

The NOSB Spring Tracking Report 2020

Introduction and Method

The Consortium for Ocean Leadership has implemented the National Ocean Sciences Bowl (NOSB) as a regional and national competition-based program for secondary students in the United States for over two decades. Regular evaluation and program assessment over the life of the program has incorporated a tracking survey to follow students after high school graduation, through college and, for some, graduate school, and into the workplace. Drs. Tina Bishop and Howard Walters, of The College of Exploration and Ashland University respectively, have developed the surveys associated to this now longitudinal tracking study, as well as numerous other instruments and data collection procedures, including interviews, site visits, as well as recurring review of appropriate literature describing STEM education research which pertains to the NOSB.

For purposes of this current report, the data and summaries following are based on a survey of current, regional participants in the NOSB. This survey was disseminated electronically in early April 2020, by the NOSB program office to its most current database of participants. A total of 149 individuals provided responses to the survey.

Demographics of Respondents

The first section of items on the survey describes the primary demographic distributions of the survey respondents. Item one notes that twenty-three U.S. states are represented in the spring response data. Of these states, the largest included California (20 respondents), Massachusetts (17), Washington (14), and Michigan (12). (Note: for all of the summaries included here in this brief report, the raw data have been entirely included with our report

submission to COL for further internal review). Item two asked respondents to identify the specific, regional ocean bowl competition in which they participated this year. This list included:

Blue Lobster	Bay Scallop
Trout	Great Lakes
Orca	Aloha
Garibaldi	Blue Heron
Surf	Stingray
Sea Lion	Nor' Easter
Chesapeake Bay	Saber Toothed Salmon
Lake Sturgeon	Quahog (participating in Blue Lobster)
Dolphin Challenge	Surf
Tsunami	Penguin
Shore	Hurricane

Item three indicates that of the 149 respondents to the survey, sixteen are freshman, thirty are sophomores, 47 are juniors, and fifty-six are seniors in high school. Item four notes that sixty-eight of the students have participated in NOSB for only one year, with forty-three finishing two years, twenty-nine finishing three years, and nine respondents participating for all four years in high school. And the final demographic item, item five, reveals that ninety-eight respondents have a high interest in a career in science, seven respondents indicating a very low interest and the remaining respondents distributing between these high and low indicators.

NOSB Career Influence Related Items

Item six asked respondents “what did you learn about ocean-related careers from your participation in the NOSB?” There were 133 responses to this query, with the majority of them containing strong details, which would suggest the students had obtained specific, career-related

information (as opposed to generalized overviews of careers). Numerous respondents described the inter- or multi-disciplinary nature of ocean sciences research as a field of inquiry. Several even offered pairs of related content that was of interest, i.e. chemistry and energy research, or biochemistry and medicine. Other respondents described how they had met particular mentors, scientists, or employers who provided career information during or associated to the ocean bowl experience. Other clear themes which were associated to career learning by the respondents were the difficulty of the field, the wide range of opportunities beyond marine biology, and the need for a wide range of coursework and preparatory activities associated to the career field. It was clear that this group of respondents perceived that the NOSB was a context for advanced learning about careers which they might pursue.

Item seven asked students to identify their most likely major in college, with the caveat that forty-six of the respondents are freshman and sophomores, whose responses are likely malleable because of their age. As expected, the largest category of responses, with thirty-four, was Undecided. Engineering, Marine Biology, and Biology comprised the next largest categories, followed by Environmental Sciences, Biochemistry or Pre-Medicine, and Chemistry. Most responses can be associated to some discipline in the STEM array. These included: nursing, computer sciences, mathematics, forensic sciences, zoology, microbiology, and veterinary sciences. Only eleven of the 147 responses to this item were outside of a STEM discipline, i.e. business, music, graphic design, fine arts, criminal justice, and architecture. As observed in prior years of study of the NOSB participants and past participants, the program has consistently attracted highly capable students who prefer STEM disciplines, and who have continued into post-secondary education into STEM majors in patterns that have been highly consistent with preferences stated during high school. Item eight asked students to identify, if they had made a

selection, the specific college or university at which they intended to matriculate after high school. The responses included selections of larger, state institutions or research universities: The University of Washington, MIT, University of Virginia, University of Michigan, and Texas A&M (partial listing of sample schools), as well as smaller, private institutions: Rice, Evergreen, Eckerd College, Pacific Lutheran, and Oberlin. No single institution dominated the listing, and while many of the premier ocean research institutions were represented on the list, these were not remarkable in their prevalence. There was not a follow-on question included to ascertain motivations or interests that drew respondents to these particular schools (the list was highly diverse), although previous research on the NOSB population has suggested that legacy relationships among families was instrumental in these selections.

Items nine and ten were “follow-on” questions related to career selection. In item nine, students responded to the prompt “how likely are you to pursue a major in an ocean science field in college?” Of the 148 responses, 47 responded very likely or likely, and 101 responded neutral, unlikely or very unlikely. Given that the respondents understood that the survey context was related to the NOSB, the strength of the negative responses to this item may reflect a higher reliability of the response data: the responses leaned away from what might have been perceived as a “desired” direction. These responses, i.e. 47 likely or very likely, closely matched the ocean sciences, marine biology or related disciplines in the previous item on the survey. Item ten included the prompt, “how likely are you to pursue a major in STEM (other than ocean sciences).” Of the 149 responses to this item, 112 were affirmative, very likely or likely. These responses were roughly consistent with the responses in item seven, and are further consistent with proportional responses from previous years of NOSB participants.

Item eleven prompted respondents, “if you have selected your future career already, please tell us about this.” This item was intended as a redundancy to the prior items, to ascertain how closely students would match their prior responses when asked about career selection from a different thought pattern. The responses to this current item closely approximated the prior categorical items, in that numerous respondents pointed to a variety of STEM related disciplines. Of interest in this more open-ended item construction, were the number of students who linked two or more academic disciplinary concerns into a single career pursuit. Examples of this included oceanography or marine biology with cinematography and photography; oceanography to economics or finance; physics and engineering with finance and business; ocean sciences and astronomy; chemistry and pharmaceutical research; marine sciences and international policy; and agriculture and international development policy. It has long been observed that ocean science is an interdisciplinary or multidisciplinary field. The student responses to this item suggest that there is an emerging or natural inclination among some members of the response pool to view careers from this perspective, both in and outside of ocean-related pursuits.

Item twelve asked, “In what ways did participation in the NOSB contribute to your selection of a major, a college or career?” For some of the respondents, the NOSB did not impact their selections. Some had previously decided these choices, and some were still undecided. However, for most of the student respondents, they assert that the competition did influence their selections. Many respondents said that the NOSB increased their interest in ocean science and marine biology. Many indicated that their curiosity about the ocean was triggered. Several realized that their passion for oceanography had been confirmed and appreciation of marine sciences was reinforced. The comments reflect the NOSB influence: “invigorated my interest in ocean sciences”, “helped me realize how much I love ocean sciences” “looking into a career in

marine biology,” “made me see ocean science as a viable career.” The competition and its associated activities helped develop understanding of potential ocean careers and greater awareness of careers in general, with some students determining their choice as a result of the NOSB participation. Visits with ocean science professionals and campus tours were seen as helpful. For another large group of respondents, the NOSB generated a strong interest in science in general, furthering knowledge and science background. The NOSB reassured decisions to enter STEM, study biology, chemistry or microbiology. Some indicated interest in ocean-related minor or double majors, or blending majors such as science and communication—as observed in item eleven previously. Others said they would take classes in ocean science regardless of major. Other said they will look at the ocean as a hobby and an inspiration for travel. And finally, others said that the NOSB increased passion and knowledge of the environment and helped them get involved with environmental activities.

Stewardship and Socio-Cultural Perspectives

Item thirteen asked respondents to “Please describe any environmental stewardship, advocacy, or conservation activities in which you have participated.” Of the 116 respondents who answered this question, slightly more than 25% said they had not participated in any of these environmental activities. Of the approximately 80 students who did provide information on this item, their experiences represented a wide variety of environmental, advocacy, and conservation activities and groups.

Fifteen students said they had been involved in beach cleanups. Other respondents mentioned park, school, town or river cleanups. Other activities included conservation work, invasive species removal, habitat restoration and bird counts. Many respondents mentioned environmental clubs at their school or other environmental groups such as *Youth for*

Environmental Action. Some students had attended camps or summer programs with an environmental focus. A few mentioned doing research on environmental or conservation topics. Several had participated in *Envirothon*. Six respondents listed volunteering at zoos or aquaria, while other participated in presentations or community outreach. A few mentioned offering educational events for younger students. Scouting involved eight respondents in environmental, conservation or service projects, and several students mentioned advocacy efforts in which they engaged.

Item fourteen expanded on the prior item by pursuing responses related to hobbies or recreational activities in which respondents participate. Of the 114 responses to this item, the largest groupings of responses were swimming (20 responses), scuba diving (11 responses), vacationing at the beach (14 responses), kayaking (9 responses), and sailing (8 responses). Other responses that were made by multiple individuals were fishing, fish-keeping/aquariums, and art or photography.

Item fifteen, continuing the theme of the last two items (personal, socio-cultural connections to the ocean) asked respondents, “what types of activities do you enjoy while visiting the ocean or coastal area?” It was interesting that 131 respondents gave input to this item, as the issue of visiting a beach had not been squarely addressed as a prompt in earlier items in the survey. The responses were primarily verb forms: walking, swimming, sitting, watching. But also included a number of recreational uses: kayaking or sailing, scuba, volleyball or other games with friends or family on the sand. And finally, there were several responses that assumed a more holistic or integrative view. The following narrative quotes express some of those:

- I enjoy building a sandcastle that is near the ocean’s edge and then attempting to build walls to protect it before the tide overruns my defenses. It helps with architecture, timing and knowledge of tides rising.
- I like looking at it. I just like being there, especially when there aren’t many people. I like the wind, the air, the splashing waters, and the birds. I like dipping my feet into the water, but not going in too far. I take pictures occasionally.
- I really enjoy kayaking in tidal areas, and watching how the landscape changes during the day as the tides ebb and flow. Though it’s something I’ve never done, I’d love to go whale watching one day to be able to observe these animals in their natural, wild habitats.
- I love tide pooling. It is so cool to see all the organisms living on the Northern California coasts. I also love seeing what tide it is based on the wet sand and debris on the shore. My favorite, of course, is boring my family with all my random oceanography facts I learned from the National Ocean Sciences Bowl.

Reasons for Participation in NOSB

Item sixteen asked respondents to identify the “primary reasons for participating” in the NOSB. The item was formatted with pre-selected categories (based on prior research with the NOSB), but did allow students to use a narrative response field to insert their own thoughts and language. There was a clear distinction in the response patterns. The largest category (130 responses) was “I enjoy science related activities.” In descending order following this category, respondents selected: “I wanted to learn more about the ocean,” “I like academic competitions,” and “I wanted the academic and intellectual challenge.” It is noted that the item allowed multiple responses. These responses are indicative of the types of responses observed over the twenty years that the researchers have tracked the program. The NOSB attracts students who are

predisposed to science, who love the ocean, and who are academically and intellectually competitive and seek out competition-styled activities.

Following on that last idea, i.e. students who enjoy academic competition, item seventeen asked respondents to identify other academic competitions in which they had participated. Respondents listed a selection of national competitions, including: State Science and Engineering Fairs (multiple); Math Olympiad; Science Olympiad; Envirothon; First Robotics; Academic Decathlon; ISEF; Geography Bee; National History Day; MathCounts; FFA Nursery Landscape; and DOE Science Bowl. In addition to these, there were numerous local, state, and regional competitions in history, physics, mathematics, and a number of humanities areas. Of the 105 respondents who provided some information for this item, nearly 100 identified an additional competition to the NOSB in their portfolio of activity in high school.

Preparation for the NOSB Competition

Items eighteen and nineteen asked students to describe personal/individual methods for preparing for the NOSB competition, and then to identify team-level methods for preparation. These items produced a fairly predictable set of individual and group study methods, as would be anticipated. These included (at the individual level) identifying and reading source materials from either textbooks, web sites, or research studies and articles. A variety of visual media included YouTube, documentaries on streaming services or from agency and government web pages were also mentioned. Respondents also identified a selection of study skills, including notetaking, creating flashcards or concept maps, and crafting sample questions for themselves and their teammates. At the team level (item nineteen), it was clear that creating sample questions and then spending significant time together as a team: practice quizzing, challenging team members, using the buzzer equipment, and reading and reciting information to each other,

frequently from assigned categories of knowledge, facilitated the team experience. The responses are indicative of a highly competitive, social or group engagement where science content is engaged dynamically and with a serious, competitive intent to enhance personal and group capacity.

Item twenty asked, “In addition to your NOSB coach, who else helped you prepare for the competition and in what ways did that/those individuals help?” Of the 100 respondents who listed responses to this item, the overwhelming response was fellow teammates, the students themselves. More than one-third of the respondents mentioned team members offering a variety of support mechanisms including answering questions, conducting practice sessions, offering encouragement and studying together and teaching each other. Team captains were specifically mentioned by respondents as being helpful in keeping things on track, motivating, and coaching. NOSB alumni and past coaches were mentioned as very supportive. Family and friends also offered help, providing everything from quizzing to science advice to making meals and snacks. Help in the school was offered by other teachers and leaders of the science club, while in the community, ocean experts and other adult mentors were involved.

Item twenty-one asked respondents to describe “any federal science laboratories, programs, or science personnel who helped with your team’s preparation and study, or which/who was/were involved with your team.” There were only three mentions of external organizations or agencies: two NOAA references that lacked identifiable information other than “labs.” And one NOAA lab which was named specifically, i.e. the James J. Howard Marine Science Lab (NOAA) which “mentored some of our students.” Given the distribution of the NOSB teams in, primarily, the coastal zones of the U.S. and the proximity of numerous federal programs and laboratories in these same regions—not to mention the local sponsorship of the

regional bowls—this response seemed deflating and unanticipated. The researchers/evaluators will return to this issue in the conclusions, but this seems to be an area where proactive effort to recruit federal support structures to these high ability students might result in significant leveraging opportunities.

Item twenty-two was a short response item which asked “Is there an ocean science or marine science course of any type taught in your high school.” Of the 148 responses to this item, 79 students (53%) indicated yes to the item. Sixty-nine respondents (47%) indicated that there was not an ocean or marine science course in their schools. Again, given the national priority of the oceans and related science and socio-cultural implications of this, the observation here—given that most of these students are from coastal U.S. states—is disappointing.

Item twenty-three asked, “How will you prepare differently next year based on your lessons learned from this year?” There were 121 responses to this question. However, 27 of them indicated this was not applicable as most of this group were seniors and would not be back again next year. Even so, one soon-to-be alumnus expressed his interest in helping next year’s team members: “Although I am a senior leaving for college next year, I wish the best for the following team next year. I plan to provide them with all the resources I have and when I have time, I’m planning to give them lectures on oceanography.” Of the nearly 100 who offered their thoughts on preparing differently, study more or study harder was a theme echoed by most of these respondents. They mentioned increasing the hours of study and studying at a faster pace. Several mentioned strategies for dividing up information to be studied by each of the team members, strategies for preparation on their own, and ways to mitigate team weakness areas. Many realized the value of starting earlier in the year, preparing sooner.

The respondents appeared to understand that they had to broaden their knowledge base, and acknowledged the importance of studying beyond the material provided. However, more than a dozen mentioned the value and helpfulness of reading the textbooks they had been given. Others wanted to use flashcards and other media, including documentaries and slideshows. They also stated they wanted to take more notes. More practice was recommended and, especially, learning to more effectively use the buzzers and how to do the TCQs and bonus questions. They needed to identify more appropriately when to buzz in and to work on buzzing faster. Broader knowledge was seen to be needed and learning fun facts and ocean trivia might be helpful. Specific topic areas seen as needing better preparation were identified, with marine policy and the Great Lakes at the top of the list. Other topics included microbiology, living organisms, government agencies, current events, and more in-depth physics and chemistry. Several wanted to focus more on glossaries, vocabulary, and taxonomy. A couple indicated their overall philosophy for the whole process, such as developing trust, integrity and respect. Others emphasized getting more sleep and being relaxed.

Item twenty-four asked, “What was the most fascinating or interesting topic you studied in preparation for the NOSB this year?” There were 134 responses to this question and the responses were wide ranging and focused on a variety of ocean-related disciplines. The largest theme of responses related to marine biology. Fascinating creatures were on the top of the list, which ranged in size from microorganisms to whales and included both vertebrates and invertebrates. Marine animals and ocean wildlife included:

- Manatees
- Salmon
- Fish
- Sponges
- Cephalopods
- Mesoplankton/phytoplankton
- Whales, sharks and dolphins

Eight respondents listed fascination with topics in the area of chemistry and chemical processes in the ocean. Physical oceanography was fascinating to many respondents, with topics such as tides, waves, and ocean currents of special interest. Several respondents mentioned geology, sea floor sedimentation, plate tectonics and oozes. Other respondents found ocean history, ship navigation, naval battles and old submarines fascinating.

There was interest in topics that spanned from the deep ocean to beaches, coastal areas, lakes, and estuaries. A noteworthy interest was shown with ten responses related to the Gulf of Mexico, including hypoxia and harmful algal blooms. Topics such as El Nino, invasive species, methane hydrates, and ocean-atmosphere processes were also stated. Climate change, ecology, and impacts of humans on ocean conservation were topics of interest too. Several students mentioned being interested in taxonomy and phyla, as well as learning acronyms. Several mentioned technology and a couple listed international law and ocean policy.

Benefits and Positive Memories of NOSB

Item twenty-five asked, “What benefits do you receive from participating in the NOSB team?” The responses of 133 respondents clustered in six, primary areas which are described as follows, and which are viewed as an important set of observations for this current survey:

Teamwork and Friendship

The highest number of comments expressed the benefits of teamwork and friendship building. These two themes emerged in a very strong way from the feedback. Teamwork responses stressed the importance of bonding as a team and improving team skills. Working cooperatively was deemed very important, as was the necessity for sharing responsibility. Many respondents indicated the benefit they derived from learning how to better work in teams. “I

think I benefitted from being part of a team because I was surrounded by intelligent and kind people who wanted to succeed as well as see others like me succeed.”

Closely related to this team benefit was the overarching benefit they expressed of meeting new friends and solidifying friendships with those on the team. They enjoyed “hanging out with friends” and expressed the importance of being with supportive, like-minded people with similar interests. They felt part of a “great community” and they felt this may lead to lifelong friends. They also mentioned meeting new people, outside of the school and outside of their area.

Ocean Science and Science Knowledge

A clear majority of the responses also highlighted the benefit of the knowledge they obtained through the NOSB experience. They appreciated the intellectual stimulation and breadth of knowledge with a wide variety of topics that were addressed. Many stated that they gained knowledge in general and on topics they might not do on their own. Many however specifically focused on their learning of ocean science and increasing their knowledge about the ocean. Comments included:

- “Greater appreciation and love for marine life”
- “New fascination for the oceans”
- “Study something I love”
- “Abundance of knowledge of the ocean”

These comments attest to the value of the knowledge respondents obtained through the NOSB experience and the realization that they will be called to share this knowledge in the future. Although many respondents specifically mentioned ocean science, others stated that they increased their science knowledge and more greatly appreciated science in general. Specific

topics included: environmental conservation (learning to treat the ocean with respect), and proficiency with scientific language as well as “the NOSB helped me appreciate the breadth of scientific research and its importance in the current era” and “I have received a lifelong appreciation of the earth and its processes by studying for this competition.”

College and Career Help

Many students mentioned the benefit of including NOSB on their college resume, in their college applications and college interviews. Several felt the knowledge gained would help in college. Others said that participating in the NOSB helped them figure out a job or a potential career. This was supported by the opportunities the NOSB provided for them to talk with scientists or science upperclassmen and any mentoring that was offered.

Academic Skills

Respondents listed enhanced study and strategy skills, competition techniques and experience by competing in a healthy way and writing research papers as academic areas that were increased through the NOSB.

Social and Emotional Benefits

In addition to the academic benefits, respondents mentioned that the NOSB helped them become:

- More reflective
- More confident
- More supportive
- More self-aware
- More patient

Fun

Over 10% of the respondents expressed the benefit of the NOSB as a fun experience. This benefit was frequently mentioned together with other comments. They seemed to enjoy the team and the wider community support, practice sessions, travel, opportunity to visit the ocean and the competition experience. A selection of quotes highlights the fun factor of the NOSB:

- “Everyone had fun and was excited about the ocean.”
- “Fun competition and learning that livens my spirits and maintains a broader focus and perspective on life.”
- “Such a good time—also learned a ton.”

Positive Memories

Item twenty-six asked respondents, “What is your most positive memory from your NOSB participation this year?” Team bonding and learning to work effectively as a team were seen as very positive experiences for many of the respondents. This was a top mentioned response to this question. Team spirit, team rapport and team camaraderie were highlighted. Making friends, working with friends, and hanging out with team members were positive memories. “Lots of fun just being buddies,” “getting closer with my friends on the team”, “having fun with my team” were also comments to echo this sentiment. And finally, learning, practicing and competing with the team and having fun during the competition were positives too.

Closely related to the internal team bonding was the realization that meeting with other teams was very positive. A good number of respondents mentioned the enjoyment and value of meeting other like-minded students from different schools and regions. Some even emphasized

that they continue to stay in touch. Gaining knowledge and specific facts and information were seen as valuable. Presentations from scientists and interactions with grad students were deemed helpful.

Other respondents described how proving themselves in competition was key. Winning a close meet with other schools, getting close to, or beating a top team, or “doing better than they thought” were seen as positives. Getting questions right, answering bonus questions, and gaining many points in a round were indications of the positive impact of the competition itself. Accomplishments such as getting the sportsmanship award, going to nationals last year, or even winning the first round were positive. For many students travel to the competition was a highlight. They enjoyed going to the hotel with the team, traveling with the team---the whole trip. Fundraising for the competition was a positive experience too.

Challenges of Participating

Item twenty-seven asked, “What was the most difficult or most challenging thing about participating on the NOSB team?” The most typical response was the expression about the need to study a lot—the amount of study for vast amounts of content, which was required. Also mentioned was the difficulty determining what to study. A number of students mentioned the wide variety of information to be covered and the difficulty of the content. Memorizing so much information also was seen as a challenge. Not knowing how to study certain topics and less common content was also mentioned, as was staying focused on studying and keeping up motivation.

Another area of difficulty was time management. This was mentioned over thirty times. Getting a realistic and manageable practice schedule for the whole team was challenging too.

Closely related to this was balancing NOSB with schoolwork and other activities and having to put in time after hours.

Finally, a significant area of concern was the emotional challenge that the stress of competing created and the pressure to do well it engendered. Some students expressed being nervous and being anxious about not knowing answers to questions and afraid they would answer incorrectly and let down their team. They ultimately realized they needed to know how to lose, and that it was acceptable to get questions wrong. Some students expressed concern about not knowing much at the beginning or being at an “intellectual disadvantage” and feeling challenged to identify their role on the team and keep up with the team. A few talked about the school’s A team versus the B team and trying to get on the A team. Challenges they mentioned about the competition included:

- Team challenge questions; not being able to see the grading of TCQs
- Learning how to buzz well; coordinating the buzzing with teammates; rules of the buzzer
- Hard questions
- Final/last rounds of the competition
- Research paper

One final challenge mentioned was attempting to answer against a good team and/or losing to a good team. Comments such as “trying to even attempt to answer a question against the most dominant team was very difficult” and “facing off against really good teams” illustrate this challenge. A few of the newer teams or weaker teams felt unprepared. Not knowing how the competition would go was a concern.

Reflections on NOSB

Item twenty-eight asked, “What is the one thing you wish you had known before you started participating in the NOSB?” Many of the 114 respondents reflected on how much they needed to learn, and their realization that they would need to study more. They now knew how much they needed to learn, with ocean science a much bigger subject to study than initially imagined. Several of them wished for more oceanography background, such as a foundational course. They acknowledged that the competition was challenging and they now knew how difficult the questions could get. They wished they had known more on specific topics, such as marine biology and the Great Lakes.

The respondents also wished they had known better how to properly study and to know at what depth to study a topic. They realized that it was never too early to begin studying. They acknowledged that they needed to study as much as possible. They recognized that there were many resources that should have been perused. Studying from textbooks was deemed to be useful.

Several students said they wished they had known the rules better. They wanted to be informed better about rules. Specifically, they mentioned scoring rules, rules about entering or leaving rooms once they went in, and moderator mistake rules. Some wished they had known more about the buzzers and had practiced more with them to become more confident with buzzing.

Several students also wished they had known more about the competition up front, about such things as double elimination, dates of the semifinal, what the setting was like and the informality of the competition format, the demands of a full day of competing, how fast paced it

was, and how many people participated. Some wished they had known how serious some of the other teams were and the fact that some teams were noticeably better. Others were philosophical, stating they wished they had been more confident. They recognized that they should not be nervous but “to take it seriously.” More than a dozen respondents wished they had realized in advance that the competition would end up being so much fun. Some quotes reiterated what they would like to have known include:

- “I wish I knew that NOSB is not just something you put in college apps, but rather a place where people with similar interests gather together and share their short high school life with you.”
- “To know the amount of commitment required to perform well”
- “If I could go back in time, I would definitely want to know how important this competition will be to me later on, which will push me to study harder and practice more before I went out to my first competition.”
- “It is possible to make a comeback in the second round. If you lose round one, don’t let it dampen your mood and keep pushing forward.

Item twenty-nine asked, “What other life skills or work, study or career skills did you develop through participation in the NOSB?” The highest number of responses to this question was in relation to teamwork. Teamwork, team cooperation, and collaboration were mentioned in some way by nearly 20% of the respondents. Additional focus on teamwork was referenced by terms such as social skills, networking, friendship, good sportsmanship, and ability to work with different people and in groups. Leadership was also a frequently mentioned skill that NOSB fostered. Improved time management skill was listed by more than a dozen respondents. This was also supported by the respondents’ emphases on the development of effective study methods

and good study habits, as mentioned often in general terms (by a dozen or more) or with specific study skill development. Specific skills included:

- Organization
- Attention to detail
- Speed reading
- Quick recall
- Note taking
- Strategy setting
- Practice
- Focus

Personal characteristics that were important outcomes from NOSB participation included:

- Independence
- Discipline
- Diligence
- Good work ethic
- Dedication
- Patience
- Stress management
- Responsibility

Additional skills of importance were communication and “learning how to learn.”

Respondents also emphasized benefits provided by NOSB participation for understanding the world of science, learning ocean facts and engineering concepts and overall “learning more and more.” A couple of noteworthy quotes were: “One thing I really learned was the notion of giving back. These scientists/volunteers were working hard to provide a great competition experience.” “And I learned that it is okay to take risks and participate in things that make me uncomfortable. NOSB was totally outside my comfort zone and my team took a lot of risks during the competition, but we could not have hoped for better results.”

Conclusions and Primary Observations

The evaluation team has consistently used a phrase over the years which seems, again, pertinent here: the evaluation data support a conclusion that the NOSB is “more than a competition.” There is evidence that the program is a complex system which accomplishes multiple outcomes in the lived experiences of the students who participate.

As observed in prior years of study of the NOSB participants and past participants, the program has consistently attracted highly capable students who prefer STEM disciplines, and who have continued into post-secondary education in STEM majors in patterns that have been highly consistent with preferences stated during high school. While it is too soon to know whether this current group of participants will follow this same post-secondary persistence pattern, certainly at the high school stage, they are similar to earlier groups of students who have persisted. Longitudinal tracking of this current group should allow an informed conclusion in years to come.

Additionally, numerous respondents described the inter- or multi-disciplinary nature of ocean sciences research as a field of inquiry. This observation seems unique or stronger in this current survey response set than in previous implementations of the evaluation. Several respondents even offered pairs of related content, summarized above, that were of interest, i.e. chemistry and energy research, or biochemistry and medicine. It has long been observed in the literature that ocean sciences is an interdisciplinary or multidisciplinary field. The student responses to these related items suggest that there is an emerging or natural inclination among some members of the response pool to view careers from this perspective, both in and outside of ocean-related pursuits.

The NOSB builds awareness of ocean knowledge on a broad set of ocean-related topics and content areas. There is strong evidence from multiple items and respondents that they are learning, deeply and systematically, and that this enhanced content understanding is a benefit to further education activity, and likely instrumental to fostering career and post-secondary decisions.

The NOSB offers an opportunity for students to learn about ocean-related careers through interaction with a range of mentors who included high school teachers/coaches, research scientists and content experts, and college undergraduate and graduate students. Previous years' research on the NOSB has revealed that these initial mentoring and social relationships formed in high school are highly durable and sustained through the college and graduate school years. The friendships formed on these NOSB teams, which are mentioned by numerous respondents, have been observed in earlier groups of participants to be sustainable over the years, and may contribute to socialization and persistence in the STEM endeavor.

The NOSB fosters a deep set of non-cognitive academic process skills which have been consistently found to foster post-secondary and career success. These include teamwork, leadership, interpersonal communications, study and organizational skills, and creativity in learning. Enhanced confidence and self-awareness under periods of appropriate intellectual stress—and loss—are a further dimension of these “soft skills” that have been associated with persistence in difficult post-secondary and employment settings. The resilience that grows in the individual student as a result of rigorous competition and preparation for competition seems healthy and desirable in preparing a future STEM workforce, but should be studied more deeply.

Report Submitted April 21, 2020

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