Summary Report on the 2013 Coaches' Survey of NOSB Program Impact

The Consortium for Ocean Leadership (COL), previously the Consortium for Oceanographic Research and Education (CORE) has implemented the National Ocean Sciences Bowl (NOSB) since its inception in 1998. The NOSB is implemented as a series of regional, quiz-bowl type competitions for teams of high school students, with expanded critical thinking, team-building and answer formats, and in some select cases, essay and public presentation events. These regional competitions throughout the country culminate in a national bowl competition where the winning teams from each region compete for a national title and substantive incentives, including college scholarships, research trips, and other awards.

The NOSB is directed to high school students, but utilizes secondary teachers, termed *Coaches* to recruit and prepare the teams of students from participating schools. These hundreds of individual teachers, primarily science teachers but frequently from other subject areas, are an indispensible component to the program's operation and long-term success. They are the closest adult in proximity to the teams of students and the arbiter of communications for the entire program. Many of these coaches have been active in the NOSB since its beginning, many more participate for many years at a time. Many of these coaches work with other high ability students in other competition programs at these secondary schools. Follow-up tracking of former student participants of NOSB over the years indicates that large proportions of past-participants remain in social networks and communication with these coaches years after graduating from high school.

Numerous past participants have reported that these coaches/teachers have had tremendous influence in their post-secondary education decisions and career choices. Consequently, obtain feedback on NOSB program impacts, challenges and successes seems a critical and necessary step toward fully understanding the accomplishments of the NOSB.

To this end, researchers at the College of Exploration (Tina Bishop) and Ashland University (Howard Walters) have been engaged to study and monitor the impact of the NOSB since 1999, and were engaged this past year to design and implement a survey of the NOSB coaches, based on an early survey of this stakeholder group implemented over the years of program operation (2000, 2006, and 2009). This survey was disseminated through COL education leadership to the coaches in spring 2013 via an email with an embedded URL directly to the survey. Raw data from the survey responses and the original survey items are appended to this summary report for the readers review.

Student and School Demographics

While select items were intentionally omitted by some respondents, for most items, a pool of 118 coaches provided complete responses to the survey. These coaches reported representation from 25 different bowls (note: some bowls have merged, diverged, or changed over the years) including (number of responses from select bowl included after the name):

- Penguin-8
- Stingray-5
- Loggerhead-4
- Sea Lion-8
- Tsunami-9
- Blue Heron-3
- Grunion-5
- Aloha-4
- Quahog-6
- Chesapeake Bay-4
- Spoonbill-6
- Blue Crab-7
- Manatee-4
- Surf-5
- Nor'Easter-6

- Salmon-2
- Orca-6
- Los Angeles-3
- Lake Sturgeon-6
- Great Lakes-4
- Bay Scallop-1
- Shore-2
- Dolphin-3
- Hurricane-5
- Trout-2

The coach/respondents further represented 26 U.S. states and 118 high schools (these are the schools and states in which they teach. [Note: for ease of reading this report and to provide the opportunity for the reader to fully review the responses, all of the data will not necessarily be disaggregated in this written report. However, a PDF file with all of the coach responses is included with the report as an appendix.]

Items 4-8 asked respondents to describe the schools in which they teach and from which their respective NOSB teams were drawn. Item 4 describes the number of students in these schools, with approximately 54% of schools reporting more than 801 students and 46% of schools reporting fewer than 800 students. The distributions of schools were nearly equal across the categories, with no particularly large/small size of school dominating participation. Of the 118 respondents (to Item 5) nearly 47% of schools are Suburban, with approximately 30% of schools Rural and 26% of schools Urban (averaged to whole numbers). From item 6, nearly 43% of the schools are within 10 miles of the ocean, 25% from 10-100 miles from the ocean, and approximately 32% of schools over 100 miles from the ocean. These figures are important, and suggest that the NOSB has become an important curricular vehicle for infusing ocean sciences into inland schools. Item 7 indicates that 44% of respondents are from schools with up to 20% non-caucasian students, 23% of respondents are from schools with from 21-40% non-caucasian students,

and nearly 33% of respondents are from schools with greater than 50% non-caucasion students. Importantly, nearly 7% of respondents are from schools with over 81% non-caucasian students. These figures support a conclusion that NOSB has served as an important intervention for reaching ethnic minority students in U.S. schools (at least 20% of respondent schools were at least 60% non-caucasian students) with ocean sciences content and with opportunities to learn about post-secondary and career opportunities in the ocean sciences. Finally, Item 8 describes nearly 40% of the respondent schools as having greater than 41% of students on Free or Reduced Lunch benefits, a proxy variable for socio-economic status of students in the schools and their families. Certainly, NOSB has made headway in taking ocean science content out of the upper and upper-middle class economic classes to reach those students at-risk for diminished educational curriculum offerings due to socio-economic conditions and limitations in their communities.

Coach (Teacher) Demographics

Items 9 and those following were oriented to the teacher his/herself. Item 9 addressed the number of years the teacher has taught. This item is an important proxy variable for the potential for long-term curriculum change in schools. A relatively younger teacher who receives the benefit of professional development such as that provided through NOSB support programs and who grows passionate about ocean sciences is likely to incorporate ocean content for many years, achieving a larger multiplier effect to leverage the funding used in the program and the number of students eventually impacted by programming. The largest category of teacher respondents are those with from 11-20 years teaching experience, solidly

mid-career, who comprised 41% of respondents (48 individuals). A total of 68% of responding teachers taught less than 20 years, 22% less than 10 years, and 5% less than 3 years.

Item 10 solicited was a factorial item that asked respondents to rate particular rationales for participation in NOSB. The highest rated rationale was to challenge high ability students, reflecting a perspective among teachers that NOSB is a rigorous, intensive and challenging program. Nevertheless, other rationales rated nearly as high, and included: emphasizing marine science in the curriculum, to support academic competitions generally, and to stress high academic achievement. Emphasizing STEM education in the school did not rate as high, dropping nearly 20% to 62% positive from the low 80% responses on the other items. On the positive side, STEM was enhanced by 1) the emphasis on the interdisciplinary nature of science, and 2) a focus on practical, real-world applications. Further, teachers mentioned careers in STEM fields numerous times in the data set.

Respondents were provided an open response opportunity to submit their own narrative to describe a rationale for participation in NOSB. Narrative analysis of these written data (and again, the reader is encouraged to review the raw data in the appendix) suggest four additional rationales held by numerous teachers: 1) many teachers are in STEM focused schools, which are highly oriented around STEM content and actively seek out STEM related programs for students; 2) many teachers perceive that high ability students need or desire additional challenges such as that provided in a rigorous, academic content focused program like NOSB; 3) many teachers are themselves interested in ocean and marine sciences and teach in

schools that lack courses in these areas. These teachers started NOSB teams to allow their own interests in teaching these ocean topics to have a venue. And 4) many teachers perceive that high ability students simply love to compete and seek out competitions of many sorts to support these students.

Item 11 asked respondents to describe their academic, undergraduate majors for purposes of determining the content expertise of coaches supervising the respective teams. The dominant majors were in the areas of biological sciences (67 individuals), followed by marine or aquatic sciences (19 individuals). The next highest category were the physical sciences/chemistry with 16 individuals. Other categories with far fewer numbers were education, social sciences and history, engineering, mathematics, and a single computer science and a single physical education teacher.

Item 12 asked respondents to identify the respective grade levels and courses they had taught during the most recent academic year. The responses covered the entire secondary science and math curricula, and the reader is encouraged to review these raw data in the appendix. Clearly, these teachers are not primarily ocean or marine sciences teachers, although those courses appear infrequently in the lists.

Over the years of the NOSB tracking study, it has become clear that for many teachers, NOSB sponsorship and coaching is only one of numerous co- and extra-curricular activities that these teachers sponsor. In that vein, Item 13 asked respondents to list the variety of other student activities and organizations with which they work. The list was expansive, but included: Envirothon, High School

Science Clubs, GLOBE, Earth Day, Swim and Dive team coaching—and a variety of other athletic coaching assignments, Honor Club or Academic Honors programs, Quiz Bowl, Earth Service Corps, and DOE Science Bowl and Science Olympiad. These coaches are clearly engaged and active student mentors. Following this same vein of questioning, Item 14 inquired about other academic competitions with which these teacher/coaches were involved. Beyond NOSB, the responses included: DOE Science Bowl, MATE ROV Competition, Science Olympiad, Chemistry Olympiad, Envirothon, Quiz Bowl, Scholastic Bowl, Science Fair, and the Geography Bee.

NOSB Impact on Students and Curriculum

Items 15-22 described the involvement in NOSB and its impact in the classroom and curriculum in the coaches respective classrooms and schools. Of the respondents, 36% have coached an NOSB team for more than 7 years, with 21% serving for more than 10 years. There remains, however, space for new teachers to enter the program, as 27% of respondents (32 teaches) have coached for 2-3 years and an additional 27% have coached for 4-6 years. Nearly 78% of respondents Strongly Agree or Agree that "participation in NOSB has resulted in an increased infusion of the ocean sciences in my classroom." Further, nearly 93% of respondents Strongly Agree or Agree that "participation in NOSB has greatly increased my students interest in science." Finally, nearly 64% of respondents Strongly Agree or Agree that "as a result of NOSB, marine science has been emphasized more as an academic discipline in my school."

Item 19 asked teachers to describe how participation in NOSB has "changed or influenced the manner in which ocean content is offered in your school." The

responses to this item are dramatic. More than 20% of the teachers report that they were able to start and offer ocean science or marine biology-type credit courses for students in their school as a result of NOSB participation. Many teachers report expanded interest in existing ocean science classes—higher enrollment, more frequent demand for courses, more interest from other students, a higher general appreciation of ocean sciences. Clearly, NOSB has reached beyond impacting only the small teams that come from these individual schools and indirectly afforded opportunities for many more students to receive enhanced ocean content. It seems likely that in no small part, this has been accomplished through the direct benefit of NOSB on the teacher/coaches themselves: as they receive enhanced ocean science knowledge, they are more comfortable teaching this as a course, more passionate about advocating for these courses, and willing to take these on. The researchers have concluded for many years that the impact of NOSB as a professional development program for the coaches and as a broader impact on the school curriculum is an oft-missed impact that needs deeper study and visibility. These data continue to affirm that conclusion.

Item 20 followed up the broader impact concerns of the previous item and described the proportion of students—beyond the NOSB team members—in the respective high schools who were engaged in ocean or marine content because the school houses an NOSB team. 57% of respondents indicated up to 10% of the student body; nearly 24% of respondents (26 teachers) reported from 11-30% of the student body; nearly 3% of respondents (3 teachers) reported from 31-50% of the student body; and nearly 4% of teachers (4 teachers) reported from 51-100% of

the student body were engaged with ocean content. Clearly, these data support a conclusion that NOSB has impacted far more students than the team participation numbers represent.

Item 12 solicited descriptions of how the perception of STEM may have changed for team members or the broader student body in the school because of participation. The largest cluster of responses from teachers centered on an increased awareness of science and science and math related careers for the team members primarily, but also for the broader student body. For some team members, there also seemed to be an increased awareness of majors within science fields. Many respondents used language such as "increased interest," "increased awareness," and "more aware of…" when describing students and STEM. Several respondents described an increase in the positive perception of science with the word "cool," such as: "Our school had the honor of attending the nationals competition twice. The second time, the entire school came out to send off the team. It has made science "cooler" to be involved in and certainly increased interest and participation in the sciences in our school. Finally, some respondents mentioned a perception of the breadth or inclusiveness of marine sciences, of a "broader perception" of science generally, and a sense that students could see a career option for themselves therein: "The students have become more aware of the breadth of marine science as well as career choices involved;" and another respondent, "The impact on those students has been large. So far THREE former LSB participants are majoring in geology, two in sedimentary geology. Almost all former participants were/are science majors in college."

Item 22 asked respondents to "Please list any courses in your school that incorporate ocean sciences content" as a means to identify the emergence of cross-disciplinary curriculum efforts by teachers. Clearly, this list provided numerous references to marine biology and introduction to oceanography sort of courses. But of greater interest—because it demonstrates efforts by many disciplines of teachers to infuse ocean content—were the non-typically ocean centered courses that were using ocean content. This selection included:

- Biology
- AP Biology
- Environmental Science
- Physical Science
- Chemistry/AP Chemistry
- Physics
- Environmental Systems
- Earth and Space Science
- Integrated Science

Item 23 solicited descriptions of barriers that teachers may have encountered in broadening participation and increasing the infusion of ocean sciences in schools. Clearly, the top response clusters were the issues of time and funding. The issue of time, for many respondents was described two different ways. First, time commitments from teachers were constrained due to budget reductions and related staff reductions that limited the types of courses that could be taught. The availability of staff to teach ocean science as a non-required elective, as well as time to coach and sponsor another extracurricular activity was a real issue for many. The second time constraint that emerged was student-centered. There are many opportunities available for these high-ability students, to include athletics and

other club opportunities. Particularly in small schools, or schools with a strong tradition in athletics, it was difficult to get students to commit time to an NOSB team. With respect to the issue of funding, the responses reflected the realities of many school districts across the nation: school fiscal resources are in decline and increasingly stretched at every level. This is being felt by the coaches/classroom teachers. Other barriers identified included: lack of administrative support, lack of teacher expertise, and a lack of scheduled flexibility due to curriculum standards and testing. NOSB administration might consider mechanisms to counteract these barriers.

Finally, with item 23, there is a selection of individual quotes that may not rise to the level of weight that a cluster of quotes might have, but are nevertheless powerful and raise issues that the NOSB leadership should consider. These include:

- "The biggest challenge for us to recruit students is competing with sports and other extracurricular activities. The majority of students in our rural town are involved with sports year-round and must train/practice daily. It is challenging to find a mutual time for NOSB practice that works for everyone. We have tried to offer multiple practice sessions at different times of the week but this doubles our staff time and commitment for which we do not have funding…Funding is becoming increasingly difficult to secure and we are in jeopardy of not continuing the NOSB coaching."
- "Students have too many commitments after school, and the competition often conflicts with a big speech and debate tournament."

- "Because of financial reasons our principal can no longer provide transportation support as he did in the past. Our parents stepped up to provide this for the students. The two coaches (who are strictly volunteers) also pay for their own transportation costs to competitions and for items such as snacks for practices. Other staff members contribute time and skills such as repairing buzzers."
- "Lack of financial support for the team. We have to pay for all our materials. That means me! I end up spending so much out of pocket for the materials we need to compete. This is the 5th year with stagnant wages and with health costs increasing I take home less than I did in 2008. It has been financially draining to get prepared for the competitions. It has also been a strain on my budget to go to the competitions. There are still many out of pocket expenses when I attend. If teams had to pay for all the food and the overnight accommodations we would have to drop out of the competition."
- "biggest barrier: testing based on state/federal curricula and a desire on the part of administrators that we stick to those things that will be on the test."

Career Information

Item 24 addressed the issue of career information that students might receive related to ocean sciences as a result of NOSB participation. The responses were, as would be expected, comprehensive. Respondents provided references for websites, university connections, speakers at the NOSB regional and national events, state and federal agencies, and many more. It is clear that, at least, the NOSB teams themselves are provided numerous opportunities and avenues to obtain career specific, and evidently, even university and degree-specific information regarding

STEM careers through participation experiences. The response data were too differentiated and individualized to effectively summarize beyond this, and so the reader is encouraged to see the broader raw data in the appendix.

Broader Impacts of NOSB

Item 25 asked respondents about school adoptions of ocean sciences or marine-related courses as a result of participation in NOSB, or evidence of other, broader impacts of the NOSB program to the student body. Of the 83 responses to this item, 33 teachers or nearly 40% named specific ocean or marine related courses that had been written and offered at their high schools that were direct outcomes of having the NOSB competition team. Further, 3 additional teachers identified marine science student clubs that had begun, and 17 additional respondents described increased enrollments and more regular scheduling of existing ocean-related courses because of increased interest among students because of NOSB. This observation, i.e. 33 schools that have added courses directly because of NOSB is a critical and important finding from these data. This suggests that well beyond the NOSB team members who have participated and obtained enhanced science content knowledge for the oceans, a much larger body of students are receiving ocean science content directly because of NOSB. Further, the NOSB program has realized extensive and broad, and permanent, changes to secondary STEM curriculum with no additional fiscal support. These leveraged, value-added changes merit much more attention and study—as well as visibility for COL and the NOSB administration.

Benefits to Students

Item 26 of the survey asked "What academic and/or life-related skills do students acquire as a result of participating in the NOSB, i.e. study skills, critical thinking, team skills, technology skills?" This item elicited strong and lengthy responses, with numerous anecdotes regarding student skill across every area of psycho-social and cognitive development. The teachers further noted enhanced skills for teamwork, leadership, communication, and a capacity for independent work. It also appeared, new for this year's data set, that there was a recognition of the increasing role of technology in science among students and teachers. In the area of academic or study skills, select responses included:

- "Students definitely understand what it means to study for and understand a grand amount of material on a very detailed level. Alumni have been quoted as saying the best preparation for college was the rigor of study for NOSB."
- "As part of the research project requirements for the Bowl, our students develop many 21st Century skills such as critical thinking, collaboration, communication, research methodology, writing, study skills, teamwork, internet/media literacy, creativity, global awareness, resource management, environmental literacy, flexibility and adaptability, initiative and self-direction, leadership, and responsibility."
- "As with all of my academic team subject areas, it helps the students prepare for and use critical thinking skills to help solve real world problems. They become aware of technology skills that are needed to help study and solve world issues as related to world oceans."

In the area of team development, select respondents wrote:

- "First, students learn to communicate with other students that have like interests. They also have to study the material related to the ocean bowl, as not all of it is covered in class. For the team challenge questions, they have to think critically and work as a team to answer the questions."
- "Team work, academic independence, intellectual hobbies, pleasure in excellence."

Other responses, and again the reader is encouraged to look at the array of narrative response that was provided in the appendix, suggests that the elements of competition, competition technique, and the joy of competing that is so strong for these high ability students is and has been only a small dimension of the academic and intellectual benefit to these young adults.

There was less robust response to item 27 regarding the benefits to other students in the school beyond those students on the NOSB team. Nevertheless, these benefits were identified by the respondents. Select responses that are generally consistent with the overall body of narrative include:

- "Our school is under-performing and receives an enormous amount of negative press. When our NOSB team won 4th place at the regionals, we did make a tiny notice in the city newspaper. It made our students proud and they realized that they can compete in the wider arena."
- "My knowledge has increased so it seeps through all my classes. The oceanography course has turned out to be a great vehicle for a senior laden elective to go beyond the normal basics."

- "Our school is as supportive of the NOSB team as they are of the sports teams. When we went to the national competition two years ago the entire school came out to "wave us out" when we left for the competition. My co-coach and I feel that the NOSB team gives a critical "small place" in a large building for like minded students to interact with each other."
- "The recognition of our NOSB team success has raised science awareness at the school. Many students work harder in math and science to prepare for the teams annual tryouts."
- "They are exposed to the success of the school's team and are proud of them—thus, science becomes a positive thing to all. Also, the NOSB students talk about ocean related subjects to them outside of the classroom—this is a good thing."

Awareness of Science Careers

Item 28 solicited feedback about the awareness of science careers and how this has changed among NOSB team members or the broader student body. These constructs are very similar to earlier questions on the survey, and so much of the response narrative is replicative. Among the themes that seem to emerge out of this set of responses is the idea that science careers are accessible to students, and extend beyond "just" being a bench or laboratory scientist. It was also evident that NOSB provided exposure to scientists, graduate students, and science departments at universities and state and federal science agencies. Likewise, there seems to be a sense that students increasingly see ocean science as a very diverse, often cross-disciplinary field, with multiple access points. As one respondent wrote, "They have a different language…it is not 'I want to be a marine biologist.' It is 'I want to study

biological engineering and make golf balls from lobster shells." Other select narrative quotations which seem rich in conceptual content include:

- "Students have become more aware because some of our alumni have gone to college programs and careers in marine science and other branches of science and technology. These alumni have come back to talk to our current teams about their experiences."
- "Students meet actual scientists at the competition and as guest speakers in my classroom in the lead-up to the competition. The regional coordinators provided outstanding outreach in the form of scrimmage practices and field trips."
- "Our participation in the NOSB helps the students understand that the breadth of science careers is very wide and careers are accessible to everyone."
- "I think as we continue to broaden our participation and outreach not just in NOSB but other STEM programs that are offered, our students begin to see that even if they want to be a photographer or a politician, there are ocean sciences applications."

Professional Development for Coaches (Teachers)

The following items, 29 and 30, turned to the issues of professional development for the teachers themselves. Item 29 asked directly, "How has NOSB influenced your own professional development activities, especially related to STEM?" Of the 91 responses, 51 individual teachers (56%) described specific professional development activities in which they have engaged that pertain in some way to ocean sciences content. Many wrote that they have taken courses, participated in other, federally sponsored STEM training such as COSEE and

ARMADA programs. Several describe reading and using online materials to expand their own understanding. Again, there is tremendous variation in the responses and so the reader is encouraged to review the raw response data. Nevertheless, it is clear, as the researchers have observed for over a decade of follow-up and impact tracking of the NOSB program, that the impact on the classroom teachers is substantive, and may in fact be the most significant accomplishment of the NOSB program. The current survey data report that 33 schools have seen teachers create new high school courses—which then are accessible to many more students than the NOSB team—and in this current item, over half of the respondents chose to seek out enhanced science content training. It seems clear that NOSB, as it motivates and engages the coaches themselves, has become a mechanism for improving the science understanding of a large cohort of teachers across the country, and through them—and with no fiscal expenditure—influenced a far broader pool of students in the schools. These new courses, even were NOSB to cease, would continue to impact many thousands of students annually over the next decade based on the mid-career status of these responding teachers.

Item 30 expands upon this professional development question to explore the issue of social networks among the responding teachers. Of the 102 teachers who responded to this item, 74% have increased their professional engagement with other classroom teachers, both in and out of state, because of their NOSB work, and 71%, importantly, have increased their engagement with university personnel/professors as a result of NOSB. Nearly 58% of respondents report an enhanced engagement with scientists. Clearly, NOSB is increasing the social

connections and relationships between scientists and educators, and thereby closing the gap between research laboratories and the high school classrooms where these teachers work. This certainly, with respect to that portion of NOSB funding that is NSF derived, is meeting the NSF mission for broader impacts and for involving more scientists in informal and formal education programming in the country.

Finally, Item 31 was an open-ended response item that asked for general suggestions for the NOSB leadership to consider in order to extend the impact of the program to other students and educators. This item solicited 76 responses, comprised of substantive narrative. It is difficult to ascertain thematic clusters, as the responses are highly individualized. It may be that NOSB leadership would find these individual comments valuable as a "brainstorming" contribution for future program planning and program ideas. The narrative in its entirety has been appended to the report.

Conclusions

It seems clear, from an abundance of data, and in reviewing the copious annual reports from the various follow-up surveys since 1998, that the coaches that work with the high school students can and do possess insight into the operation of the NOSB, and a perspective that is very important in consideration of the Nation's broader concerns for K-12 STEM education, the STEM Career Pipeline, and the issues of recruiting high ability students into research leadership. The coaches who responded to this current survey uniformly perceive value in the NOSB program. This value or benefit is certainly seen as it falls to the student participants

themselves. Coaches report many alumni who have entered science disciplines (and student/past-participant follow-up data confirm these anecdotes.) Coaches report many instances of new high school courses focused on ocean content, with greatly expanded opportunities for the NOSB teams, but also for the broader student body in these high schools to participate in these new courses. Coaches report that NOSB has motivated behavior change themselves: they have actively sought enhanced content knowledge through a variety of professional development opportunities. Coaches report, finally, in large numbers that they are more actively engaged around science content with practicing scientists and science professors because of NOSB.

Further, it seems evident that the coaches, the high school teachers, are key stakeholders in the success of the NOSB program, and are fundamental contributors to the projects impact. This understanding is not new. STEM education, in both formal and informal settings, has long relied upon the relationship and access that high school science teachers have with their students. What seems clear from these current data, and from the stream of follow-up data on the NOSB program since 1998, is that not only are the high school teachers key for organizing the school-based teams, for motivating and encouraging student effort, and for guiding and delivering science content to these teams, but the teachers themselves have undergone some profound changes in their own relationship to the science content as a result of NOSB. It seems also clear that, whether through an enhanced understanding of the science or an enhanced excitement and passion for ocean sciences—or both—these teachers have, with little to no fiscal support, created meaningful and durable expansions to the teaching of ocean content in these high

schools. Clearly, their role in the impact and success of this program remains ripe for research on school reform, curriculum reform, and science education and STEM pipeline issues.

An additional observation within this current data set, which is also sustained by many years of follow-up research on the NOSB, is that within these high schools, there has been an increased infusion of ocean content in a multi-disciplinary and cross-disciplinary manner. As we observed and summarized in the above report, there has certainly been substantive effort and success in creating "stand alone" ocean science related courses in these high schools. Nevertheless, it seems likely that the greater curricular success has been the infusion of ocean content into more traditional, required science courses such as Biology, Chemistry, and Physics. This success should be viewed as noteworthy, as many STEM education and curriculum efforts from numerous ocean agencies have attempted just this objective for decades, with far less systemic success than seems to have occurred through the NOSB—even though this was not necessarily an essential goal, and certainly not a funding category, for NOSB over the years of its implementation. Again, this leveraging was highly related to the incorporation of the high school teachers as key collaborators and agents in the basic, organizational design of NOSB from its inception.

In conclusion, from these data, it is clear to the researchers, and the research team has repeated this in years past, that NOSB is well more than "just a competition." It is a venue that has become a social network; it is a highly complex social system with sub-communications channels and relationships established to

disseminate ocean sciences content to ever-widening pools of secondary students. Many of these broader impacts are unfunded, and represent leveraged impacts of front-end funding on the direct program costs. COL is encouraged to try to capture and quantify these secondary and tertiary impacts for clarification of the overall impact of the NOSB program and COL Education efforts. In an era of federal austerity, it would seem important to demonstrate in multiple ways what the researchers have again observed in these data: NOSB has and is making a difference in the STEM education pipeline.