

NOSB Fall 2015 Tracking Report

Introduction and Background

The Consortium for Ocean Leadership (COL) annually implements the National Ocean Sciences Bowl as a regional and national, competition based program for high ability secondary students in the United States. Annually, a tracking survey has been implemented twice annually, to follow students after high school graduation, through college and, for some, graduate school, and into the workplace. Beginning in 2000 and continuing annually since that year, Drs. Howard Walters and Tina Bishop have developed the surveys associated to this new tracking study, as well as numerous other instruments and data collection procedures. This year, in Fall 2015, a revised tracking survey was prepared and, with review and input from COL staff, disseminated to past participants as an electronic survey using existing databases from program registration. This study is implemented on a new database of participants and past participants supplied by COL. The survey was substantially updated from previous years to reflect emerging social and cultural interests related to the STEM pipeline and science learning, as reflected below. Summary results follow, with interpretations and discussion at the end.

Data Summaries and Observations

Of the 150 respondents who provided information, 50% (n=75) were female and 50% were male. With respect to current education involvement, 21% (32) are currently high school students; 20% are college freshmen, 13% are college sophomores, 8% are college juniors, 6% are college seniors, and 15% are college graduates and not in formal education currently. An additional 17% (25) are currently graduate students. Of the 107 students who are currently college students, a set of 190 distinct majors were provided to describe their academic programs of study (students reported double majors). The largest concentrations of these majors were in the sciences, with 36% reporting biological sciences, 24% ocean or marine sciences, 19% chemistry/biochemistry, 20% engineering, 18% environmental science, and 9% physical sciences. An additional 14% reported pre-medicine and 6% reported mathematics majors. Overall, 71% of the total 150 respondents reported they are currently seeking a bachelor's degree, with the majority of those in a STEM field or discipline. Of the majors reported, 22 were in the *Other* category, and reflected a high diversity of majors, from business to library science, to Spanish, education, and communications. The only observable cluster of majors within the *Other* category was business, with 8 responses. It should be noted that there is a selection bias for the respondents in that respondents' interest in science are likely also more interested in NOSB and more likely to respond to the survey.

Items 4 through 6 focused on specific curricular content included in respondents academic work. Of 149 responses to item four, 43% (64) reported that they had

taken courses in marine, aquatic, or ocean sciences. Of 147 responses to item five, 39% (57) of the respondents indicated that their career would ultimately include an emphasis on marine, aquatic, or ocean sciences. This suggests that the NOSB is either attracting or influencing a pool of young academics with a curricular and vocational interest in marine, aquatic or ocean science, although any effort to establish the type and level of the relationship is not addressed in the current research methodology.

Academic Programs

Item six asked respondents who were currently college or graduate students to list any STEM related coursework taken in the last semester. This item seeks to generate explicit and discrete evidence to substantiate the categorical responses from items four and five. Prior survey research suggests that such follow-up questions that drill into related and more specific responses are an effective mechanism to increase the credibility of the survey data. In this case, a nearly encompassing set of courses across the STEM fields in higher education emerged from 88 individuals who described their post-secondary or graduate level programs of study. All of the historic STEM courses are listed, as well as a large variety of boutique STEM courses, i.e. Water Engineering in the West, Oceanography of Stellwagon Bank, Solar Energy Conversion, which are increasingly common in universities across the country.

Continued Social Involvement

Items seven and eight solicited information about the regional competitions at which respondents had participated as team members or, subsequent to that, as volunteers. The Regional bowl affiliations included 27 distinct bowl names, and an additional 9 bowls that were named by city, state, or region—and it was unclear exactly which bowl was referenced. It seems clear that there were responses representing each of the functioning and a few of the former regional bowl locations. This supports a broad use of the survey responses to describe the overall competition. Of the 109 responses to the volunteer item, 30% have volunteered at one of the regional bowls after graduation from their high school teams. This observation, combined with previous and current data describing the strong social bonds developed in the NOSB, is one of the strong features observed in the overall program data over the years. The NOSB, while a strong example of instantiated programming, extends beyond this to creating and sustaining a deeper-impacting community of practice around aquatic, marine and ocean science. Further, the observation of participants becoming volunteers as they enter the workforce is an excellent example of a “pipeline” of growing involvement in ocean sciences.

Item 9 asked respondents to identify the primary benefits that had accrued to them personally from participation in the NOSB. 133 of the 150 respondents provided extended responses to this item. The evaluators used a constant comparative

analysis technique to identify common themes of responses in the narrative. These included the following:

1. Enhanced college information and access;
2. Information and direction for careers;
3. Life and Study Skills that are broadly applicable;
4. Networking with people of similar interests in science;
5. Personal growth and enrichment; and
6. Instilled a conservation and stewardship ethic.

The narrative provided sorts into these thematic categories, which in turn capture nearly all of the response data provided. Select quotes and summaries of these areas are as follows.

Enhanced College Information and Access:

Respondents, in numerous ways, described the importance of NOSB participation as a support for their efforts to learn about college, to meet college and graduate students and potential professors, and to enhance their understanding of majors and programs of study, and of specific institutions of higher learning. Select quotes that illustrate this theme include:

- NOSB opened my eyes to new majors, helped me meet new people, and increased my knowledge of current events and my impact on the ocean and globe in general;
- I learned a lot about the ocean, things that gave me a head start when they were covered again in college and graduate school. I also found I was good at it. I came from a very academically competitive high school, where I was never particularly near the top of classes, sports, or music. At Otter Bowl though, compared with the other teams, and even my own team-mates, I was actually really good. I was that kid who was always on the buzzer, always interrupting with the right answer....I do think feeling like ocean science was something I was good at may have helped steer me in that direction. Volunteering with NOSB has also helped me to learn skills in teaching and engaging with outreach.
- Meeting college students, grad students, and professors, even some who specifically encouraged me to attend college and pursue science.
- NOSB helped prepare me for college level science and study. It taught me also how to work well under pressure, in a team, and how to be good with independent studying.
- NOSB inspired me to pursue a B.S. in Marine Sciences, which in turn led me to the real of fisheries science.
- NOSB completely changed my life. It made me realize that I love ocean science....Now I'm in college studying to be a chemical oceanographer.

- I came into college with a much greater knowledge of the ocean than my marine science peers. It gave me confidence in my classes and in my career path choice.
- NOSB set me up for a number of opportunities I wouldn't have had otherwise. The NOSB scholarship was extremely helpful in paying for my education, and I was able to leverage my knowledge that I had from NOSB to get a research internship in chemical oceanography the summer after my freshman year. I used those two qualifications as stepping stones into my career with NOAA.

Information and Direction for Careers

Numerous respondents described the relationship between NOSB participation and their decisions to pursue particular careers. Select narrative responses illustrating this include:

- NOSB provided multiple opportunities to learn as well as network with people related to my potential future career.
- Incredible exposure and learning experience about marine science, without NOSB I would not have pursued a career in marine biology.
- Really driving me to study marine science. I also participated in the SCA/COAST internship program through NOSB which was an incredible experience that also led me to choosing a career in marine science.
- Explore and promote education regarding oceanography and fields that connect to oceanography, all of which is not readily available and taught in my school district.
- It gave me an opportunity to explore a potential career. It also gave me another opportunity to make some connections. It also gave me a lasting impression of what Marine Biology can pertain to.
- NOSB made me more passionate for marine science, more knowledgeable in various marine sectors, and introduced me to a wide swath of professionals involved in archaeological work, SCUBA, biological and oceanographic research, and many other fields.
- Exposed me to marine science, let me explore my interest there, and let me meet people who love ocean science.
- NOSB opened me up to oceanography in general, and I knew nothing about it. It gave me my career basically, because now I know what I want to do with my career thanks to NOSB.
- I am now an Environmental Science Teacher and coach my own team.

Life and Study Skills

As in years past, the survey has afforded respondents the opportunity to describe in detail the types of life and study skills that they obtained from the NOSB program. Numerous respondents perceived that NOSB participation was highly beneficial,

either because of the academic rigor or because of the team-nature of the experience or the competition structure itself. Respondents perceived that these skills are widely applicable in vocation and life pursuits. Select narrative includes:

- NOSB gave me basic and complex life skills that have advanced me to a level above my peers. It has taught me to embrace public speaking, write strongly and to reach out and converse with experts.
- Getting into college. Learning to work in a team environment (very very important). Develop good studying habits and being able to write scientifically.
- Part of a team, built discipline, work ethic, and study habits. Incredible chance to travel around the country for an academic event. Probably significantly helped my prospects for being accepted into an undergraduate program.
- Study habits, small team cooperation, working under pressure, exposure to new concepts, fun learning environment, opportunity to travel.
- Leadership skills, team player skills, study habits, ability to effectively take notes and write study/competition questions, connections with peers across the country.
- NOSB taught me so much about how to put your all into a goal, work with a team and be a team leader. I greatly value everything I have learned from being part of NOSB.

Networking

Respondents described the opportunity to meet, dialogue, and network with other, similarly interested high school students, college and graduate students, university professors and research scientists, and individuals interested in environmental stewardship and conservation issues. This networking was perceived as important to help with college and career decisions, for a life commitment to environmental conservation and stewardship, and for building social communities of interest. Select narrative includes:

- It opened my eyes to a larger group of intellectual people. I think that it gave me many opportunities including helping me get into UVA.
- It allowed me to connect with students from around the country.
- The team bonding and the opportunity to gain a foundational knowledge of marine sciences.
- I have met people who have changed my life. I have learned things I never would have otherwise, and I hold a much deeper and more fluid understanding of the way our world works.
- A focus on marine sciences and the chance to interact with professionals in the field serving as volunteers.
- Networking and introduction to maritime occupations.

- Instill a sense of teamwork, passion for sciences, awareness of science in social & cultural context, respect for marine and environmental sciences, expanding networks of people, travel to interesting places for competitions, and for providing memorable and formative experiences.

Personal Enrichment and Growth

Respondents described a sense of their own development as individuals, of emerging life-passions and an enriched sense of understanding of their place in the world and their life callings. This type of growth is somewhat explained by the typical, four-year sequence of involvement over the high school years. It is interesting, however, to see that it comes to mind as these individuals reflect on the program and its worth to them. Select narrative includes:

- It brings awareness of the world around me and how it affects humans.
- It helped to instill a love for science.
- NOSB helped me focus and embrace my love of marine science and contributed greatly to my desire to do something to protect our marine environment. It was the highlight of my high school career and helped set me on my current path.
- It's where I discovered a passion for all things water.

Conservation Ethic

The final theme that emerged was an expression of stewardship or conservation ethic that had been obtained, enhanced or sharpened through the NOSB program. This ethic seems attached in some ways to the content studied, but also from rubbing shoulders with likeminded individuals and from seeing the environment first hand in some cases, through field experiences. Select narrative includes:

- Appreciation for environmental issues and conservation.
- NOSB was a wonderful experience that not only deepened my knowledge of the sciences, specifically marine science, but also gave me a new found respect and desire to protect the ocean and the world in general.
- Because I have a baseline knowledge about the science behind oceans, I can better understand things like the environmental impact of products or companies.

Items ten through fourteen were oriented toward degree attainment for those respondents who had already graduated college and/or graduate school. From the pool of 150 respondents, 45 continued into this section of the survey and provided responses. Of this 45, 71% (32) had completed a B.S. degree, 22% (10) had completed a B.A. degree. At the graduate level, 33% (15) had completed M.S. degrees and 7% (3) had completed M.A. degrees. Finally, 4% (2) had completed

Ph.D. degrees and 2% (1) had completed an Ed.D. Item eleven asked students to identify the university from which they obtained their degrees. There is a large overlap in this list with the list of universities related to the Consortium for Ocean Leadership:

University of Akron	Harvard
University of Virginia	Berkeley
Western Washington University	Queen's University
University of Washington	Virginia Tech
Stanford	Roger Williams
UNC Wilmington	Rensselaer
Caltech	Michigan State
UC San Diego	The United States Coast Guard
University of Rochester	Academy
University of Washington	University of New Hampshire
Louisiana State	Stevens Institute of Technology
Rice	William and Mary
University of Wisconsin	University of Pennsylvania
University of Houston	Brown
Notre Dame	University of Colorado Boulder
Univeristy of Texas Austin	University of Miami
Indiana University Purdue	Stony Brook
College of Charleston	Yale
MIT	New York University
University of Rhode	Columbia University
Island/Oceanography	University of Texas Pan American
Duke	Grand Canyon
University of Michigan	

It is interesting to observe, in items 12 and 13 that the students reported in large numbers (74% or 35 individuals out of 47) that they obtained their degree in a discipline or content area that they intended at the point of high school graduation. This phenomena has been observed in NOSB tracking data in prior years and is noteworthy for two reasons. First, it is highly credible data as the assertion is backed up by specific descriptions of college coursework taken over the years of matriculation and by degrees and majors awarded. And second, this percentage exceeds the average of all college students, which suggests that the typical entering college student will change majors from 2-3 times in the first two years of college. NOSB program graduates report a far more stable matriculation and completion pattern than this. It is hypothesized that intense, content based academic competitions or co-curricular activities, that not only enhance content knowledge but life skills, social networks, and opportunities for career and college exploration may result in high school graduates with far more stable and durable decision patterns related to post-secondary educations. Given the inefficiencies in higher education, low overall graduation rates, and loss of momentum due to changes in majors, this observation within the NOSB program data has relevance to broader

questions being raised about higher education generally. Finally, item fourteen responses report that 41% (19) of the 46 responding college graduates obtained a degree that included an emphasis in marine, ocean, or aquatic science. This high level, also observed in previous years' tracking data, again reinforces a conclusion of some type of durable relationship between the NOSB program and the students it is reaching. Whether NOSB is causing students to enter marine, aquatic, or ocean science fields—and there is some evidence that this is true for some students—or whether NOSB draws students already prone to these fields, nevertheless NOSB and its funding organizations are most certainly contributing to the ocean science pipeline for college and careers in their support of this particular group of students.

Items fifteen and sixteen relate to the development of a durable social community around the NOSB program and have been asked consistently over the 18 years of program tracking. 82% (45) of post-secondary respondents indicate that they remain in communication with other NOSB participants from when they were in high school. Further, 75% (42) respondents indicated that they remain in communication with their former NOSB coaches/high school teachers. This type of durable social community built up around the program is credible evidence that the program is much more than a one shot, short-burst program from which participants move on and never look back.

Employment

Items seventeen and eighteen explored employment for those individual respondents who perceive they have already entered something akin to their initial or permanent career phase. The range of employment categories provided is highly diverse and includes: teachers, engineers and scientists of various types, community service professionals, lawyers, architects, a librarian, healthcare professions, and a Coast Guard Officer. Numerous respondents used this category to note they are on assistantships as graduate students or PhD students, and one post-doctoral appointment. It is clear from the descriptions of the nature of the work with which these individuals are engaged that the alignment between academic majors and vocational pursuits is far more fluid, dynamic, and unpredictable than in the past. Individuals and institutions construct careers around applied work tasks and issues that require the application of critical thinking skills, problem solving, and the application of base content knowledge to highly variable work requirements. It is equally likely that the life skills, social skills, and team skills mastered by these respondents through programs like NOSB contribute substantially to career success in these environments. Given the pressure in most states and federal agencies on budgets, which mitigate against deep and consistent support for co-curricular and extra-curricular activities in high schools, the nebulous and static nature of academic programs when perceived through the dynamic nature of the workforce should give pause to diminishing the availability of co-curricular programs such as the academic competition programs typified in the NOSB.

College and Career Pathways

Item nineteen explicitly asked respondents to address the relationship between NOSB participation and their education and career pathway. This item elicited responses from 48 post-secondary or post-bachelors respondents.

The association of NOSB to career and college selection was made around several focus areas. First, NOSB raised awareness and understanding, of basic knowledge, of science applied to ocean and aquatic areas. This understanding and interest led eventually, for many respondents to a choice of major in college and a career field. One respondents wrote, “I loved marine science before participating in NOSB (that’s why I did it), but NOSB helped me to formalize and organize my knowledge. Interestingly, when I was in NOSB, I hated geology—it was my least favorite question area. But now I’m a biological oceanographer studying paleoceanography—I use geology all the time.”

For other respondents, it was an emotional attraction: NOSB instilled within them a love or passion for the ocean and the environment. Two select narrative responses are illustrative of this impact: “NOSB definitely fueled my passion for science. Undergrad I did a certificate program in Marine Science, which NOSB definitely influenced. My interest in shipbuilding, my first job with the Navy, was also likely influenced by my experience with ships through NOSB. Now, my interest in renewable energy is sustained by my passion for the environment.” And another, “NOSB fostered my love of marine science and the marine environment. I now serve my country in a way that allows me to enforce laws that protect our environment.”

Attraction and Interest in Science

Items twenty and twenty-one sought to describe the underlying interest in science among the respondents, as well as the perceptions these respondents had of effective science teaching and learning experiences. The attraction to science, for many of the 44 respondents (those who were beyond formal education primarily) related to one of two different themes. First, science was perceived as attractive because it was an open-ended and highly complex and systematic way to view the world that continued to hold open the possibility of new discovery. One typical response here was: “I like the challenge and I like the curiosities of this because I can always learn more and do more and there is an infinite amount of scientific knowledge.” Another respondent wrote: “Science is an ever-changing topic. New discoveries always affect the way we see the world which is why it is so interesting. Science is not static and many innovations are directly tied to STEM activities in both academia and private businesses. Science research propels society forward by providing new cures for disease or better understanding of the environment.”

A second recurring theme categorizing these respondents’ attraction for science was a desire to understand how “the world,” or particular physical or biological systems worked. Respondents expressed satisfaction at deep study to understand holistically these systems. A selection of narrative responses in this theme included:

“The ability to think critically through a problem and ask and answer questions about the world around me. Science provided me the tools to learn about the world around me....I’m really interested in learning the ‘why’ of how things are the way they are....I have a passion for understanding how the world works on microscopic and macroscopic scales, and for identifying and simulating its key processes.”

Perceptions of Quality Science Teaching

In responses to item twenty-one, the past participants were asked to respond to the prompting question: Some science and math teachers are particularly able to engage students with interesting and exciting class experiences. Without names, describe a teacher in your past that did this. What was the class “like” and what types of activities were so interesting to you. There were 46 respondents to this item, nearly all of whom had ultimately obtained a major from a university in a science field. Consequently, the responses seem highly pertinent and interesting to an examination of quality science education from the perspective of those who were perhaps most influenced by it.

The most frequent occurring theme in the responses pertained to the personal disposition, passion and engagement of the teacher as an individual. There seemed to be a typical “kind” of teacher associated by these respondents to memorable and impactful science and math classes. These were teachers who were happy and made the class fun, a positive social space. These were teachers who were fully engaged with their content, their courses, and their students as individuals. Teachers who frequently led or created co-curricular and extra-curricular opportunities for interactions with students—around science, but also in ways that enriched and supported overall student development. Select narrative responses in this area include: “My teacher was genuinely happy to teach the class even though some of the students were not as receptive as I to the subject...Very engaging in class lectures, but the best part was a willingness to engage with me outside of standard class times on additional topics and research opportunities....She was also the most enthusiastic, energetic grown-up I think I had ever met, always seemed excited about class, and science, and everything. She also seemed to understand us, better than other teachers, and when we needed advice with things, from what classes to take to how to get along with others, she helped us.”

The next theme in the responses regarding interesting and exciting class experiences described classes that were constructivist and hands-on in their basic organization. Students were not following predictable and text-driven activities, but were rather engaged in open-ended and discovery activities where the outcomes were not predetermined nor necessarily even teacher-driven. There were frequent opportunities for students to provide leadership and choice, for exploration labs that were driven by student selected inputs, hypotheses, and procedures. Open-ended questions, emerging from student choice and control, led students to novel and interesting outcomes. Several respondents described classes where students were “in charge” and able to shape the course of events, the content selections, and

the procedures used. This ownership invested the students with a desire to participate and to engage. Select narrative supporting this theme includes: "It was so unlike normal high school 'science.' The typical classroom has you doing 'experiments' where you follow the instructions provided to arrive at a preordained result. This wasn't like that. We were coming up with our own questions, our own methods, and then succeeding or failing on our own merits...My high school freshman science class involved learning all about water quality and involved a big project where we walked down to the creek several times to collect water samples and then analyzed them back at school. I loved doing it because it seemed like there was an actual purpose to the science instead of controlled classroom experiments."

A third theme regarding interesting and exciting science class experiences related to authentic, field trips and nature encounters. Respondents frequently described particular field trips that the teachers had taken them on outside of the school and frequently outdoors. An opportunity to be immersed in a natural setting, on a beach, in a river, hiking in a forest, was memorable and tied to interest in science for many respondents. Select related narrative includes: "Field trips and labs were the parts of my biology classes that got me excited about learning the material. Whether it was hiking in the Santa Monica Mountains, touring an aquarium, snorkeling off Catalina, or dissecting squid, the hands on immersive activities engaged me in the subject...Marine biology, oceanography, and marine chemistry all had field trips utilizing the nearby beach, research vessel, or shared NOAA lab facilities. Anything that allows students hands-on experience to reinforce classroom material goes a long way."

A final theme emerging in the data related to the emotional excitement of some classrooms. Students described science classes as fun, exciting, energetic, and dynamic. Reading the narrative, there is a clear sense of academic rigor and content focus in these classrooms, but one never loses the sense that impactful teachers and classrooms understand students as social creatures, as adolescents who may be passionate about learning, but are still developmentally in need of fun. These respondents remembered those kinds of classes.

Entrepreneurialism and Technology

Items twenty-two and twenty-three explored the respondents perceptions of NOSB as a mechanism for fostering entrepreneurial interests and skills, and for enhancing the use of technology skills. These two survey areas emerge as an interest driven by social and cultural interests in education broadly in the United States, but elicited a more limited number of responses (31) than other items. Among the entrepreneurial interests and skills that respondents perceived were fostered by NOSB participation, independent research and study, organization and self-discipline were mentioned by many respondents. Other skills mentioned included public speaking, networking, study habits and self-confidence in meeting and talking with new individuals under stress. Finally, the collaborative and interpersonal social skills needed to work in a team environment were viewed as also relating to entrepreneurial development.

The responses to item twenty-three on technology were generally insufficient to form conclusions. It seems that much of NOSB remains a cognitive knowledge driven exercise and technology use seems limited to accessing information via a variety of search platforms.

Stewardship and Free Choice Learning

Item twenty-four asked respondents to describe the link between NOSB participation and their involvement in environmental stewardship activities. The 29 responses, though limited in number, were rich in their descriptions. Numerous respondents described active work as volunteers in a range of activities (coastal cleanups, community action, policy advocacy) and organizations (public aquariums, parks and environmental centers). Several individuals described their careers in environmental areas as having been fostered and encouraged through NOSB: "I promote environmental awareness in my work place, my home, my friends' homes, and pretty much anywhere that topic comes up. NOSB taught me a lot about how much the world needs us to do something about our parasitic actions while living here. I work in an environmental lab because I hope that we reduce the amount of pollution in some level in this country." Finally, numerous responses described actions, driven by awareness, that emerged in part from NOSB participation: "...I volunteer...I encourage recycling...I arranged and participated in several beach clean ups....I joined an environmental sustainability consulting group in college to encourage restaurants about safe environmental practices....I am more careful about buying seafood from sustainable fisheries."

Item twenty-five asked respondents how NOSB incorporated or encouraged self-directed, free-choice learning, and elicited a rich set of narrative responses. Free-choice learning is a concept that relates to individual control and autonomy as a learner to explore and create one's own intellectual interests. Respondents perceived that NOSB was a highly supportive platform for this idea. As one respondent wrote: "NOSB was all about free choice learning. There were no marine classes in my high school and I really wanted to learn more about the ocean. NOSB allowed me to learn about the ocean in a more structured and goal oriented environment. It also allowed me to focus on my main interests of biology and social sciences within marine science."

Among the responses on the topic of free-choice, a strong theme emerged about self-directedness. Respondents described their teams as frequently student-led and coordinated. Students themselves determined the learning goals and focus, the systems of preparation, and were only loosely directed, if at all, by teachers/coaches. This allowed the opportunity to develop and practice leadership skills, including organizing time-tables, assigning individualized work tasks to support a comprehensive project, and social dynamics. Overall, the perception that ocean sciences is such a large and encompassing field supported a concurrent

perception that there was space and creative room for numerous individual pursuits.

Conclusion

In most cases, the data have been summarized with concluding thoughts and extensions in the sections above, obviating the need for extensive conclusions at this stage in the report. Nevertheless, a few overarching observations seem relevant to punctuating this current report. First, the narrative responses are, in the main, highly skewed by the 78% of respondents who are already in college, graduate school, or in the workforce. Consequently, they have had years, many of them in some cases, to reflect on the impact of this high school experience. From that view, the narrative they provide has been filtered by these years of reflection and, in many cases (31% in the workforce or graduate school) by intervening realities from employment, life, and the rigors of graduate education. Thus, the descriptions of the attractiveness of science, or the retellings of classes with impactful teachers have been distilled thoughtfully. These perceptions have enhanced value and credibility because they come from first-hand participants in the NOSB, who have endured in the STEM pipeline in many cases, and who speak now as adults, interested in science. This is an important voice, not often measured and brought to the table in planning for science education.

Additionally, while it was stated earlier in this report, it is worth noting again that NOSB is an excellent model of pipeline development in any content area where there is a concern about recruiting high quality students into and through post-secondary education and into the workforce. The data reflect high school participants graduating, persisting through a variety of STEM majors to graduation, entering the workforce, and then returning as volunteers to serve the NOSB program to support the next generation. The social community observed here reflects a much more significant way of framing “success” in STEM outreach programming than is typically expressed.

Finally, the multifaceted nature of the STEM pipeline, in both its inputs and outputs, continues to evolve and expand. The complex and dynamic employment environment allows a near-endless variety in the types of careers possible, and the avenues through which STEM content can be actualized in vocational practice. Thus, biology majors can become Coast Guard Captains giving environmental lectures to scout groups. Financial planners with business degrees, and a passion for environmental stewardship garnered on an NOSB team in high school, can advocate for conservation issues in communities. Journalists with a passion for clean air and water, having learned team-building through NOSB, can build networks of concerned citizens for action for cleaner waterways. This diversity supports opportunity, and supports the work of NOSB in building durable, social networks of knowledgeable, passionate, and connected past-participants who remain committed to each other, to the program, and to conservation and environmental stewardship.