

Report on College Tracking: Spring 2013 Study of NOSB Past Participants

The Consortium for Ocean Leadership and its funding agencies provided fiscal support to investigate the impacts and benefits of the National Ocean Sciences Bowl program to its past participants. These benefits are likely accruing to those students currently enrolled as high school students on NOSB teams across the nation, although follow-up tracking surveys and data collection are targeted to high school graduates who are currently matriculating in college or graduate school, or who have entered the job market.

This increasing pool of college graduates have been tracked from high school, through their undergraduate (and in some cases graduate) education and into careers as these individuals represent a source of information pertaining to the overall impact and accomplishments of the NOSB. Consequently, this longitudinal study has evolved annually, adding and deleting specific survey items to best capture the most useful demographic information from students. The NOSB Past Participants who initially registered for the study from 2006 to 2011 were surveyed electronically in March 2013, to ascertain enrollment in post-secondary education activities related to STEM careers to include college coursework, internships or cooperative education programs (co-ops), or graduate school. Past participants were surveyed each semester from Spring 2007 up until this current, Spring 2013 semester, to ascertain continuing post-secondary education information, on a once-per-semester schedule. It should be noted that the surveys go to the same pool of past respondents annually, but the respondents themselves may vary from year to year; survey responses annually are reported as aggregates and not by

individual student response. Based on findings from the first period of the current longitudinal study (2006-2011) of NOSB Past Participants, this current study queried past participants specifically with respect to courses and majors in which they remain enrolled in college, and they were queried regarding ongoing relationships with coaches and NOSB team members.

An overall database of 440 past participants were provided a URL to an electronic survey using registration information these individuals had previously provided to the researchers. It should be noted that over time, the utility or accuracy of these email addresses diminishes, and the actual study database should be seen as smaller than the macroset of data. A total of 66 past participants ultimately responded to the request for information in 2013. From past years experience, this is a smaller number of responses, but likely remains near 25% of current, accurate contact email addresses.

Survey items 1 through 5 focus on identifying key demographic information pertaining to past participants. For the 66 respondents, 32% (21 individuals) are currently in graduate school (an increase of nearly 10% from previous survey responses); 15% (10) have completed a college degree and are not currently engaged in formal education; 41% (27) are currently enrolled in college. No respondents in this 2013 data set are currently in high school. The researchers continue to find it substantive and noteworthy that so many (n=66) past participants in the program, nearly two thirds (40) of which are beyond post-secondary schooling, remain so impressed with the vocational and academic impacts of the NOSB which they were in high school that they chose to remain willing to participate in follow-up data collection for the organization. This observation further supports the researchers sustained belief that—in an environment of

little follow-up research on STEM education program funding—the NOSB and its past and current successes remains an important case study which could be substantially expanded for future research on learning science through informal and non-formal methods, and on recruiting high ability students to the STEM pipeline.

Items 2 and 3 collected basic demographic information for student respondents. These items describe the respondents as 65% female (35% male) and primarily White (67%) and Asian American (22%). It should be noted that these response rates pertain only to survey respondents and not to participation demographics in the NOSB.

Item 4 solicited information regarding specific regional NOSB bowls in which students/respondents participated as a means of monitoring distribution of the surveys and to also monitor for disproportionate response rates from any select bowl. The item allowed respondents some latitude in naming their regional bowl, and so it was clearly possible to identify only 22 of the regional bowls, although it seems likely the remaining bowls are represented in the data. Clearly, no cluster of responses from any particular bowl emerged, suggesting that conclusions drawn from the survey data are sufficiently disaggregated across the NOSB program and can be viewed as representative of past participants generally.

Item 5 reveals that, for those students currently enrolled in college, 18% (12 respondents) are pursuing Marine Science related undergraduate college degrees. Additionally, 26% (17 individuals) are pursuing a degree in Biological Sciences; 18% (12) in engineering; 15% (10) in geological/earth sciences; and 13% (9) in physical sciences. Other respondents identified a variety of science related fields, such as pre-medicine (10% or 7 respondents) or mathematics (8% or 6 respondents) or

biochemistry/chemistry (12% or 8 respondents). The nature of the complexity of undergraduate education has rendered this particular item increasingly complex for analysis, as students most typically are constructing cross-disciplinary undergraduate degrees that make basic categorical descriptions mute. And, while it is problematic, at the least, to link the NOSB causally to the decisions of these students to continue to formally study science, it is nevertheless evidence that NOSB—at the point these young people are in high school—has developed a recruitment strategy that engages a population that is interested in science and does influence them in measurable ways at that point. An obvious weakness or limitation of the survey data on this point is most certainly the interest in science would be both correlated to undergraduate degree selection and an orientation or disposition to remain connected to the NOSB program. From this perspective, these survey findings should be followed up in future research efforts looking at STEM pipeline recruitment.

Finally, items 6 and 7 reveal that 58% (38 individuals) of the students have taken or are taking courses in marine, aquatic, or ocean sciences. And, from the 66 students who responded to these items of the survey, 35% (23) indicate that their career ultimately will include some emphasis on marine, aquatic, or ocean sciences (an increase of 1% from 2011). Finally, and importantly, 65% (27) of the past participants indicate that they are currently in contact with former NOSB team members, and 46% (19) remain in contact with their high school coach.

The past participants currently enrolled in college were asked to specify the general category of their major or degree area, and to identify specific courses (item 8) which they have completed in the immediate past semester. The purpose of these

questions is to cross-validate within competing survey items for consistency of responses over time, and also based on the principle that greater specificity of response has been associated with enhanced reliability of self-reported data. Specific majors and/or degrees which these students report have remained unchanged since the previous survey administration and include:

- Natural science
- History of science
- Neuroscience
- Environmental science
- Economics
- Marine science
- Urban planning
- Oceanography
- Geochemistry
- Animal behavior and psychology
- Sociology
- Forestry
- Earth science
- Freshwater biology
- Geoscience

When asked about specific science, technology, engineering or math-related courses, the students report from their college or graduate school transcripts during the previous semester, are correlated with the degrees and majors that they report. While we do not see in the data nor include below basic mathematics and basic science required courses, this is likely due to the respondents being weighted toward later college or graduate school levels when these courses are already completed. A selection of the types of courses report includes:

- Marine biology
- Marine engineering
- Marine propulsion
- Fisheries science

- General physics 1 and 2
- Organic chemistry 2
- Biochemistry of vision
- Genetics
- Cell biology
- Meteorology
- Chemistry/organic
- Oceanography
- Aquaculture
- Geology
- Discrete mathematics
- Aquatic pollution
- Conservation biology

For the 66 students who provided course registration information to the researchers (item 8), 94% (62 individuals) provided courses that included at least one from a clearly recognized STEM content area. These reports demonstrate a high degree of consistency from year to year reviews of the self-report data (the most recent earlier report from 2011 included 55 responses or 93% for this item). The students are consistent in the courses listed, the degrees and majors reported, and the degrees (post-graduation) that they indicate as goals.

A final demographic-type question (item 9) solicited information about past-participants who may have returned to their regional bowl as a volunteer. Of the 52 respondents, 24 or 46% have remained sufficiently connected to the NOSB as to serve at least once as a volunteer at the program. One respondent indicated that he/she is now coaching a team—suggesting that this past-participant may now be a high school teacher in that state, and subsequently suggesting another line of questioning for future survey data collection.

Respondents were asked to delineate or describe the ways in which participation in NOSB in high school may have benefited them in college. It is noted that 92% of

respondents (58 individuals) responded positively that NOSB had benefitted them in college, with 49 of these individuals providing content narrative to explain and describe these benefits explicitly. This narrative response data was lengthy and rich. Using a Constant Comparative analysis procedure, the researchers identified 3 thematic clusters that likely capture the primary sets of benefits observed by these past participants. These clusters, with select narrative quotations are:

1. An Inspired Passion for Science

- “Inspired a passion and interest in ocean sciences. Made me feel like it was a real career and not just something that a kid who liked dolphins would dream about. Helped me realize that it was a difficult career—which was more interesting and challenging.”
- “It inspired my interest in pursuing marine science as a career. The knowledge I gained through NOSB has greatly helped me excel in my classes.”
- “Preparing for NOSB required dedication to a subject outside of my school classes. It was like having an extra class, but I really enjoyed it. Visiting Harbor Branch was a fantastic opportunity and it allowed me to see the possibilities in a Marine Science career track.”
- “Instilled an appreciation and love for the oceans, inspires me to integrate care for the sea and public health in the future.”
- “It helped foster an interest in science and discovery in general.”
- “I went into geology and marine sciences because of NOSB. I now have a PhD in Antarctic Marine Geology.”

2. Enhanced Academic, Leadership, and Social Skills Needed in College and the Workforce

- “Quick recall of facts, competitiveness, prior knowledge of science.”
- “My participation helped me to realize my full academic potential and has reinforced my good study habits.”
- “Working in a team is important for interdisciplinary subjects and group work. Disciplining oneself to study outside of the necessary school material has been helpful in my academic studies.”
- “NOSB prepared me for the intense studying that college requires.”
- My participation opened me to new career ideas and appreciation for marine life. I prepared myself for NOSB as I would for real exams at the University and it has helped me a whole great deal being knowledge about certain topics covered by NOSB in my military career.”
- “The presentation aspect of the Tsunami Bowl helped me learn how to speak in front of people. Also, learning how to write a 20 page research paper before coming to college was extremely beneficial.”

3. Increased Science Knowledge

- “I absolutely retained large amounts of knowledge from NOSB which helped lessen the amount of studying I had to do for college. My Intro to Marine Science class was completely covered by NOSB.”
- “Excellent base knowledge of ocean sciences and interaction”
- “Learned more about science.”

- “I gained leadership skills in NOSB. I also found that I had learned the material covered in the competition so well that I excelled in many classes.”
- “ A broad knowledge of the Earth’s oceans has had application to several of the classes I have taken.

An additional series of questions were designed to capture data to describe the high school experiences of these past participants (items 11-15). Item 11 solicited descriptions of preparatory activities used in high schools to prepare for the regional bowls. These responses certainly covered a broad range of study techniques, i.e. practice quizzing, reading, oral review, practice questions, team discussions and field trips to marine centers. It seems clear that there was a solid, academic focus to the preparation activities, well beyond simply mastering the techniques of quiz-bowl competition such as buzzer practice and anticipation. Item 12 addressed the issue of science clubs in high schools, and reports that nearly 71% of NOSB team members (respondents) were members of high school science clubs (beyond the NOSB). Item 13 asked for descriptions of other (non-NOSB students) students in the high schools and how these students may have been involved in ocean content. The responses were weak—only 41 respondents of the 66 provided responses—and of this limited response, many indicated that little to no ocean content was available to other students in the school. There were references to ocean or marine related courses, but these seemed to be exceptions and were not offered to large numbers of students and broadly across schools. Many respondents explicitly stated that few to no other students in their schools were exposed to ocean content. It seems, unfortunately, from these data that there remains a gap in the inclusion of ocean content in high school curricular experiences of students. It seems

likely that this may not have been a reliable question, given the time that has passed since high school and the relatively limited perspective on the broader high school curriculum these or any students may have had. Item 14 reports 55% of these schools offer some type of marine biology or ocean science course, while 45% do not—and these are from schools with a high interest in ocean content among faculty sufficient to pursue NOSB involvement.

Finally, Item 15 asked respondents to describe any specific information they received in high school regarding careers in STEM fields and their recollections of this information. As can be expected, for many respondents, many years have passed since high school, which has likely diminished the specificity of information. Nevertheless, this serves a function: it is likely that the information that does remain was presented with sufficient strength as to be impactful, and also it is likely that the memories that remain of this career information accurately describe the most common practices. In that vein, of the memories that are shared, an overall, general pressure toward STEM careers surfaces, as well as numerous memories of specific colleges and universities that were recommended. These data correlate with earlier NOSB research that observed that students were in fact obtaining specific, institutional information for career advancement in the NOSB program—but again, these response data were more limited (only 45 of 66 respondents provided information, and over half of these provided negative responses).

Item 16 addressed those individuals who have already completed degrees at the post-secondary level or beyond. Of the 37 respondents in this category, 34 have obtained BA or BS degrees, 9 have obtained MA, MS, or MBA degrees, 2 have obtained PhDs, 1 has obtained an MD and 1 a JD degree.

Item 17 requested that students list the college or university from which they obtained their degree. The list, included as follows, includes a significant number of the COL partnering institutions (the names are recorded exactly as the respondents provided them; it is understood that these are not, generally, the correct and complete names of these institutions):

- CalTech
- Scripps Institute of Oceanography
- Virginia Tech
- University of Hawaii
- University of California
- University of Rhode Island
- College of William and Mary
- Louisiana State
- Georgia Tech
- University of Michigan
- UNC Wilmington
- University of New Hampshire
- MIT
- Florida International
- University of Colorado at Boulder
- University of Texas
- Yale
- Harvard
- Berkeley
- Ohio Wesleyan
- Boston University
- Duke
- University of Arizona
- University of Georgia
- Mount Holyoke
- USC
- University of Virginia
- University of California San Diego

Item 18 solicited responses regarding the content area in which students received their degrees. While this item is somewhat overlapping with the earlier item about majors, it was provided as a credibility check with an additional item (number 19) that asked students if they obtained their degree in the area that they intended when they graduated from high school. Importantly, 71% of the 42 respondents indicated YES, they obtained the degree in the same area intended at high school graduation. This response rate far surpasses research estimates that over 50% of college graduates have changed majors numerous times prior to post-secondary graduation, and suggests that the NOSB past participants have a more focused and settled selection of college major at the point of high school graduation. The reader is cautioned not to assert causality to this observation, but it is clear, given the concerns over college costs in the U.S., and additional costs associated with changing majors during the post-secondary years, that this characteristic observed in NOSB past-participants seems fruitful for further research. The raw response data have been appended to this report if the reader wishes to review the broader set of content degrees reported by respondents to this item.

Items 20-22 further focused on degree content areas of the respondents who have completed post-secondary work. Item 20 reveals that nearly 27% of respondents obtained a degree with an emphasis in marine, ocean or aquatic sciences—with another 28 students reporting in item 21 a cross section of other STEM disciplines that are primarily cross-disciplinary—again an observation of an emergent trend in higher education. Item 22 obtained responses regarding college minors and included a range of content areas—education, French, economics, conservation, statistics. Two respondents reported marine related minors.

Items 23 and 24 pertained to social networks, i.e. were respondents still in communication with past team members or coaches. These data have been reported previously in the demographic section of this report.

Items 25-26 solicited information regarding the employment of the past-participants responding to the survey, and asked students to describe the nature of their work and career goals. Only 36 provided responses—which is nearly all of those who have indicated they have finished formal education at the post-secondary or graduate levels and entered the workforce. The responses are highly specific and capture a number of state and federal science agencies, the military, universities and a few private companies. A select list of these agencies and organizations includes:

- Pacific Science Center
- AmeriCorps VISTA
- Google, Inc.
- U.S. Department of Education
- Molokai General Hospital
- University of California, LA
- University of Rhode Island School of Oceanography
- U.S. Department of Defense
- U.S. Navy
- NOAA
- California Institute of Technology
- MIT, Mathematics Department
- Rice University
- State of Arizona, Auditor General
- Luntz Global
- URS Corporation
- Scripps Institute of Oceanography

In Item 26, respondents described a wide variety of work tasks associated to the wide range of specific jobs and skills that matched their academic background and employment area. Nearly all pertained in some way to “doing science.” Again, the

reader should avoid causally connecting science employment with NOSB participation—as the issue of selection bias in responding to this type of survey is certain.

Nevertheless, as the researchers have concluded in prior years' work, it does seem clear that at the least, the NOSB as a program is connecting with students at the high school level who seem, in robust numbers, to eventually obtain STEM related college degrees and enter the STEM workforce. To the extent that this secondary level connection is established and supported (as perhaps “one touch along the journey”), the NOSB is likely obtaining positive results for its investment. The specific employees of these respondents are not listed here, but can be found in the PDF file of raw data accompanying this report, as is the work task descriptions of the graduates.

Item 27 asked respondents specifically about the contribution of NOSB to their career and education paths. The responses provided correlated nearly exactly to the prior content item on the benefits of participation in NOSB, as would be expected. The respondents themselves, from the fewer number of responses and the guarded nature of some of their narrative, seemed to anticipate the inherent bias of this type of questioning—perhaps because of their science background. Nevertheless, these raw data are also included in the appended document.

Item 28 revealed that 51% of the respondents (41 to this item) had been involved in some type of career mentoring to high school students now that they are a career professional—suggesting (again acknowledging selection bias in the survey responses) that there is a second generation of mentoring occurring of NOSB past-participants who are now engaged in STEM careers and who are further reaching out to a new generation of high school students themselves. It seems likely this is a noteworthy observation, and

raises questions about more systematically reaching out to past participants for current program support. This also seems to be an avenue for further research.

A final item (number 29) was appended to the survey to capture any extraneous science content areas where students have had formal study or professional experiences. These were viewed as possible “trend items” as the survey item intentionally noted “professional experience” in the item stem. The largest response category to this item was mathematics, with 71% of respondents (n=20) checking this response. Geosciences, (50%), Engineering (42%), and Climate Science (42%) were the next highest response items.

Conclusion and Recommendation

There has been a remarkable stability to the past-participant responses over the fourteen years of data collection. The strength of the longitudinal approach in this assessment/research is that over time, consistent themes of narrative responses and highly correlated numerical responses emerge. Past-Participants of the NOSB program have a strong social network, likely a bond over the shared interest in STEM content and the intense social experiences in common in the formative high school years. These individuals, at least the ones who self-select to remain active in the follow-up surveys, developed early on an interest in STEM content and pursued that through college, sometimes through graduate school, and for many, into careers. It may be a strong, second network exists among those past participants who remain as active volunteers in the NOSB regional competitions, and perhaps also for those individuals solidly within the ocean science career network. While the survey response numbers have declined over

the years—as would be expected because of change of addresses, change of email addresses, and other social mortality issues—the findings continue to represent one of the only long term follow-up studies of a federally funded, informal STEM education program in the nation. It is clear from the various data summaries discussed above in this and earlier years’ reports, that much fertile ground remains for deeper academic study of the past-participants themselves, and this remains the primary recommendation of the research team to the NOSB governing organization.