hands-on science activities.
- 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.

Graduate Student Focus Groups and Faculty Interviews conducted by the Donahue Institute

The UMass Donahue Institute also conducted focus groups with graduate students who had participated in the Museum of Science *Sharing Science* programs and interviewed faculty of the NSF Center for High-rate Nanomanufacturing (Northeastern University, University of Massachusetts - Lowell, University of New Hampshire) whose students had participated. Their report led to a decision by CHN faculty to continue to place a high priority on integrating *Sharing Science* programs and events into their graduate education curricula.

From *Sharing Science Workshop & Practicum* participants surveyed between 2012-2015 (n=125):

- 92% reported increased confidence in engaging public audiences in conversations and science demonstrations.
- 88% rated the workshop session as "very useful" and 94% would recommend the workshop to their peers.
- In the open-ended response questions, participants frequently mention the following aspects as the "best" parts of the Workshop & Practicum experience:
    - the interaction with kids & families, and seeing their excitement about science.
    - the opportunity to practice their communication skills using hands-on demos.

From the NSF Center for Integrated Quantum Materials (Harvard University, Howard University, and MIT) 2015 tracking survey report by independent evaluator Lubella Lenaburg:

- "Regarding communication skills, the tracking surveys show that the Sharing Science Workshop and general communication training by Boston's Museum of Science have received a lot of praise from those who participated. Participants feel better prepared to discuss science with the public."
- "Members who have participated report experiencing benefits. One postdoc participant cited the outreach activities as the most beneficial of the education, knowledge transfer, or outreach activities provided by CIQM, stating, *"Presenting in front of young school kids and trying to approach young kids has been beneficial to me - it's quite different than presenting in a conference environment. ...* Faculty ...commented on the benefits of these workshops [as well:] *"The Sharing Science workshops, presentation workshops have been great - and offer a different perspective to the students."*

Student, Post-Doc, and Faculty Focus Groups conducted by Lubella Lenaburg for CIQM in 2015

These focus group interviews and subsequent reporting by Dr. Lenaburg confirmed the value of the *Sharing Science* program and led to a decision by faculty and staff of the Center for Integrated Quantum Materials (Harvard, Howard, and MIT) to renew and expand the professional development opportunities science communication and education and outreach provided by the Museum of Science.

Evaluation Instruments and Protocols

We use formative evaluation instruments – surveys and informal interviews – to monitor participant and stakeholder experience of the *Sharing Science Workshop & Practicum,* and to improve subsequent implementations. We recommend that formative evaluation protocols be applied with each new collaborator in each new location in order to continue shaping and optimizing the program for local needs and conditions.

The following pages contain samples of formative evaluation survey instruments we have used. You may adapt these with appropriate modifications, or simply consider them as guidance for making a set of inquiries better adapted to your implementation. Please keep in mind that in many situations, particularly those that involve minors, you may be required to have your evaluation protocol and survey instruments reviewed by a local Institutional Review Board charged with protecting the rights of those human subjects involved in research and evaluation. Some basic protections can be implemented in the design of the survey and the data collection process; for instance, not collecting names and aggregating data so that individual responses are not identifiable. Informal interviews and discussions with stakeholders and university faculty are invaluable, as is tracking the continuing involvement of participants over time.

The NISE Network also provides a Team-Based Inquiry Guide (http://nisenet.org/catalog/tools_guides/team-based_inquiry_guide) designed to help teams formulate their own research and evaluation questions and design approaches to investigating, reflecting, and improving program design and implementation.

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 the questions below, 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*. We'd appreciate your feedback on the experience and any ideas you have for improving the program. Please take 5-10 minutes to respond to these few questions. 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.

SHARING SCIENCE WORKSHOP & PRACTICUM

Planning & Implementation Guide, v. 4.0

Afterword: 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. We will be happy to hear from you about your experiences with the program and how you have introduced innovations, or adapted it for specific needs. Please share with us any recommendations you have for improving future editions of this *Planning & Implementation Guide,* at nano@mos.org.

If you are based in a science museum, we suggest you consult 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 guide, by Carol Lynn Alpert, provides step-by-step guidance for science museums wishing to build stronger collaborations - and funded collaborations - with members of their local research community. Such partnerships can grow out of initial education outreach collaborations launched with implementation of the *Sharing Science Workshop & Practicum* and can also help recruit participants for further implementations, encouraging more scientists and engineers to become involved in outreach.

Science museums and centers of research may also be interested in implementing our *Research Experience for Undergraduates (REU) Science Communication Workshop.* This two-afternoon program, implemented across the ten weeks of a typical undergraduate research experience, is designed to guide students in developing science communication skills that will assist them in producing excellent presentations and posters about their research projects, and sharing more about their research with family and peers. It has been successfully implemented and evaluated at a dozen universities across the country. The ***REU Science Communication Workshop Planning & Implementation Guide*** is available at www.nisenet.org/catalog/tools_guides/reu_science_communication_workshop

With all good wishes,
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