

Planning an Education Outreach Event Around NCSLI Metrologist Kits

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Abstract:

The NCSL International recognizes the need for a new generation of technicians, engineers and scientists in the calibration/metrology community. Metrology Ambassador is the title given to someone willing to go into the community and make a connection in an effort to excite and inspire young people to pursue further education in the technical sciences. One way to accomplish this is through an outreach event where you visit a local school or organization and involve the children in scientific experimentation. The NCSLI presently has six Metrologist Kits with four themes, containing a variety of sensors. The heart of these kits is the Vernier LabQuest™, a powerful and easy to use data gathering and analysis tool. This paper provides tips on using a Metrologist Kit as the focal point of your metrology ambassador outreach event and outlines helpful steps from the inception of your outreach idea to the conclusion of your outreach event.

Learning Objectives:

Session attendees will be able to identify outreach resources focused on NCSLI Metrologist Kits, plan an outreach event and document their activity.

Resources from NCSLI:

Metrologist Kits consist of a sturdy black plastic case, about 60cm x 36cm x 25cm (about 24" x 14" x 10") and weighing about 5 kg (10 pounds). The contents of each Kit were purchased by NCSLI from Vernier Software & Technology and contain a variety of sensors and a LabQuest (Figure 1). The LabQuest is a handheld device containing a 416 MHz application processor, with six sensor ports, 1 USB port, 1 mini USB port, 1 SD/MMC expansion slot, 9 cm touch screen graphic display and a few other goodies.



Figure 1: LabQuest with Stylus

Sensors are the transducers that convert an energy source into a format that can be captured and analyzed by the LabQuest. Vernier offers more than 60 different sensors such as, sound level meters, motion detectors and a variety of temperature devices. The NCSLI Training Aids Library presently maintains 12 unique sensors and a total of 28 sensors with redundancies. The sensors are divided up into 6 Metrologist Kits. Table 1 is provided here as a quick reference of the different names NCSLI has applied to the kits and Table 2 shows you what sensors are in each kit.

Metrologist Kit Name	Kit #
Environmental Lab Kit 1A	1
Environmental Lab Kit 1B	2
Experimental Lab Kit 1	3
Experimental Lab Kit 2	4
Light, Sound, Temperature Lab Kit 1	5
Light, Sound, Temperature Lab Kit 2	6
Optional Lab Kit	7

Table 1: Metrologist Kit names and numbers.

Device/Sensor Name	Part Number	Metrologist Kit #						
		1	2	3	4	5	6	7
LabQuest	LABQ	1	1	1	1	1	1	
Light Sensor	LS-BTA	1				1	1	
Motion Detector	MD-BTD	1						
Sound Level Meter	SLM-BTA	1				1	1	
Infrared Thermometer	IRT-BTA	1						
PH Sensor	PH-BTA		1					
UVA Sensor	UVA-BTA		1					
UVB Sensor	UVB-BTA		1					
Stainless Steel Temperature Probe	TMP-BTA		2	2	2	2	2	
Exercise Heart Rate Monitor	EHR-BTA			1	1			
Hand-Grip Heart Rate Monitor	HGH-BTA			1	1			
Surface Temperature Sensor	STS-BTA					1	1	
Force Plate	FP-BTA							1

Table 2: Sensors found in each kit.

Another resource is the Metrology Event Tracking form (Appendix A), which I'll provide guidance for filling out later. I think it's a good resource for ideas and tracking purposes, it also works well alongside an event checklist, which I'll offer later as well. It's very important that you submit the Metrology Event Tracking form at the completion of your event as it is a requirement of the Combined Federal Campaign (CFC Code 26683).

Resources from Vernier:

To tap into Vernier's resources you need to check out their web site at <http://www.vernier.com/labquest/>. I'll start with some keywords which I'm going to list in what I perceive as a hierarchy, starting at the top: Subject Area, Lab Book, Student Lab, Innovative Uses, LabQuest, and Sensors. I'll give you a brief synopsis of each of these keywords so you'll know what you're looking for when you surf the Vernier website. You're already familiar with the bottom of the hierarchy; LabQuest and sensors, now let's go to the top and talk about Subject Areas. These aren't physical items, they're simply a way to categorize lab books and associated resources, and there are presently 15 different subject areas from Agricultural Science to Water Quality. When you get to the website you'll want to check out the abundant resources under the "Physics" subject area. **Lab Books** are physical items, each containing student experiments with a materials list, step-by-step instructions, data tables, and questions. There's a Teacher Information section for each experiment to guide you through setting up the experiments with helpful hints and sample graphs and data. Table 3 lists the lab books presently in the NCSLI Training Aids Library. Note that some of the lab books fall under multiple subject areas.

Lab Book	Subject Area
Forensics with Vernier	Forensics, Middle School Science
Investigating Environmental Science Through Inquiry	Earth Science, Environmental Science
Middle School Science with Vernier	Middle School Science
Physical Science with Vernier	Physical Science
Physics with Vernier	Physics
Real - World Math made Easy	Math

Table 3: Lab books in the NCSLI Training Aids Library.

That brings us to the **Student Labs** which are the actual experiments to be performed using the LabQuest and sensors. A typical student lab begins with a synopsis of the experiment and some background or basic concepts then lists the objectives, the materials list and a few preliminary questions. This takes you to the actual hands-on step-by-step procedure of the experiment where the sensors and LabQuest are put to work and data can be acquired by the LabQuest as well as recorded by the students in the data tables supplied. Next you move to the analysis phase of the experiment, again with step-by-step instructions. Sometimes the student lab will include "extensions" where you're given ideas of more questions to pose and theory to explore. Extensions will come with any necessary formulas. The student lab also has safety information, essential instructor background information, directions for preparing solutions and important tips to insure your experiments are successful. The last of the keywords is **Innovative Uses** which are basically articles and ideas on experiments without the detail of a Student Lab. By now you should have some idea of the mountain of information available from the Vernier website: 15 subject areas, about 20 lab books, 60+ sensors, and hundreds of student labs and innovative uses.

Planning a Metrology Ambassador Outreach Event:

What I'm offering here is by no means definitive, I simply want to get you thinking about things you may want to consider. You'll also find that some of the activities follow others while some happen concurrently.

1. **Pick an audience:** Do you have a child, niece, nephew or neighborhood kid you'd like to see benefit from your Metrology outreach event? How about a teacher or a school? You probably have someone in mind already and maybe you've already done some networking. It's called an "outreach event", so reach out to a scout troop, church group, the local YMCA or YWCA. How about organizing with your NCSLI Section Coordinator to do something at the next section meeting? The idea is to inspire the younger generations to increase their math and science skills and some day choose a calibration or metrology related career. If you think you'd feel more comfortable or just want to try a test run with your peers as students, go for it! From there you can graduate to high school, then middle school and maybe to grade school.
2. **The Match Game:** I call it this because we need to match up several of our resources. We have an idea who we want to reach, we know what kits are in the NCSLI inventory, we know which sensors are in which kits and we have an idea as to the capabilities of the LabQuest and sensors. Now might be a good time to contact your prospective audience, inform them of your affiliation with NCSL International and your wish to facilitate an outreach event as a Metrology Ambassador. Find out where the class is in their studies, can you offer something that fits in with the current lesson plan? Can you reinforce something from a recent lesson? How can you match your resources with the teacher's needs? You also need to match your schedule with the teacher's schedule. Select a date and know how much time you'll be allotted for the event. Keep in mind that this is somewhat of a juggling act between schedules and kit availability so pencil in the date until all can be confirmed.
3. **Draft a Lesson Plan:** You know the age of your audience and you've decided on a topic for the event based on the teacher's and class' requirements, kits and sensors, and your personal knowledge base. Now you need to decide if you're going to use a lab book and student lab or create your own experiments. This is up to you and maybe the teacher, either way you at least have a basic concept of the experiments and their objectives. Start penciling in a schedule, material list and checklist. If you're going to use a Vernier student lab download the evaluation copy to get you rolling. Evaluation copies are available on the Vernier website free of charge. On your schedule allot time for things like; set-up, introduction, experimentation, closing, tear down and pack-up. Keep in mind that experimentation includes; preliminary questions, data retrieval and recording, crunching the numbers, data analysis, and discussion with Q&A. You may want to create one materials list that includes everything you'll need for the event or you may want to break the items into multiple lists, whatever you feel most comfortable with is what will work best.

4. **Reserve your Metrologist Kit:** Kits can only be loaned to member companies of the NCSLI and need to be ordered through your company's NCSLI member delegate. If you don't know who your member delegate is you can surf the NCSLI website for the Who's Who Volunteer Roster and look it up or call the business office (303-440-3339). Once you've identified your member delegate and you know when you'll need the Metrologist Kit, you and your member delegate can place the order. Kit loans are for 30 days so you'll need to time it appropriately, unfortunately at this time the process only allows you to order the kit and doesn't allow you to reserve it for a future date, so timing is important. I suggest you also allot yourself some time to practice with the kit prior to your event. When you are ready to order the kit have your member delegate log into the ncsli.org website and click "Log On" at the top of the page. This will require your member delegate to know their Logon, typically their email address, and Password. You may want to do a practice run so you're both familiar with the process when you're actually ready to place the order. When you order a kit, it will not automatically come with a lab book. If you want to check out a lab book, so you can take advantage of the student labs, you can check them out separately from the Training Aids Library at the same time you order the kit. Remember, you can always contact the business office if you have any problems with the any online process.
5. **Receive the Metrologist Kit:** The kit will typically arrive with the hard plastic case packed in a cardboard box. Inspect it for damage and perform an initial inventory. I recommend creating an inventory list with 4 columns for check-off; the first column for the initial inventory, the second column to use just prior to your event, the third for prior to leaving your event, and the fourth for prior to returning the kit to the Training Aids Library. I can't stress enough how important it is to know what you have and when you've had it so if you do misplace something you have a chance of retracing your steps. Be sure to save the cardboard box and any packing materials for reuse when you return the kit. I also recommend connecting each of the sensors in the kit to the LabQuest and verifying all is in working order.
6. **Finalize the Lesson Plan:** You need to start inking in your draft lesson plan, either once you know the kit is on its way or once you've received the kit and have had a little time to familiarize yourself with it. Ink in the date and time with the teacher. Start gathering any ancillary materials required for your experiments. You know what comes with the Metrologist Kit so make sure that either you or the teacher has everything else you need. Does the classroom have a Bunsen burner, ring stand and beakers? How about an icemaker or should I bring a small cooler of crushed ice? Make a list of all the materials you'll need, to include any handouts, brochures, cleaning supplies, trash bags or any incidentals you can think of. Keep in mind that you can always request items from the NCSLI business office through your member delegate. Depending on what they have available, you can get pens, key chains, flashlights, metric conversion charts and holographic World Metrology Day rulers. Not to mention scholarship posters and

postcards and “Find a Cool Career in Metrology” DVDs. Make sure you have your best guess of the headcount to give the business office so you have enough goodies to pass around. Take a look at the Ambassador Event Tracking form (Appendix A) and locate the section titled “Resources Distributed”, this isn’t a definitive list so don’t be shy about asking what’s available.

Include another Q&A session after the conclusion of the experimentation process. Ask the students something like, “What did you learn today that you can’t wait to share with your friends and family?” Allot time in your schedule for them to write down their responses. Ask if anyone wants to share what they wrote with the class and be sure to have them turn in their papers, you’ll need them later for the Ambassador Event Tracking form. You might want to discuss your questions beforehand with the teacher so they can offer suggestions and assist in the process.

7. **Practice:** Once you’ve received the Metrologist Kit you’ll have something to play with. Familiarize yourself with the LabQuest and whatever sensors your experiments will require. Run through the experiments with friends, co-workers or family members so you’re comfortable with the process and have reasonable confidence that you’ll get similar results with the students. When you’re ready to pack everything for your event, grab that inventory checklist you made when you first received the kit and run through inventory #2. Remember to pack the inventory checklist in the Metrologist Kit.
8. **Perform the Outreach Event:** This is what all your preparations have led up to so: relax and have fun with it! Keep mental notes of ways to improve your process for the next time and if something goes wrong, remember that failure is a large part of experimentation. Keep your lesson plan and schedule handy and try to stay on schedule.
9. **Closeout:** Before you leave the classroom make sure you’ve handed out all of the goodies and collected the kid’s written responses. You don’t want to leave anything from the Metrologist Kit behind so run inventory #3. Finalize any follow-up plans with the teacher and make sure you have all the notes you need to complete the event tracking form. Clean up the lab area and make sure all trash is disposed of properly.
10. **Ambassador Event Tracking Form:** Let’s go over the form so you have an idea of what’s expected. The following bullets are the requirements from the form (in bold) followed by my guidance for replying.
 - **Ambassador Name and Contact Info, NCSLI Section Number:** You’re the ambassador so you should know this info. Ask your member delegate if you don’t know the NCSLI Section you fall under.
 - **Event Contact Info, Organization, Phone, Email, and Mailing Address:** Who did you organize this event through; Teacher, Scout Master, Grand Poobah? Be sure to get all of the details requested (required for CFC funding).
 - **Date of Event:** No brainer...

- **Number of Teachers:** I think this is a little ambiguous if your event is taking place at a school, but the use of “teacher” here refers only to you and any teaching assistant you have and not any of the school’s teachers.
- **Number of Students:** This one is straight forward.
- **Assessment of Diversity:** Political correctness takes somewhat of a back seat here. As the form points out, this information is used for outreach reporting and grant proposals. So please be matter-of-fact, maybe slightly blunt, but definitely not insensitive. Example: Inner city 4th graders, 8 Asian, 7 Indian, 6 Hispanic, 5 African American, 4 Caucasian
- **Response/enthusiasm from group (please explain):** This requires two things; circle a rating from 5 to 1 and give a written explanation. Explain why you selected the particular rating. Let’s say you circle 5 and say “during Q&A I asked what the students will tell their friends and family about today’s event. The many excited responses told me that learning objectives were met and the kids were already applying their new knowledge.” Maybe you circle 1 and say “due to a facilities problem the room temperature was uncomfortably warm and the kids were having a hard time staying focused.”
- **Feedback from attendees:** If you had the students hand in papers, compile the feedback into a Word document then cut and paste it into the block on the left side under (please explain). Also document any feedback you received verbally. Be sure to circle your feedback rating.
- **Overall, how do you think it went?** Same as feedback from attendees only from your perspective.
- **Resources Distributed:** Aside from the materials specifically used for the experiments, what goodies did you hand out? If you don’t see it listed go ahead and add it under “Other”.
- **Resources Used:** Check off any of the resources listed here. If you used something that isn’t listed but you feel it should be in the list, go ahead and add it under the last item.
- **Follow-up Planned or Requested?** Describe what you’ll do to as follow-up. As an example; maybe the students will be tested in two weeks on concepts covered during your event. Ask the teacher if she/he can provide you with test result numbers, no names just numbers.
- **Describe the activity/event. Provide feedback on NCSLI Resources:** How’s this sound for the first part? “Metrology Ambassador Outreach event using the Environmental Lab Kit 1A and performed experiments showing the freezing point of water.”

For NCSLI resources; how easy was the NCSLI website to navigate? How did the kit ordering process go and did the kit arrive when you expected it to? Did you get the handout materials you requested?

For lessons learned, relate anything that occurred throughout the entire process which you'd hate to see someone else suffer through.

Measurement kit tips and other suggestions, relate anything that occurred throughout the entire process which you'd love to see someone else experience.

- 11. Return the Metrologist Kit:** Let's say the event is over and it's been 18 days since you received the kit, so you need to return it within the next 12 days (remember 30 day loan). Are you done with it? If so, go ahead and return it to the Training Aids Library. The return address is on the case of the kit. Place the case back into the box it was shipped in and label it with the return address. You can either contact the NCSLI business office for return authorization or ship it through your company's resources, whatever is easiest for you. If you do use your company's resources please allow for \$750 worth of insurance.

What if you came up with a really neat idea for an experiment while you were in the middle of your presentation? Hey, you have 12 days left, go ahead and do some experimenting on your own. Research the Vernier libraries to confirm your idea is unique. You just may be able to submit an innovative use, student lab extension, totally new student lab or helpful hint for an established student lab. Be sure to send your modifications in with your Ambassador Event Tracking form so other ambassadors can benefit from your creativity! Now that would add a win to a win-win situation!

- 12. Event Process Checklist:** For a suggestion of the type of things you might want to track in a checklist, let's refer to Table 4. This is strictly for you, it is not a requirement of the NCSLI so do what you want with it, however there are items on the list that are also requirements on the Ambassador Event Tracking (AET) form. I've also placed some example data in the notes column. Appendix B contains a blank checklist.

Conclusion: We can see that both the NCSLI and Vernier Software & Technology offer a great deal of resources. You now know which sensors are in the kits and what kits are available from the NCSLI Training Aids Library (ncsli.org). You know what a student lab is and how to identify which lab books have the student lab to suit your needs. You understand the relationship between subject areas and lab books and resources like innovative uses and student lab extensions. You've been given the main steps involved in conducting an Ambassador Event and a checklist. Now it's time for you to get involved and become a Metrology Ambassador!

Check	Item	Task	Notes
√	1	Event Title	Mr. Smith's 4th Graders
√	2	Member Delegate & Info	Joe Lincoln, ext 5548
√	3	Event POC & Info (AET form)	Larry Smith, see AET
√	4	Prospective Event Date	June 17th
√	5	Firm Event Date (AET form)	June 19th
√	6	Draft Lesson Plan Complete	June 1st
√	7	Metrologist Kit Identified	Kit 2, 3, 4, 5 or 6
√	8	Metrologist Kit & Order Date	Kit 2 on June 1st
√	9	Metrologist Kit Receive Date	June 8th
√	10	Metrologist Kit Inventory #1 (Initial)	June 8th
√	11	Metrologist Kit Inventory #2 (prior to event)	June 18th
√	12	Metrologist Kit Inventory #3 (prior to leaving event)	June 19th
√	13	Lab Materials List (supplied by me)	see attached
√	14	Event Materials List (supplied by me)	see attached
√	15	Lab Materials List (supplied by event POC)	see attached
√	16	Event Materials List (supplied by event POC)	none required
√	17	Final Lesson Plan	June 11th
√	18	Metrologist Kit Drop Dead Return Date	July 3rd
√	19	Student Responses Compiled	June 21st
√	20	Ambassador Event Tracking (AET) submitted	June 22nd
√	21	Metrologist Kit Inventory #4 (prior to return to NCSLI)	June 22nd
√	22	Metrologist Kit Returned	June 22nd
√	23	Follow-up Responsibilities	Call Larry Smith to follow-up on July 15th

Table 4: Ambassador Event Checklist

APPENDIX A

Ambassador Event Tracking

Ambassador Name and Contact Info, NCSLI Section Number:		
Event Contact Info: Name, Organization, Phone, Email, and Mailing Address		
Date of Event:		
Number of Teachers:		
Number of Students:		
Assessment of Diversity (used for outreach reporting and grant proposals). Please describe in your own thoughts the diversity of the group.		
Response/enthusiasm from group (please explain)	Excellent 5	4 3 2 1 Poor
Feedback from attendees (new sign-ups, Q&A, etc.) (please explain)	Excellent 5	4 3 2 1 Poor
Overall, how do you think it went?	Excellent 5	4 3 2 1 Poor
Resources Distributed:	<input type="checkbox"/> Multi-Media Career DVD <input type="checkbox"/> NCSLI Membership Brochures <input type="checkbox"/> NCSLI Call for Papers <input type="checkbox"/> NCSLI Poster(s) <input type="checkbox"/> Metrologycareers.com link	Not available yet: <input type="checkbox"/> Virtual Physical Laboratory <input type="checkbox"/> Other: _____ _____
Resources Used: <input type="checkbox"/> NCSLI PowerPoint Presentation – Introduction to Metrology (available: http://www.ncsli.org/training/education.cfm) (English and Spanish versions) <input type="checkbox"/> NCSLI PowerPoint Presentation – Careers in Metrology <input type="checkbox"/> Video/DVD (which one(s)?) <input type="checkbox"/> Laboratory equipment and/or standards (give examples) <input type="checkbox"/> Measurement Kits (from NCSLI training library) <input type="checkbox"/> Self-developed lesson plan (please submit copy) <input type="checkbox"/> NCSLI Outreach or Learning and Development Poster <input type="checkbox"/> Job Descriptions Article ¹ <input type="checkbox"/> Education Projects and Sponsorship Flyers <input type="checkbox"/> CFC ads and magnets		
Follow-up Planned or Requested? Please describe follow up plans.	Yes/No	
Describe the activity/event. Provide feedback on NCSLI Resources, lessons learned, measurement kit tips, other suggestions:		

¹ The Metrology Job Description Initiative: NCSLI and ASQ Partnering for the Future, Christopher L. Grachanen, Measure Journal, June 2007, chris.grachanen@hp.com. Return this form to: elizabeth.gentry@mist.gov (301-975-3690).
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APPENDIX B

Ambassador Event Checklist

Check	Item	Task	Notes
	1	Event Title	
	2	Member Delegate & Info	
	3	Event POC & Info (AET form)	
	4	Prospective Event Date	
	5	Firm Event Date (AET form)	
	6	Draft Lesson Plan Complete	
	7	Metrologist Kit Identified	
	8	Metrologist Kit & Order Date	
	9	Metrologist Kit Receive Date	
	10	Metrologist Kit Inventory #1 (Initial)	
	11	Metrologist Kit Inventory #2 (prior to event)	
	12	Metrologist Kit Inventory #3 (prior to leaving event)	
	13	Lab Materials List (supplied by me)	
	14	Event Materials List (supplied by me)	
	15	Lab Materials List (supplied by event POC)	
	16	Event Materials List (supplied by event POC)	
	17	Final Lesson Plan	
	18	Metrologist Kit Drop Dead Return Date	
	19	Student Responses Compiled	
	20	Ambassador Event Tracking (AET) submitted	
	21	Metrologist Kit Inventory #4 (prior to return to NCSLI)	
	22	Metrologist Kit Returned	
	23	Follow-up Responsibilities	