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Addressing the Call to Increase High School Students' STEM Awareness Through a Collaborative Event Hosted by Science and Education Faculty: A How-To Approach

Abstract

With the economic competitiveness of the United States dependent on an adequate supply of high-quality workers in the STEM fields, President Obama outlined a broad agenda to reinvigorate our country's interest in STEM. Responding to this call, organizations such as the National Lab Network and the STEM Education Coalition began efforts to raise public awareness to inspire K-12 students to pursue STEM careers. Answering the call to action, faculty from a Land-Grant institution developed their own version of National Lab Day (NLD), which extended beyond traditional college and departmental boundaries. This article describes a model used to create a greater awareness of STEM careers among attendees, recruit high school students into STEM fields, and provide STEM researchers with opportunities to disseminate their research to the general populace. It further describes the responsibilities of the NLD planning committee, which consisted of research and education faculty from each of the participating colleges across our university; the layout of the program; and the recruitment of STEM researchers, volunteers, and high school teachers and students. Data from NLD participants provides evidence of the success and impact of this five-year program. In addition, the possible implications of these efforts on research institutions are addressed.

Keywords: National Lab Day, outreach, STEM majors, student recruitment

Introduction

The growth in science, mathematics, engineering, and technology (STEM) related jobs has nearly doubled that of all other fields over the past decade (U.S. Department of Labor, 2007). The economic competitiveness of the United States is dependent on an adequate supply of high-quality workers in the STEM fields. However, many students who are academically qualified for postsecondary studies in STEM fields don't pursue those programs (U.S. Department of Labor, 2007). Concerns addressed in the seminal National Academy of Sciences study, *Rising Above the Gathering Storm* (2007a), still resonate today in that, absent a serious and rapid response, the U.S. will lose quality jobs to other nations due to an underprepared workforce.

Teachers are arguably the single most important factor in student achievement. But according to a 2010 survey by the American Society of Quality (ASQ) and Harris Interactive, while teachers have adequate science content knowledge, some do not provide students with adequate information about how science is useful to future careers (as cited in Causer, 2010). If teachers are not informing students about careers, then students may have little knowledge of the vast number of STEM career options available. In 2009, President Obama outlined a broad agenda to reinvigorate our country's STEM enterprise in an effort to increase the competitiveness of the United States in these important fields by urging STEM research faculty to play a vital role in this endeavor:

> I want to persuade you to spend time in the classroom, talking and showing young people what it is that your work can mean, and what it means to you … to think about new and creative ways to engage young people in science and engineering … [to] encourage young people to be makers of things, not just consumers of things. (National Science Foundation, 2009)

Responding to President Obama's call to action, business and education advocates formed the STEM Education Coalition in an ongoing campaign of events to: (1) improve educational outcomes, (2) inspire students to pursue STEM careers, (3) improve hands-on laboratory environments, and (4) raise student, parent, and public awareness of the importance of science and technology to our nation's future. A National Lab Network began enabling STEM professionals, in partnership with teachers and schools, to contribute knowledge and skills to improve secondary school laboratory facilities and foster educational activities that support learning in a hands-on environment.

The original concept behind National Lab Day (NLD) was to pick one day a year to facilitate and promote hands-on learning across our nation's classrooms. Later, the name changed to National Lab

Network to reflect the spirit of on-going community and connectivity. This article describes a multifaceted, collaborative program developed to address the initial call to action of introducing high school students and their teachers to a variety of STEM majors and careers. Our event has sustained success for five years with year six in its initial stage of planning. We offer this descriptive article as a guide to help other faculty and administrators interested in holding effective National Lab Day events at their institutions. What follows is a depiction of the event, suggestions and rationale for each component, and evidence we have gathered to evaluate our success.

Our Version of National Lab Day

Overview

Our version of NLD consisted of three major components – concurrent interactive sessions in scientists' laboratories, lunch with the scientists, and a *Major's Showcase* – all sandwiched between brief opening and closing sessions. During the opening session students meet the guides who will escort them for the day, have pictures taken with campus mascots, and listen to a short presentation by a scientist comparing the STEM of the scientist's youth to the STEM of today. The students are also given a preview of what they can expect throughout the day. During concurrent lab sessions, teachers and students participate in three small-group sessions of their choosing led by scientists and their graduate students. In each 45-minute session, held in the laboratories of the hosting scientists (if safety permits), the scientists and their graduate students briefly introduce themselves and their research and allow high-school students to engage in an experiment, investigation, or simulation. At lunch, students and teachers eat with the NLD volunteers and scientists. During the *Major's Showcase*, student advisors from the participating colleges briefly describe the options available to the students and answer questions. During the closing session, students and teachers receive backpacks filled with souvenirs, college information, and pictures of the day.

A Brief History

The initial NLD Planning Committee consisted of four faculty members from two colleges within our university who were asked to answer the call for partnerships between K-12 educators and STEM research professionals. The planning committee's goal was to develop an on-campus STEM research awareness experience for high school teachers and students. This one-day event was to pair teachers and students with STEM faculty researchers who could promote an awareness of potential college majors and careers not previously on their academic radar. Over the past five years two additional STEM-focused colleges have joined our collaboration, with a fifth college joining in the upcoming year.

While researchers are in the spotlight throughout the day, the event also involves a large number of individuals working behind the scenes. In fact, the success of our program comes from the diversity of participating individuals. During this program, STEM researchers from across four colleges and eighteen departments open their labs to teachers and students from rural, urban, and suburban schools across the state. Each teacher/student group is escorted by an NLD volunteer throughout the day.

Buy-in by College Deans

Colleges joined our efforts for the opportunity to recruit potential students and to provide community outreach. Colleges were invited to participate when faculty in that college expressed interest in hosting teacher/student groups in their research labs. The NLD committee chair then contacted the dean of the college and set up a meeting to seek financial and professional support for the program. The financial support is used for purchasing morning snacks, lunch, photos and frames, nametags, mascot rental, etc. We also asked the college deans to recommend one or two faculty members to represent each college on the NLD planning committee. The program is internally funded by the deans of the four participating colleges, who each provide $1500 to cover program expenses. The more colleges that commit to our program, the less time required to seek external funding and the more scientists' session options we can offer visiting teacher/student groups.

Role of the NLD Planning Committee

The NLD planning committee begins meeting each year in September to plan the NLD event that takes place the following May. Selecting a day requires consideration of both university and high-school constraints. Table 1 provides a nine-month timeline of the major events addressed by the planning committee. During the day of the event, if committee members are not hosting their own lab sessions, they work with the event planner and volunteers to make sure the day runs smoothly.

Table 2 is the NLD schedule as designed to accommodate our increasing number of participants. Throughout the day, each teacher/student group is escorted to three labs. During each 45-minute lab session, researchers and graduate students engage groups in an interactive science activity relevant to the research conducted in their lab. An increase in the number of teacher/student participants requires the committee to recruit additional researchers and volunteer group-leaders, and acquire access to larger general session accommodations. The number of teacher/student participants we could host was limited initially by the availability of rooms large enough to hold sessions when all teacher/student and volunteer participants were together. For this reason, we have moved to a split lunch. While half of the participants partake in lunch and enjoy the interactive table decorations, the other half attends the *Major's Showcase*. The split lunch concept allows all groups to stay on the same time schedule.

Selecting the Date

We selected a day (*i*) immediately after university finals, (*ii*) after mandated state testing for the high school participants, and (*iii*) before high school students are released for the summer break. Selecting a day before mandated

Table 1. NLD Planning Committee's Year-long Timeline

Timeline	Activity
September – May	NLD Planning Committee meets once a month from September - December, twice a month from January-March and then weekly until National Lab Day. The committee consists of faculty representatives from participating colleges.
September – November	• Each participating college donates $1500 • Reserve a large lecture hall for the opening & closing sessions. This is the limiting factor in the number of teacher/student groups we can host. • Reserve a large room for lunch • Reserve a room for the *Major's Showcase* • Reserve catering service for morning juice & donuts, and Lunch
December	• Send out initial Save-the-Date recruitment emails encouraging STEM research faculty to participate in the May NLD event. We contact college Deans, Deans of research, and department heads to help spread the word. • Contact academic advisors about participating in the *Major's Showcase*
January	• Send teacher/student registration information to the Oklahoma Department of Education and the State Science Teachers Association
February – March	• Recruitment of volunteers for NLD (one volunteer for each teacher/student group plus 5-8 additional volunteers) • STEM researchers turn in session titles and abstracts • Order: picture frames, lanyards, name tags • Teachers are selected from the pool of applicants with priority given to rural schools and schools with large populations of underrepresented students. • Solicit Freebies for teachers and students • Confirm availability of the university mascot for group pictures
April	• Researcher's session titles and abstracts are sent to participating teachers for selection of their top five session-choices • Once teachers have returned their session-choices a schedule is developed
The day before the NLD event	• Stuff teacher/student bags with freebies • Volunteer's meeting • Name Tags printed • Registration packets stuffed • Set up lunch tables with science decorations • Set up registration table
Day of the event	• Ready, Set, STEM Research!

state testing was completed would have reduced the pool of participants because teachers and students were using all available time to prepare for or complete tests. After the tests, teachers often look for new activities to engage their students. While selecting a day when university classes were in session would have provided a larger pool of undergraduates to serve as guides and assistants, most students would have conflicts with classes or exams and faculty would be involved with class preparation, testing or grading. Furthermore, classrooms, auditoriums, and parking facilities were unavailable for use. Soon after the semester ends, faculty take vacation or continue research in earnest and the undergraduates are gone. In our case, our NLD event was held on the day semester grades were due so faculty members were still on campus before summer events began.

Soliciting STEM Researchers

STEM researchers are the backbone of the event as they volunteer their time, energy, lab, equipment and graduate students to ensure participating teachers and students have enjoyable and worthwhile learning experiences. Research faculty, especially, faculty from newly participating colleges, are recruited by their college's representative on the NLD planning committee, through emails, announcements at faculty meetings, or personal visits to offices and labs. Note: General emails passed through administrators solicited few participants, while most responses were to second solicitations (in person or email) directly from NLD committee members to researchers. To simplify data entry for interested faculty and the committee, we created an online registration form using Qualtrics® which asks for contact information, maximum number of lab sessions to be offered (up to three), session title and abstract. No incentives or inducements are offered for participation. We found that veteran participants responded much more rapidly when NLD committee members solicited their participation in an email that included their registration data from the previous year. Many of our STEM researchers have participated for multiple years (see Table 3). Once they have agreed to participate, STEM researchers (their graduate students and all other volunteers) are required to complete the *Minors on Campus Policy Training*.

Session Design

Research sessions with catchy titles (e.g., "What's on the Menu?," "Termite NASCAR and other Insect Investigations," "Lassoing Lizards," "Space Cowboys," and "What do Math and Science Have to Do with Sled Dog Racing?") and interesting abstracts are selected most often regardless of the STEM discipline. Thus, we encourage researchers to spend time on their abstracts or seek guidance from science education faculty who work regularly with K-12 teachers and students. We have found that 45-minute sessions are long enough for researchers to conduct an activity and short enough for teachers and students to remain engaged and leave the lab with continued interest in the researcher and subject matter investigated. We ask that sessions involve students in interactive activities such as data collection and analysis, extracting DNA, inoculating agar plates, interacting with "smart" robots, or deconstructing various materials. Researchers are encouraged to create items that students can take with them; PowerPoint lectures are discouraged.

Table 2. NLD Model Schedule

Time	Activity
8:00 – 8:45	Registration, group photos, and morning snacks
8:45 – 9:15	Opening remarks
9:15 – 9:30	Walk to first session
9:30 – 10:15	Lab session #1
10:15 – 10:30	Walk to second session
10:30 – 11:15	Lab session #2
11:15 – 11:30	Walk to lunch room
11:30 – 12:00	Group 1 Lunch Group 2 Visit with Academic Advisors at *Major's Showcase*
12:00 – 12:30	Group 2 Lunch Group 1 Visit with Academic Advisors at *Major's Showcase*
12:30 – 12:45	Walk to third session
12:45 – 1:30	Lab session #3
1:30 – 1:45	Walk to closing session
1:45 – 2:15	Closing remarks and hand outs
2:15	Leave to return home

Soliciting High School Students and Teachers

High school teachers served as our contacts for bridging high school students and researchers. Invitations to teachers and schools are sent by the NLD planning committee chair who is familiar with teachers and schools across the state. Email invitations are also sent to teachers through the State Science Teachers Association and the State Department of Education listservs. Similar to the registration for researchers, teachers register online and identify seven students to accompany them to the NLD event. We encourage teachers to select students currently in their sophomore or junior year as our NLD event also serves as a recruitment opportunity for participating colleges, and the University application date for seniors has passed when the event occurs. We identified seven as the optimal number of students to accompany each teacher because (*i*) seven students and one teacher could comfortably and safely ride in most school vans; and (*ii*) seven students, one teacher, and one NLD volunteer-guide could comfortably and safely move around in research labs on our campus.

Three weeks prior to the NLD event, teachers receive a list of titles and abstracts for the NLD research sessions. From the list, each teacher selects five session choices based on the interests of their students. Teachers and students from the same school remain together and attend sessions as a group. This provides an extra layer of management, as teachers understand and are familiar with the behavior and health issues of their students. This teacher-student group strategy also allows our research faculty to interact freely with each teacher/student group without having to deal with classroom management issues that might interfere with the learning experience. Pictures are taken throughout the day and the teachers guarantee that every student participating in our NLD event has a signed photo release form in addition to the other permission forms required by the participating high-schools. Because program impact data are collected, teachers also distribute, collect and return signed Institutional Review Board (IRB) informed consent forms.

Major's Showcase

We offer a split lunch period (high-school students are used to this as most are normally provided only 30 minutes to eat), which allows us to strengthen the event as a college recruitment tool. During the lunch period, when students were not eating, they attend what we called the *Major's Showcase.* Similar to a career fair, this session provides academic advisors time to talk with students about different STEM majors available at our university. Prior to the NLD event, the planning committee meets with academic advisors to explain the purpose of the event and how best to serve students during each of the two 30-minute sessions. We have learned to set up a large room with tables where advisors display their informational materials and interactive displays. During the showcase, students chose the academic areas and the specific advisors with whom they wish to speak. Advisors are asked to refrain from distributing pamphlets because students tend to leave them in post-lunch laboratory sessions. Instead, we place advising materials in bags/backpacks that teachers and students take home at the end of the day. This method keeps researchers' labs free of paper clutter and ensures that recruitment materials go home with the students.

Importance of Volunteers

NLD volunteers consist of graduate and undergraduate science majors, academic advisors and undergraduate students pursuing a degree in secondary science education. Preservice science education students use this event to strengthen their professional resume and network with teachers from various parts of the state. Volunteers work at the registration table, decorate tables for lunch (we find 4L Erlenmeyer flasks filled with colored water and dry ice a fascinating conversation centerpiece for students), dispense food during breakfast and lunch, prepare teacher and student bags, and serve as NLD group leaders. To ensure that volunteers know our expectations, we hold a mandatory meeting the day before the event during which we address potential issues or concerns, provide the schedule of the day's events and, for the group leaders, identify the location of each laboratory session they will attend the following day. (Note: Do not assume student volunteers know the names or locations of research buildings. We recommend that group leaders actually walk to their three assigned lab sessions before the actual event.)

Table 3. NLD Participants

	2010	2011	2012	2013	2014
Schools	6	9	10	16	19
Teachers	8	9	12	18	21
Students	46 Total 25 Males 21 Females	62 Total 24 Males 38 Females	87 Total 32 Males 55 Females	126 Total 59 Males 67 Females	130 Total 52 Males 78 Females
Researchers	15	19 Ten returning from the previous year	14 Twelve returning from previous years	27 Fourteen returning from previous years	26 Sixteen returning from previous years
Volunteers	12	14	17	24	27

During the volunteer's meeting, group leaders are assigned to a specific school group giving them time to learn the names of the teacher and students in their group prior to the event. Then, as individual groups arrive at the registration table and receive their packets, each volunteer extends personal greetings making teachers and students feel welcomed right from the start. Group leaders stay with their assigned groups throughout the day and are responsible for making sure each group is photographed with our school mascot, a NASA astronaut suit, or a 5-foot, black-and-orange Mexican subspecies of green iguana named Elvis; is offered donuts and juice before heading to the opening ceremony; and is escorted to each lab session, lunch, the *Major's Showcase*, and the closing session. During each research session, volunteers photograph group members interacting with STEM researchers. These pictures are provided to researchers for promotion of their K-12 outreach efforts. In year five, we expanded these efforts to include a real-time Twitter feed.

Program Evaluation and Evidence of Impact

Evidence of program impact can be gathered by both quantitative and qualitative means. First, in addition to a growing number of participants served each year, data provided by the University reflects a high recruitment rate of the participating students into STEM majors following NLD experiences. Results from an exit survey distributed to researchers, teachers, and students in 2014 inform an understanding of why they participate and what they gain from the NLD experience. The discussion section contextualizes these findings within a *broader impacts* model for exposing students to authentic science practices.

Who We Served…

One goal of our NLD event was to recruit students into STEM majors by providing a fun and educational snap shot of and connection to authentic STEM researchers. Table 3 provides the number of participants in our NLD event over the past five years. There were increases in the number of schools, teachers, students, researchers, and volunteers participating. Of the 195 high-school sophomores or juniors who attended our NLD event during the first three years, 41 students (21%) have declared a STEM major and are currently attending our university. Additionally, we have found that faculty in all STEM areas are extremely interested in disseminating their research and recruiting students into their programs. Our NLD event is one venue faculty and colleges are using to accomplish this. Each year we have over 50% of our lab sessions conducted by research faculty who have participated in previous years.

Over the past five years, increased interest in the program has forced us to manage teacher registration on a first-come basis. This past year, we reached our maximum teacher/student limit within five days of sending our "Save-the-Date" notice, demonstrating an increasing interest in the program.

Following the 2014 NLD event, an anonymous exit survey was distributed to researchers, teachers, and students. Researchers received their two-page survey in a self-addressed campus envelop that was hand delivered by an NLD volunteer during the researcher's first lab session. Teachers received a packet during the closing session that contained a four-page teacher survey and a four-page student survey for each student., Teachers were asked to return completed forms in self-addressed, pre-stamped envelopes which we provided. Surveys included fixed response questions on a seven-point scale and open-ended questions. The following sections summarize the program evaluation findings.

Why They Participated…

Researchers. Ninety-four percent of the participating 2014 NLD researcher survey respondents (N=17) indicated that they would participate in our NLD event again and offered a number of reasons for their initial participation. One overarching theme of the open-ended responses spoke to concerns and interests in National Science Foundation (NSF) broader impacts and university outreach interests. In addition to raising general interest and enthusiasm for science, most researchers referenced their desire to recruit or expose students to their research field. One researcher stated, "*Enrollment in our program is extremely low. I saw this as an opportunity to introduce a field that few people know about to young people who might be interested in pursuing it as a career*." Another researcher indicated an interest "*in outreach opportunities for [their] research within K-12 schools*" while being unsure as to how to make initial contacts and seeing NLD as a mechanism to make this happen. A third researcher uses the NLD event to make connections with schools

indicating an interest "*in mentoring high school students in [their] research lab*."

When asked about their perceived impact on students visiting their laboratories, NLD researchers pointed to the lab as a way to generate interest and awareness about a variety of STEM careers. Researchers were motivated to demystify common misperceptions about the work of scientists as only "*located in labs*" or all about "*petri dishes and lab coats.*" As one researcher reflected, "*We showed them they are already scientists.*" When researchers were asked how they conducted their sessions, 100% indicated that they engaged students in hands-on activities. They also incorporated physical demonstrations (82%), some form of discussion or constructive argumentation (81%), or a visual presentation (71%). Fifty-eight percent of the faculty provided handouts or some kind of science "take-away" such as DNA, inoculated agar plates, plants, bird feathers, or lizard lassos.

Teachers. The 2014 teacher respondents (N=10; 48%) offered several reasons for participating in National Lab Day. Teachers often cited the opportunity as valuable to improving student understanding of science research and lab experiences. Nearly all the participating teachers expressed the need for students to be exposed to possible STEM careers and "the university" experience. As one teacher explained, "*My students attend a small, rural high school and have little or no exposure to universities. I feel that this opportunity gives them an idea of what universities are about. They also gain an understanding of what true research is.*" Another teacher stated, "*Many of my students have a very narrow idea of what science and science research looks like. NLD helps them see that science can be video game design, trapping lizards, investigating a roll doll's death or any other number of things.*" Teachers want to "*expose students to authentic learning and teaching opportunities*" and "*to science careers.*" One teacher uses NLD to provide her students with "*more experience with lab settings*" stating, "*We are not fortunate enough to have a lot of labs at our school.*" Supporting the recruitment efforts of the NLD researchers, teachers use NLD as a way for their students to "*go to a college campus, get excited about college, and to show them there are fun, smart science labs going on and they can be a part of it*."

Students. When asked about motivations for attending the 2014 NLD event, student respondents (N=58; 45%) overwhelmingly mentioned the opportunity to investigate a college campus and potential majors and careers with statements such as:

- "*I wanted to participate in NLD to observe a true college research lab and to help in my decision for the future.*"
- "*I thought it would help further my decision on my career choice.*"
- "*I wanted to learn and possibly figure out what I want to do in college.*"
- "*I plan to major in chemistry and I wanted to have an experience of what I might be doing in college when I graduate [from high school].*"
- "*… to figure out what I have to prepare for in college.*"
- "*It seemed like it would be a good chance to learn about different fields of science in general and the education that goes into them. I also wanted to familiarize myself with the campus.*"
- "*I wanted to explore different majors and career options.*"
- "*I was not sure what I wanted to take in college and thought NLD would help me decide.*"
- "*I thought it would help me figure out what I want to do in college*."

Two students shared that while they felt that the NLD event would be fun, it would also allow them "*to miss school for a day*."

What They Gained…

Researchers. A prominent theme in researcher responses was the perceived value of learning about the needs and classroom experiences of high school science teachers and students. Researchers learned of teachers' limited resources, concerns over mandated state testing, rural schools' limited access to external educational sources and resources, and the diverse range of students' preparedness for engaging in STEM learning. Open-ended questions invited researchers to reflect on their own outreach demonstrations and communication skills. Some first-time participants learned that they needed to restructure their sessions in order to keep students engaged and to fit their presentations into the 45-minute timeframe. Their suggestions included: making the "*activity even more interactive by including a few more active learning opportunities*"; "*spending more time on individual tasks*"; or bringing "*other materials to show students*."

Many of the NLD researchers explained the value of including graduate students in their NLD sessions to allow them to gain experience in communicating and educating others about their field of science. They expressed that NLD is an opportunity for their graduate students to: have "*more interactions with [high school] students*"; have "*an opportunity to teach at a different level*"; gain *"experience communicating science and share ideas with small groups*"; establish "*confidence explaining their research*"; and "*think about how to simplify the science to make it more accessible*" for a general audience.

Teachers and students. Using a rating scale of 1-7 to indicate how they were treated throughout the day (with 1 representing being treated poorly and 7 being treated very well), 100% of the teachers rated their treatment as a 7, with 96% of teachers rating their overall NLD experience as a 7. Using the same rating scale of 1-7 to indicate how they were treated throughout the day, 97% of the students rated their treatment as a 7, with 96% rating their overall NLD experience as a 7. Overwhelmingly positive responses about their experiences support our NLD model.

Teachers indicated that in successful sessions, scientists were able to connect their research efforts to applications outside the lab. For example, one teacher indicated gaining a "*better understanding of how mass spectrometry and robotics are being used to improve society and*

how those disciplines can be incorporated into [the classroom]." Another commented that students gained "*a greater appreciation for the work done by [college] researchers*." Similarly, student respondents preferred sessions where researchers "*related*" to them, "*spoke on their level,*" and used hands-on demonstrations. When prompted about what they learned, students included both science content and new knowledge about the various avenues for science careers, and opportunities for college students.

Interestingly, while 100% of the researchers indicated that they conducted "hands-on activities" in their sessions, teacher feedback did not agree. Less successful labs, as indicated by teacher ratings, were as one teacher described it "*basically just a lab tour"* and neglected hands-on and interactive experiences for students. Similar to researchers, students and teachers felt that some sessions needed additional time, while other lab sessions failed to utilize the allotted 45-minutes. An apparent discrepancy of what it looks like to engage high school students in "hands-on" activities provides a framework to assist new NLD researchers to be more successful in preparing for and hosting high school students in their research laboratories (Nolen, 2003; Pintrich, 2003; Zady, Portes, & Ochs, 2003).

Teachers and students were asked to list five words that best described their NLD experience. The word cloud depicted in Figure 1 highlights words used to describe their experiences, with the size of the word representing the frequency of use. The words "Fun" and "Exciting" were the two most common words used by teachers, while "Fun" and "Amazing" were the most commonly used words by students.

Figure 1. Word Cloud

Discussion

In an effort to stimulate public interest in STEM careers, our university's version of National Lab Day crosses college and departmental boundaries and has a positive impact on the recruitment of high school students into STEM fields. This is demonstrated by the percentage of students who have attended our NLD event and who have gone on to enroll in a STEM major at our Land-Grant university.

Lab Lessons in Authentic Science Practices

An overarching priority of the PCAST report (2010) is creating "STEM-related experiences that excite and interest students of all backgrounds." Our NLD model provides high school students with a portrait of STEM research that is likely to influence their attitudes about STEM researchers, majors, and careers. Introduced in *A Framework for K-12 Science Education* (NRC, 2012) and implemented in the *Next Generation Science Standards* (NGSS Lead States, 2013), NLD participants engage in scientific discourse with STEM researchers. Engaging in the authentic scientific practices helps students begin to observe science as not just something they read out of a textbook, but as something in which they can actively participate. Furthermore, findings from Malgwi, Howe, and Burnaby (2005) and Porter and Umbach (2006) suggest that students often select college majors based on the ethos and personalities of individuals they encounter. Initially, the NLD program was hosted by two colleges and offered lab sessions in animal behavior, botany, chemistry, environmental science, genetics, microbiology, and physics. With the addition of two colleges, we have expanded our lab sessions to include areas such as aerospace engineering, food science, geology, mathematics, robotics, supercomputing, video gaming, and more. Our program evaluation findings confirm that engagement with scientists in their laboratory settings assists students in developing a more informed image of potential STEM college majors and careers.

Broader Impact Model for Researchers and Universities

In an effort to promote a stronger STEM workforce, scientific funding agencies require researchers to invest portions of their grant budgets in outreach (Frodeman & Parker, 2009). This broader impact component is often used to link the work of university researchers to K-12 science education. Unfortunately, researchers can fail to deliver outreach activities due to a lack of detailed information about potential outreach opportunities and/or institutional support for outreach efforts (Andrews, Weaver, Hanley, Shamatha, & Melton, 2005). Our NLD model clearly provides institutional STEM faculty with a mechanism to disseminate their research efforts to a

broader audience that includes support from their college administrators. Rather than relying on education and public outreach professionals to implement broader impact programs with little input from the research scientist (Holbrook & Frodeman, 2007), this event encourages researchers to open their labs and share their research via engaging activities. Our program also allows STEM research faculty to gain familiarity with the challenges that high school-level science teachers and students face.

One major strength of our NLD program is the *espirt de corps* of the faculty from diverse colleges at our university that participate in this program. Despite offering no incentives for participating, we attracted sufficient researchers for the event with little effort. Administrative involvement was garnered through the provision of a low-cost, unified university-wide STEM recruitment campaign, future collaborations with the K-12 community and a chance to support faculty outreach. The NLD model presented provides research-active institutions with a mechanism to expand the impact of their research programs within their extended scientific education communities, while bringing awareness to a populace that may have had limited opportunities to explore STEM careers.

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