

NOSB 2020 Coach Instructional Choices and Team Preparation Report September 2020

The Consortium for Ocean Leadership (COL) annually implements the National Ocean Sciences Bowl (NOSB) as a regional and national competition-based program for secondary students in the United States. A variety of tracking and follow-on surveys have been implemented to follow students, former students, coaches (teachers), and other program stakeholders beginning in 1999 and continuing annually since that year. Drs. Tina Bishop and Howard Walters, of the College of Exploration and Ashland University respectively, have developed the surveys associated with these longitudinal studies, as well as numerous other instruments and data collection procedures. In prior years, in addition to the student tracking surveys, an additional research project was undertaken focused on one or more of the other constituency or stakeholder groups attached to the program, including scientists and graduate students, judges and volunteers, teachers and parents. For this year, COL personnel directed that the study be focused on instructional strategies and team preparation for both students and coaches, as a follow-up to a similar study which was implemented in 2014-15. Two separate surveys were administered, one for students and one for coaches. (The student survey data are presented in a separate report).

For purposes of this current report, the data and summaries following are based on a follow-up survey to coaches (high school teachers primarily) who led teams in competitions from 2016-2020. The survey was disseminated in late May 2020, by the NOSB program office to its most current database of coaches. A total of 27 individuals provided responses to the thirty-six items on the survey, as summarized below. The entire raw data set is provided as an appendix to the report to COL. Given the large number of survey items, some with overlapping topics, and the relatively small number of available coaches to complete the survey, in the interest of clarity, some of the survey item responses are merged in the summary narrative below.

Twenty-seven coaches filled in this survey. The respondents represented 21 regional NOSB bowls/competitions from across the nation, with two responding for the Aloha Bowl, and two responding for the Blue Heron Bowl. Two coaches had participated in two bowl locations.

Items one through six were essential demographic items to describe the coaches and their professional contexts and relationships to the NOSB. Item one identified the coach's stakeholder group. Two-thirds of the twenty-seven respondents were teachers, while the other third was comprised of volunteers, a parent, retired teachers, or scientists. One respondent was a former NOSB student who is now coaching a team. Item two asked respondents how many years they had served as an NOSB coach. Of the twenty-seven responding, nine respondents indicated they had coached for more than ten years. This longevity of commitment was important and interesting. Many of the respondents had been to the National Finals Competition multiple times. It is reasonable to conclude that this set of respondents is an experienced and knowledgeable group and able to provide important feedback on the NOSB program.

When asked about the number of times winning their regional competition (item four), seven of the respondents indicated one time, and thirteen respondents indicated *multiple times*. In describing the highest placement at a competition for one of their teams during the period from 2015 to 2020, seventeen indicated first place, with three respondents indicating fourth through eighth place. The final demographic item, item six, asked respondents about their school providing resources to support their local participation in the NOSB. The responses were divided

with 60% reporting Yes, and 40% reporting No. The evaluators are unsure how to interpret this allocation of funding, and whether this represents a change in the program’s funding structure over time or not.

Items seven through ten asked a variety of questions about time invested for coach and team preparation. When asked about the number of hours per week the coach invested in preparing *themselves* to work with the NOSB team, 89% (of the twenty-seven) indicated 1-5 hours. Only one coach invested more than 15 hours per week. Twenty out of twenty-seven respondents also reported that the team spent 1-5 hours a week together preparing, with three stating the team prepared 6-10 hours. Only one person said the team prepared 10-15 hours per week. Interestingly, 85% (twenty-three out of twenty-seven respondents) said that the team prepared on their own without coach instruction or participation.

Item eleven turned to types of instructional *strategies* that were used to prepare the teams. For the competitions. The highest listed instructional strategies used to prepare the team were providing sample questions (88%) followed by providing practice quizzes (84%). The next most mentioned was providing resource readings and textbooks (nearly 84%) followed by visiting the NOSB resource page (81%). An important next category of preparation was the coach’s participation in online Professional Development Webinars, mentioned by 65% of the respondents. The importance of the NOSB program as a vector or opportunity to reach classroom teachers with informal professional development for the teacher’s content knowledge growth was first observed nearly a decade ago in the tracking surveys. This observation reveals a secondary outreach “program” of COL, i.e. teacher education, that may be overlooked in strategic planning and reporting.

Item twelve asked about the coaches’ approach to leading their teams. The responses indicated that a variety of pedagogical and leadership approaches were used. Thirteen coaches said that their approach was moderately *coach led* with some student work on their own (48% of twenty-seven), while the other responses ranged from fully *coach led* to entirely students working on their own (11% of twenty-seven).

Item thirteen asked coaches to identify primary resources for NOSB Preparation. Table 1 as follows provides the disaggregated responses to this item:

Table 1: Resources for team preparation for the NOSB.

Resource	Number Selecting
Textbooks	27
Lab Kits	1
Web pages from science curriculum companies	9
Question banks	21
Web pages from science museums, aquariums	11
Webpages from government agencies	21
Material from workshop personally attended	7
Videos from any source	10
Materials from the NOSB web site	24
Human resources, e.g. lectures, grad students	7

Webinars	11
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Most mentioned were textbooks and material from the NOSB web site. Several other resources were also listed including an individual coach’s own knowledge and experience or the coach’s own written materials. Item fourteen extended the question regarding resources to include enrichment activities used in team preparation. The three most cited activities were a trip to an aquarium or science center (15 coaches), a visit to a science lab (11 coaches), and a visit to a beach, lake or stream for lab work (9 coaches). It seems clear that the preparation activities themselves assume the characteristics of rich educational experiences themselves before the team ever arrives at an NOSB competition at any level.

Item fifteen asked coaches to describe further the nature of the local team. Some teams function as ocean science clubs; other teams function as general academic quiz bowl teams participating in numerous bowl type competitions; and some teams are simply a subset of an ocean related high school course. Table 2 below disaggregates the coach responses to this item:

Table 2: Nature of school team.

Team as stand-alone group	12
Team as part of ocean club	6
Team part of other academic competitions	3
Team as part of ocean science course	4
Mix of all	2

Item sixteen asked the coaches if they worked with or led other teams of students for other academic competitions at their schools. Twelve of the twenty-seven respondents stated that they coached other academic competitions, mentioning the National Science Bowl, Olympiads (Science, Biology, Chemistry), Quiz Bowl, and Robotics competitions as well as Envirothon for the next academic year.

Item seventeen solicited information about the transfer of ocean related content knowledge to other students in the schools represented by these coaches. In prior survey years, it has been observed that in schools with an NOSB team, other students do obtain benefits from exposure to NOSB team preparation activities (at least indirectly from teachers’ inclusion of ocean science content in other course teaching where those students are participating—these teachers are creating an atmosphere of ocean-infused content teaching in a variety of courses which are discussed below). There were responses from twenty-three of the twenty-seven coaches that described affirmatively that this phenomenon is happening in their schools, and provided numerous examples. Select narrative responses that describe this secondary level of education or exposure include:

- Students have to write a paper for participation in the regional bowl. We ask a number of English classes to offer their students to critique our papers to help our kids improve their writing skills. Additionally, our high school is generous enough to allow us to use the

auditorium to practice our presentation to the student body; classes are invited each class period. Upwards of 100 students are watching our team present on an ocean related topic.

- One example of indirect benefits to other students: when our team planned a field trip to the university to visit the School of Ocean and Earth Science and Technology department, the Science Club also invited students from a STEM class (and their teacher) to join us.
- The club makes a big World Ocean Day activity annually that is open to all students. They share with their friends.
- Sometimes there are younger students (ninth and tenth graders) that have been asked by team members to come join the team before taking the class. They learn some material while preparing for the competition then decide to take marine science as a class once they have completed their other prerequisite science requirements.

Items eighteen and nineteen drilled more deeply into instructional philosophies and teaching methods used by these successful science teachers and coaches. Item eighteen asked, “Some science teaching is highly inquiry driven and constructivist; other models emphasize content delivery or acquisition of factual knowledge. How do your team preparation activities fit along or within these models?” The predominant response clusters were nearly in the middle of this constructed continuum. Of twenty-seven responses, twelve marked balanced and fourteen marked focused on factual knowledge. No response was recorded at either extreme end of the provided continuum. Several teachers provided narrative to enhance their understanding of this item that is very helpful here:

- I see some teams that treat this as a million flashcards. We look at it by topic and integrate it. Still very fact oriented, but the connections and understanding are how we get to do well. We are not as strong when it comes to memorization of some number (or fact).
- We try to have students gain as deep a knowledge/understanding of any information that relates to the ocean.
- Since most students have me in class, they get the constructivist position during instructional time. We focus more on buzzer practice and brushing up on factual knowledge during practice.
- Learning best takes place when students can connect between their experience and what new knowledge that the teacher wants to impart. So I tried to give them basic tools and information and tried to connect them to more complicated situations.

Item twenty concluded the section on methods, strategies or resources with a focus on use of instructional technology and “keeping relevant” in the midst of substantive and rapid changes in technology. Twenty-three of the teachers provided brief narrative responses. Most respondents tended to allow students to drive their own incorporation of technology—and it seemed that most respondents interpreted the question in the context of team NOSB preparation and not the broader instructional contexts of public education. There were no really consistent themes or clusters of responses across the narrative set, although there seemed to be some cohesion around

that idea that students drive the movement of these technologies, and that there is some value to the internet and internet derived resources to enhance acquisition and use of data in learning.

Items twenty-one and twenty-two addressed expanded learning benefits among student participants from the NOSB competition. These are not essentially or primarily the focus of the NOSB, but they are important to the COL leadership. These are concepts for environmental stewardship and concepts for free-choice learning by the past or current participants.

Respondents provided a number of interesting observations about the development of these concepts by participants:

- Many of my Ocean Sciences Bowl team members have gone into either ocean-related research or environmental programs at their chosen college as a result of the interest sparked by. Preparing for and participating in the competitions.
- Most of our kids don't come from families with extensive science backgrounds. Our kids come out of this program understanding climate change, fisheries policy, and other useful knowledge that is relevant in our world today.
- Oftentimes, students upon learning an interesting fact, enjoy delving deeper into the topic. There are a plethora of interesting topics in ocean science that this particular group of students find intriguing.
- When students arrive in high school, most of them are not aware of what is available to them. Through their participation in the NOSB they become more aware of the choices that are available to them. This exposure leads them to investigate other areas and often changes their goals, but more importantly, their self-image. I believe that had they not participated, they might have settled for much less than what they are capable of.

Item twenty-three asked respondents to identify the primary challenges faces by their teams in preparing for the NOSB competition. The overwhelming response (15 out of 23 responses) was the lack of available time with the students to prepare for competition. Numerous coaches described that the typical NOSB team member is a deeply engaged and active young adult. Other clubs and organizations, sports, jobs, and volunteer work are only a few of the competing issues for these teams. This issue of time has been a recurring response for the entire history of the NOSB program. The kinds of high energy, high engagement, and highly capable high school students who are attracted to the NOSB keep themselves very busy and engaged.

Item twenty-four asked respondents to identify, as a reverse to the previous item focused on challenges, what are the primary benefits to students who participate in the NOSB. The two largest clusters of responses pointed to deeper understanding of science content and learning, followed very closely by increased social networking, team building, and meeting other similar students. Other smaller clusters of responses were associated to helping prepare for college, to access scholarships, and simply as a fun activity that appealed to this "type" of student. These coach observations were very similar to the responses of students or past participants when asked theses same types of questions.

Item twenty-five returned to the issue of a wider inclusion or distribution of ocean science content in academic courses at the high schools. Numerous teachers indicated that they did this, indicating that a much wider group of students were getting exposure to ocean content in their schools. Specific classes which were named included: physics, anatomy, environmental science, chemistry, AP environmental science, AP chemistry, and biology. In the follow-up question (item twenty-six) fourteen coaches indicated that they used the Ocean Literacy Principles as a guide to infuse ocean science into their regular classroom teaching.

Items twenty-seven and twenty-eight probed more deeply into the strategies or instructional contexts for infusing math, engineering, the social sciences, marine policy and technology into their NOSB preparation activities and also their classroom teaching. No single cluster of responses emerged, but there were a number of helpful and informative comments from these experienced coaches that merit consideration (the raw data with all of the narrative response is provided separately with this report):

- I provide practice content from the NOSB, which has a mathematics section along with engineering questions via the physics section. I have also used Science Olympiad material for engineering activities to help my students with team bonding.
- We encourage our students to take all of the math and science courses that they are comfortable with.
- Social science and marine policy are areas that we struggle with. There is so much information and it is hard to know what to teach. A narrowed down list of marine policy topics, or an update of the questions bank regarding these topics would be helpful.
- This is student driven for the most part...it is challenging.

Items thirty and thirty-one explore sources of information for college and career information that coaches may provide to students. The responses are nearly as varied as there are respondents to these items. Many of the coaches access this information from the NOSB web site or links to related agencies beyond that site. Some have direct connections with specific ocean science departments at specific universities and mention those. The internet is ubiquitous as a source of finding information in many contexts, and this seems one of those, with numerous respondents pointing to internet searches and sources. With respect to the issue of colleges or college selection, interestingly, few coaches possessed or provided explicit information about specific colleges. They encouraged student searches and one shared a list of “good” oceanography programs. Several invested time exploring interests with students, and then providing generic search information to guide college identification. Two coaches have a direct relationship with universities and provided specific information to students about those programs. Again, the students, in their separate survey, concurred with the coaches that they did receive career guidance and information, and some limited college information, from their participation.

Final questions solicited information from coaches about their own professional development sources - which yielded fairly standard sources as would be expected. Item thirty-three extended that line of questioning to ascertain which local, state or federal agencies they had contacted for their own content knowledge enhancement as teachers. The responses most regularly included

NOAA or a NOAA line office, and a range of state fisheries or environmental organizations. Sea Grant emerged for several individuals, as did the EPA, USGS, and several university programs.

Item thirty-four asked coaches who had coached for multiple years, which included twenty-six respondents, the degree to which they had changed their NOSB team preparation activities over time. The largest group, fourteen coaches, had made some changes, but only five additional respondents had made significant changes. Interestingly, seven of these respondents had not made changes at all over time.

The final two questions on the survey were open-ended and solicited coaches to provide either specific recommendations for team strategies that they had learned over their extensive experiences leading NOSB teams, and to make any additional comments about the program which they wanted communicated to COL leadership. These sets of responses are rich and are provided separately in their entirety to COL. It may be that particular responses to item thirty-five might be edited into an informational flyer for new coaches as onboarding information for these new individuals.

Conclusions and Recommendations

It seems remarkable that an informal science education program such as the NOSB—which does not reimburse nor incentivize classroom teacher participation annually—could not only attract high quality teachers to coach these teams, but maintain the interest and participation of these teachers for nearly two decades in a few cases. The large number of teachers in this response pool that have coached a team for many, many years is a statement in itself of the value that these teachers extend to the NOSB. This is an incredible resource or asset for COL and the NOSB leadership. It is recommended that consideration be given to this relationship between COL and these long-involved teachers. What motivates a teacher to continue engagement with an external program over time, in the face of multiple opportunities and other options? In part, the answer to this question could guide the development of other, high quality informal science education initiatives that require mediation by classroom teachers to reach students at a variety of ages and grade levels.

It seems further obvious, in light of the data provided by respondents in this survey, that notwithstanding the emergence of a nearly endless quantity of information available through the internet, there is a durability in use, focus, and awareness among these experienced coaches for a fairly stable set of agencies and content resources. Teachers go to the federal science agencies consistency and with regularity. This observation in a relatively modestly funded program such as the NOSB, could be lost unless it is carefully fostered and communicated upstream by COL. It is recommended that COL and NOSB personnel attempt to bridge the communications gaps between teachers who use, for example, NOAA educational resources and personnel, and those senior level NOAA administrators who determine funding for those NOAA resources. COL's proximity in Washington, D.C. to EPA, USGS, NOAA, Sea Grant, and Fisheries leadership augments its ability to communicate with the leadership of those agencies the “facts on the ground” for classroom teachers at the grassroots of American science education. Those teachers rely on those agencies. Those agencies should know this. They have value.

An additional recommendation emerging from these survey data is for the COL/NOSB leadership to consider the provisions of study materials, practice buzzers, or practice resources for preparation of the local teams. Several coaches, in different items, alluded to deficiencies or gaps in these materials or items with their teams.

And finally, one coach noted that she/he would benefit from support for public relations or press releases that could be available to the coaches to support this activity at the local level. While this was only mentioned by one individual, it points to an authentic need—that is not typically something that a high school coach might undertake—which could easily be supported by the COL office.

The longer-term view of the NOSB, in conclusion, has been remarkably stable. Students and teachers are consistently engaged, and perceive that they obtain value from this engagement. This value accrues through enhanced content learning, extended social networks, and a life-long attachment to the oceans which began, for many of these students and teachers, on or with an NOSB team at a local high school.