Improving STEM Recruitment through a Theme-Based Summer Residential Camp Focused on Sea-Level Rise

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Abstract

This paper presents an enrichment program that focuses on science, technology, engineering, and math (STEM) concepts. This program is named Building Leaders to Advance Science and Technology (BLAST), held each summer at three different universities across the Commonwealth of Virginia: Old Dominion University, Norfolk; University of Virginia, Charlottesville; and Virginia Polytechnic Institute at Blacksburg. BLAST is sponsored in partnership among these three universities and Virginia Space Grant Consortium (VSGC) and is funded by the General Assembly of Commonwealth of Virginia. Its main purpose is to expose high school students to the topics related to different STEM fields through engaging hands-on activities so that more high school graduates would choose to pursue STEM careers. This paper focuses on the session that was held at Old Dominion University in June 2016, ODU BLAST 2016. It was held for the first time in the summer of 2016. Two additional sessions followed in the summers of 2017 and 2018. Each year, 80 students entering either ninth or tenth grade from across the state participated in this summer enrichment program. The program is residential and lasts full three days, from Sunday to Wednesday, with an overarching theme focused on the resilience to climate change and sea-level rise. It includes faculty and students from various colleges and different STEM fields. The main program has four rotating daily sessions with additional sessions held on each of the three evenings students spent on the ODU campus.

Introduction

Sitting between two tidal rivers, the threat of tidal storm flooding is nothing new to Old Dominion University (ODU, 2018). The university frequently has to consider recurring flooding when deciding whether to cancel classes because of the potential threat to people's safety; considering locations for new buildings or razing old ones because of issues related to flooding; or making a sundry of other daily decisions by an institution that is open 360 days a year.

Hampton Roads is located in the southeast region of the United States, in southeast Virginia, on the cusp of Chesapeake Bay, an area that represents one of world's largest metro areas vulnerable to the flooding from tidal storms related to climate change. Climate change and resilience has been identified as one of the main research focuses of the Old Dominion University, supported by the university administration and local government. Various research efforts across campus focus not only on various climate change issues, such as its causes, but also on the ways more resilient communities can be designed and improved to adequately resist future climate changes and sea-level increases (Marfield, 2017).

Several new programs, centers, and courses have been implemented at this university (Tomovic & Jovanović, 2016). Building Leaders to Advance Science and Technology (BLAST) is an educational program funded by the General Assembly. Its main objective is to increase number of high school students that will pick STEM as their future career. BLAST programs are administered and funded by the Virginia Space Grant Consortium (VSGC) in the Commonwealth of Virginia (2018). These programs are currently offered at three Virginia universities, with a similar program structure across all locations. VSGC advertises and accepts students based on academic performance, teacher recommendations, and gender; they strive for equal numbers of boys and girls. Over the course of two days and three nights, 80 students are divided into eight gender-specific groups of 10 students that rotate through four three-hour STEM workshop sessions and three specially designed STEM evening events that complement the workshop sessions. In these evening sessions, high school students are introduced to the deans of each participating college. Deans introduce their respective colleges and research efforts related to the climate change and sea-level rise.

Program offerings, as well as who is involved, differ among the locations. The ODU BLAST 2016 program had four main workshop sessions that were designed and implemented by the faculty from College of Science and College of Engineering and Technology. Evening events were designed and implemented by faculty from College of Sciences, College of Education, and College of Arts and Letters.

Opening Night Session: Questioning Climate Change and Sea Level Rise

Faculty: C. Tomovic and V. Jovanović

ODU BLAST 2016 kicked off at Pretlow Planetarium. In this session, students were introduced to the administration team and participating faculty. Students were asked to reflect about the connections among STEM careers and tackling important challenges that are happening to the communities due to the climate change and sea-level rise. Participants then watched a full-dome film, *Our Living Climate* (2009), which addresses the historical and recent causes for slow, rapid, and sometimes violent changes in Earth's climate. The film focuses on how the Earth's atmosphere is a dynamic system that has changed many times throughout history. It presents how the atmosphere formed from some of the earliest organisms, how it was altered by supervolcanic eruptions such as Toba, the methods for directly measuring the past composition of the atmosphere, and atmospheric changes due to the extensive use of fossil fuels. While the movie focuses on the history of the Earth's atmosphere and slow atmospheric changes over hundreds of thousands of years or longer, it also discusses the rapid climate changes currently being caused by humans. Portions of the film discuss some of the current technology being developed to help fight climate change. After the film, faculty from the College of Science facilitated a healthy discussion on whether the causes of climate change were natural or man-made.

Using the planetarium for the ODU BLAST 2016 opening night allowed us to start the week's events in a unique, interactive environment. Full-dome planetarium movies are an immersive and inspiring atmosphere, and our goal was to start ODU BLAST with enthusiasm. After the film and the discussion, the director of the planetarium showed off some of the current stars and planets visible in the night sky above Norfolk. The evening's events were concluded with everyone getting the opportunity to look at Jupiter, Saturn, and Mars through several of ODU's telescopes.

Over two days, students attended four hands-on intensive workshop sessions (Tomovic & Jovanović, 2016) that focused on science and engineering topics regarding solutions to mitigating the effects of climate change and sea-level rise. A description of each workshop in greater detail follows.

Session 1: Our Home Planet and Its Place in the Cosmos

Faculty: C. Tomovic, V. Jovanović, B. Terzić, and J. Mason

Faculty, staff, and students from the Department of Physics designed a session whose main goal was to show and teach the basic physics behind climate change as well as taking a larger look at the reasons for protecting the planet.

Part 1—The Greenhouse Effect

The activity started by having participants set up a simple model that demonstrated the greenhouse effect. For each session, the 20 participants were divided into four groups of five students and given two 20 oz. bottles filled about a third of the way with water. In one of the bottles, they add two tablets of Alka Seltzer. When Alka Seltzer is mixed into the water, it releases carbon dioxide (CO_2). The caps to both bottles had been drilled with holes in which a thermometer was fastened. The caps were then screwed onto the bottles. Both bottles were placed close to a desk lamp with a 75W lightbulb. During the subsequent 30-40 minutes, in three-minute intervals, the students recorded the temperature of the air in both bottles. At the conclusion of the experiment, each group plotted, in different colors, the temperature versus time for each bottle. Each person was given colored pencils and a pre-made piece of graph paper with temperature on the y-axis and time on the x-axis. Having the participants graph their data by hand, rather than using a program such as Microsoft Excel, reinforced some basic math skills that the students already knew. Figure 1 shows a typical graph.

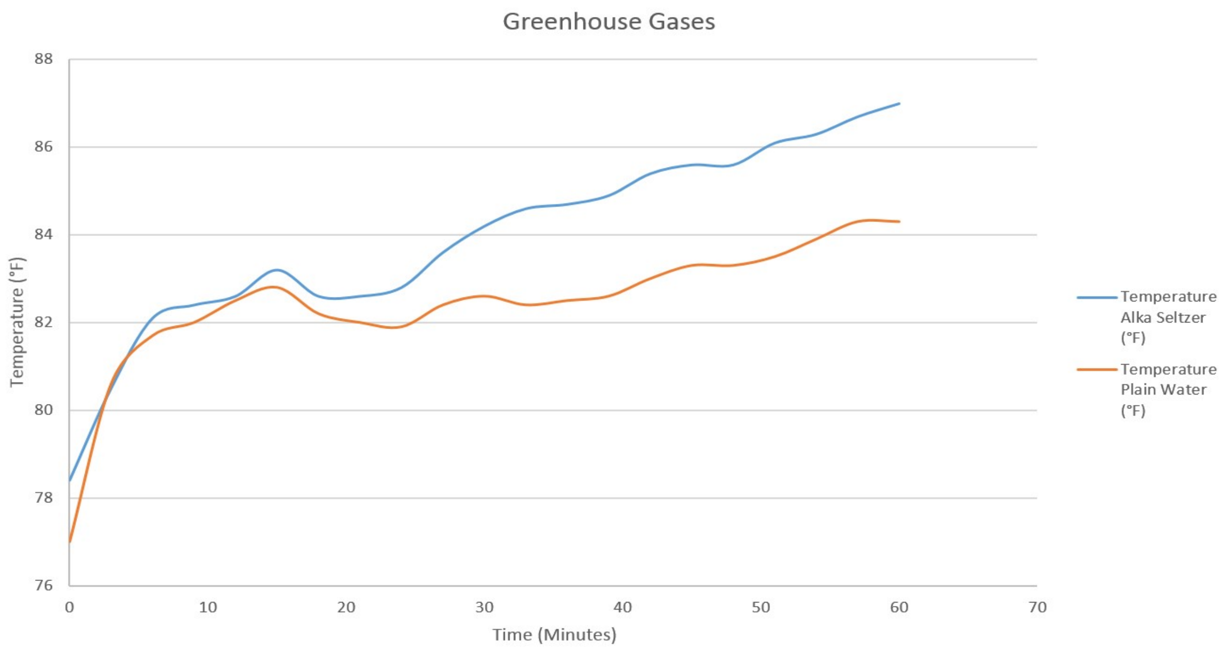

Figure 1. Temperature versus time for greenhouse gases.

Once all of the groups had prepared their graphs, one of the graphs was projected on the wall, and a discussion was held about how the presence of CO_2 could be observed in the bottle with the Alka Seltzer tablets. Typically, the air in the bottle with the extra CO_2 from the Alka Seltzer tables becomes several degrees warmer than the bottle without the tablets. The CO_2 inside the bottle with the Alka Seltzer tablets simulates and acts as a greenhouse gas, meaning that it traps more heat. This demonstration allows participants to create and observe the greenhouse effect in a simple, inexpensive, and effective manner. One important thing to note, during this experiment, however, it that typically one group in five will have difficulties, which probably happened because of the simplicity of the equipment. It is likely that the CO_2 in the bottle was escaping rather than being held in the bottle. Another issue observed was that the bubbling from the Alka Seltzer deposited water droplets on the thermometer and cooled it.

Part 2—Waves

Taking temperature data for 40 minutes alone would not be very exciting for the students, so during the same time the groups are performing the greenhouse experiment, they are also performing an experiment to learn about waves and wave motion. Since photons interact with our atmosphere and can act as waves, participants were introduced to the concept of waves, wavelength, wave speed, and frequency. This session needed advanced setup so that the time fit into the overall workshop time. The main setup had an elastic string, stretched across the table. That string was mounted over a pulley. A weight that was suspended on a spring was around 400g. A frequency generator was then attached to a speaker, and the string was run through the top of the speaker. The speaker then vibrated the string at various frequencies and created standing waves, such as those in Figure 2.

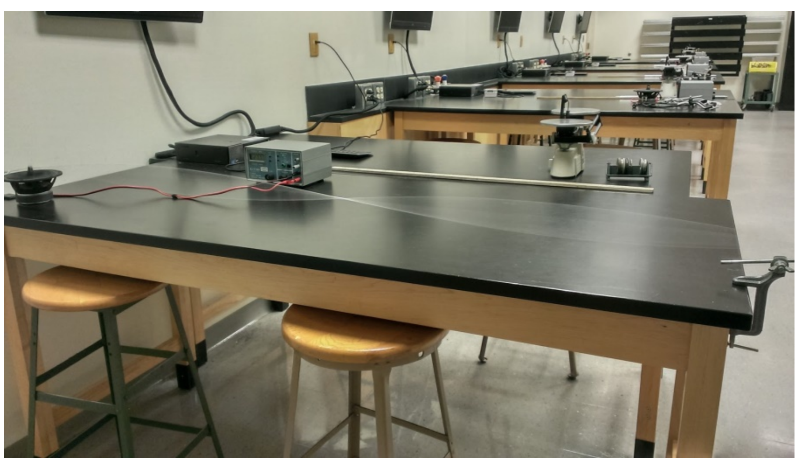

Figure 2. Experimental setup for the waves and wave motion.

The participants were tasked with finding multiple harmonics of the standing waves, measuring their wavelengths, and calculating the velocity of the waves of the string. After everyone had time to thoroughly investigate standing waves, participants were given a 10-minute challenge to see who could produce the most number of harmonics on the string. This challenge was well received by all groups, as it was a chance for competition. The record set by one group was 23 full waves in just two meters of string. The only drawback to this challenge was that some of the groups wanted to continue to go back to this part of the workshop rather than move forward to the next experiment. This was typically only a problem with the boys' groups and not observed with the girls' groups.

Part 3—Infrared Light

The third portion of the workshop allowed the groups to explore different forms of light and demonstrated the presence of light forms unperceivable by the human eye. By this point, students had been introduced to the nature of waves and light and their interaction with our atmosphere. Now the goal was to show the participants that light can come in different forms. To qualitatively show different forms of light, the participants were given a solar panel plugged into an oscilloscope. Then they were given three different kinds of flashlights: normal, visible-light; ultraviolet (UV); and infrared (IR). The participants were given 15-20 minutes to investigate the different types of light and how they influenced the power output of the solar panel. They were encouraged to shine the light on the solar panel repeatedly, flick the power switch, put pieces of paper between the flashlight and the solar panel, and, given time, investigate the solar panel itself.

The normal flashlight produced expected rises in the solar panel's power output as the groups expected. The UV-flashlight also produced rises in the power output of the solar panel. The students were somewhat interested in this flashlight because it produced the novel "black light" glow. However, many were interested in the IR-flashlight because the infrared light could not be seen, yet it produced the largest power output of the solar panel. They were particularly interested in this flashlight when they found it had strobe capabilities and could produce both red and blue flashes. They then examined whether the IR or UV light produced the same effect on the solar panel. The students liked this portion of the workshop because the directions were less rigid; they were given the equipment and free reign to explore how all of it interacted. At the conclusion of this section on infrared light, an IR camera was connected to the projectors in the room so that all could see themselves in infrared light.

High school students enjoyed activity with infrared camera, how they measured light emitted by the heat of their bodies, and shared multiple images of it on various social networks. Participants could see themselves in the dark as they continued to glow in the infrared, even if they could not easily see each other with their own eyes. They were shown how their bodies give off infrared light and how that light could or could not pass through some everyday objects. For example, the infrared light was blocked by a piece of glass (normally transparent to visible light), but it passed through a trash bag (normally opaque to visible light). The students were then allowed to have fun and encouraged to get in front of the camera to see themselves and their friends in infrared light. Figure 3 shows some of the groups with the infrared camera.

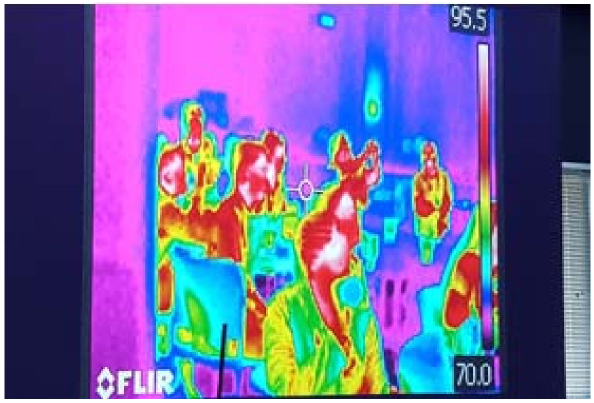

Figure 3. Infrared camera activity during Our Home Planet workshop.

Part 4—Life in the Universe

Finally, after covering topics such as greenhouse effect, waves, and different forms of light, we take a step back to look at the bigger picture of our Earth and its climate. Two 5-minute videos were shown to the participants. The first video (Dudnik, 2013) covered the Drake equation (Drake, 2015) and the statistical likelihood of life in the universe. The second video was about the Fermi paradox (2016) and possible reasons we have not seen or had contact with alien lifeforms. After the videos, a discussion focused on the participants' thoughts as to why we have not found any evidence of aliens and their existence. This discussion allowed the faculty to focus students' thoughts towards the idea of taking care of and protecting our planet. The students arrived at the conclusion that if the only known life form in the universe exists on Earth, then we should be addressing climate change to protect our planet.

Session 2: Water Water Everywhere and No Place to Go

Faculty: C. Tomovic, V. Jovanović, and M. Erten-Unal

The main objective of this session was to introduce students to civil and environmental engineering. Students learned about the green infrastructure and low-impact development technologies. The main purpose of these activities was to showcase one of the engineering solutions that is frequently use to alleviate flooding issues that happen as a result to storm waters and negative effects of sea-level rise. After being introduced to these natural and innovative stormwater management strategies, the students built and tested the performance of bioretention cells. Bioretention cells contain different media including top soil, sand, pea gravel, mulch, and geotextile material to enhance infiltration and improve water quality. They explored how bioretention cells slow and treat stormwater runoff to alleviate flooding and improve water quality. The reactors to simulate and house the media for the bioretention cells were constructed from Plexiglas and had an inlet type of drain and gutters that fed them.

Students were provided the materials and media including sod, sand, gravel, mulch, and topsoil to build their own bioretention cells. Students brainstormed as each group designed its own mix media configuration. They recorded the types of media and the ratios of each material added to the Plexiglas containers. The students used two parallel units, shown in

Figure 4, one of which they built as a bioretention cell designed to reduce flow volume and velocity and pretreat the applied water. The other unit did not have a bioretention cell but instead had a Plexiglas surface that simulated an impermeable surface, much like pavement. The students observed the differences between the two containers when they applied equal flow rates to the two alternatives. See Figure 4 below.

(a) (b)

Figure 4. (a) Unit with mixed-media bioretention system; (b) Unit without bioretention system.

Both systems required a water connection and a water distributor made up of perforated pipes, which simulated a “rain’ event. The students measured and compared the amount of runoff collected from parallel units with and without bioretention cells.

Water quality parameters were also introduced, as were the concepts of engineering design through the redesign activity of improved bioretention cells. Their redesign included different configurations, all for the purpose of better design performance. They compared the two bioretention cells’ mixed media characteristics (the materials and their thickness) and determined the travel time of the water within the media and shared their results between groups. Through this experiment, students developed an understanding of the concepts of infiltration rate, percolation, runoff, and storage capacity. They learned about properties of different media and, additionally, how they affected the movement of water within each medium.

Session 3: Changing Oceans: Exploring Acidification and Albedo

Faculty: C. Tomovic, V. Jovanović, and V. Hill

This session was designed by faculty members from the Department of Earth, Ocean, and Atmospheric Sciences. Albedo and acidification were chosen as the focus because these two phenomena produce prominent impacts on climate change in the ocean environment. The aim of this workshop was to introduce students to the principles of climate change in the ocean and to stimulate their interest by providing them with experiences in collecting data, subsequent analysis, and synthesis. Both parts of this workshop session were structured to take students from simple to more complex experiments.

Part 1—Albedo

The main focus of this part of ODU BLAST 2016 educational program was to focus on reflective properties of materials and how these properties play a role in light absorption and heating. The Arctic was used as a case study. The session started with a 10-minute presentation that demonstrated the albedo effect (the fraction of light reflected back from an object), an important concept to convey when discussing the warming of the ocean and why melting sea ice and terrestrial snow cover impacts temperature. The students were encouraged to participate by asking questions about their knowledge of changes in the Arctic and its impact on ecology and local residents. After the presentation, students were presented with two cans filled with water, one black and the other silver. Students used their new knowledge to predict which would result in a greater heating of the water inside. Students then observed and recorded the temperatures inside the two cans at an interval of two minutes once the lamp was switched on, as shown in Figure 5.

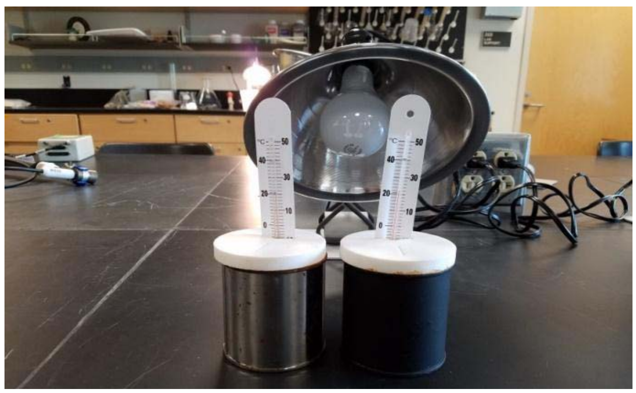

Figure 5. Experimental setup for albedo session, each can contained the same volume of water and was capped by a foam disk with a thermometer inserted into the water. The lamp was switched on after the time zero temperature was recorded.

After 20 minutes, the students plotted the temperature data from both cans. They were provided with a graph with pre-marked tick marks on the axis. Students had to decide which variables should go on each axis and plot the data. They then drew a line of best fit by eye. The rate of temperature increase for each can was calculated to determine in which can water more rapidly heated. Students were introduced to the main concepts of scientific research through the hypothesis testing and by presenting their results. They then went outside, where they used a light sensor to measure the reflectance of various objects including a white plaque that stimulated sea ice, a pond surface, soil, grass, and other objects of their choosing. Students calculated the percent of reflected incident light and discovered that darker surfaces, such as soil and water, absorb more light in comparison to the white objects, thus simulating the highly reflectivity of sea ice and snow. To conclude, students discussed how to apply this knowledge to the impacts of climate change in the Arctic and more locally.

Part 2—Acidification

In acidification, students learn that burning fossil fuels increases atmospheric CO_2, which is absorbed by the ocean. Increasing CO_2 in the ocean causes the water to become more acidic, thereby impacting coral, bivalves, and certain phytoplankton. This session started with a 10-minute presentation explaining the process of ocean acidification and its impact on organisms. Students were asked to identify which animals are affected by acidification and then then moved to test substances for vulnerability to acidification. They were provided with samples of coral, carbonate sand, silicate sand, oyster shell, and granite.

After writing down their predictions, students used dropped several drops of weak hydrochloric acid on the samples and recorded their observations. Students were asked if they knew why some substances fizzed under the acid; then the explanation was shared with them (release of CO_2 gas). They then used a BTB solution to demonstrate that CO_2 affects the pH of seawater. When blowing into the tubes of the solution, CO_2 in their breath caused a reduction in pH, which was shown by a change in the color of the BTB solution from blue to yellow. In the last experiment, students used CO_2 gas bubbled through seawater to observe and record changes in pH as CO_2 concentration increased through the setup, as shown in Figure 6. This session used the setup demonstrated by the University of Hawaii's C-MORE outreach (2016).

Figure 6. Experimental setup for acidification session, including a pH probe inserted through a stopper into a glass jar into which CO_2 was allowed to flow, and a CO_2 sensor, which measured CO_2 concentration in air that was displaced from the glass jar.

Students recorded pH and CO_2 using sensors connected to a Vernier Labquest mini; they then plotted the data to look at how pH changes with CO_2 concentrations. They were asked to discuss what they had learned with respect to their understanding of ocean acidification. The aim of both sessions was to expose students to concepts that they may not have been introduced to before and to provide an opportunity for hands-on experimental experience as well as an opportunity to analyze and plot data and calculate rates and percentages.

By finishing each session with a discussion and synthesis portion, the aim was to have students solidify their new knowledge and see that even small laboratory experiments could provide them with an understanding of the larger ocean environment. By starting each session with simple demonstrations of concepts and then building on them with more complex experiments, an increasingly challenging environment was provided to students with a wide range of abilities. From the albedo part of the session, students learned that as ice and snow melt in the Arctic, lower albedo surfaces were exposed, which resulted in more energy absorption and heating. Due to this phenomenon, the loss of snow and ice in the Arctic impacts climate changes. In acidification, points for discussion included an explanation on the changes in pH that were used in the experimental setup and whether it will exceed what is expected in the ocean over the next 100 years. Also, it was used to demonstrate the relationship between CO_2 and pH and to demonstrate that even small changes can have detrimental impacts on marine organisms; in particular, that affecting just one species can have cascading impacts on marine ecology, as other organisms rely on them for habitat and food.

Session 4: Satellites, Laser, and Drones: From Sci-Fi to Studying the Impacts of Climate Change and Sea Level Rise

Faculty: C. Tomovic, V. Jovanović, G. McLeod, and D. Smith

The main objective of this workshop was introduction to the technologies that are used for mapping of effects of climate change on a sea-level rise.

Part 1—Introduction to GIS

This session conveyed the critical importance of geospatial tools and technologies in recording, understanding, and communicating the impacts of sea-level rise and storm surge flooding. Students were introduced to a four-step geographic information systems (GIS) problem-solving cycle (Figure 7) as a framework for how geospatial scientists tackle the problem of flooding.

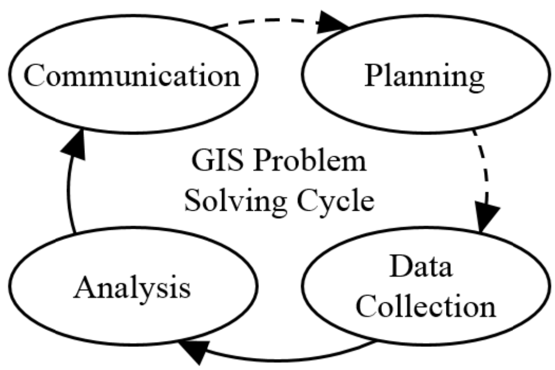

Figure 7. GIS problem-solving cycle.

Using this framework, students were tasked with answering the fundamental question, “How will flooding from sea-level rise impact my community?” They conducted four primary tasks as they worked towards developing their answer: Task # 1: Planning to collect locations and pictures of buildings and areas impacted by flooding; Task # 2: Collecting simulated flood

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damage data using GPS, tablets, and digital cameras; Task # 3: Performing visual overlay, analysis, and synthesis of flood hazard data; and Task # 4: Communicating their findings by creating an interactive "live" Esri Story Map website (2018). At the inception of this session, participants were divided into four five-person teams with a graduate student assigned to guide each team through the process of geospatial discovery and the communication of their results. As the focus of their study, each team was assigned a specific flood-prone neighborhood area within the City of Norfolk (Figure 8).

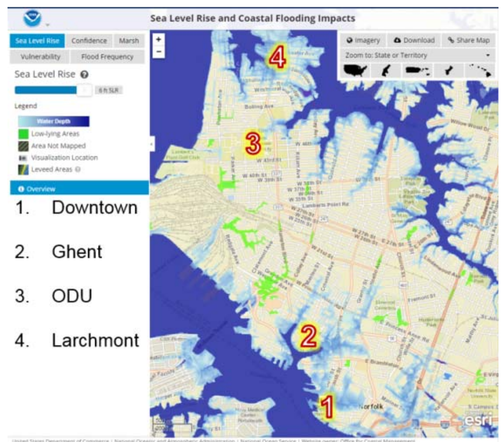

Figure 8. Flood-prone study areas in Norfolk: (1) Downtown, (2) Ghent, (3) ODU, (4) Larchmont.

Part 2 - Data Collection:

After a brief classroom introduction to the nature of geospatial data and technologies, students were taken outside to a natural area surrounding the ODU science pond. A demonstration explained how researchers use small unmanned aerial vehicles (sUAS) to collect data more quickly and efficiently than traditional means. Students were shown how UAS was capable of rapid acquisition of imagery, video, and other data that provide critical information for emergency responders and recovery operations after major storms and flooding events. After the UAS demonstration, the student teams split up to perform a hands-on exercise simulating the collection of flood damage data. Teams were equipped with two different collection technologies, stand-alone GPS and Web-connected tablets. The main purpose of such activities was to discuss positive and negative sides of use of these different technologies. The other goal was to explain why it is sometimes necessary to have redundant data collected from various sources for scientific research.

Students were instructed in the fundamentals of the GPS, GPS receiver operations, and conditions of optimal GPS data recording. The differences between capabilities of ruggedized GPS receivers, smartphones, and tablets were highlighted and explored. Student teams spent approximately 45 minutes on data collection, learning how to create and generate hazard damage assessment data that were output directly to a "live" website. These simulated data described the condition of a flood-impacted property with an attached photo of the actual damage. Upon completion of their data collection, student teams regrouped in a central location to engage in a 10-minute discussion about their findings and their experiences with using multiple data collection platforms to collect redundant data.

Part 3—Synthesis and Communication

Students returned to the GIS computing laboratory to learn more about sea-level rise and begin the data synthesis process. A 15-minute instructor-led presentation was delivered to introduce students to the regional- and local-scale impacts of sea-level rise in Hampton Roads and Norfolk. Students resumed work in their five-person teams with two objectives: to learn more about the impacts of flooding in their assigned areas and to effectively communicate this information to diverse high school students. Towards these goals, teams engaged in Web research and group discussions regarding the history and issues specific to their study areas. They were led in the discovery of a variety of flood mitigation and adaptation strategies that were available for communities dealing with persistent and recurrent flooding challenges.

Prior to developing their communication piece, students were required to engage in organizational planning and to divide up and execute the tasks necessary to complete their communication piece in a compressed timeframe. They worked collaboratively to use data collected in the field and information acquired online to build multi-page story map websites that explained the flooding condition and impacts of their study areas. Esri story maps are Web applications that let authors combine GIS data, maps, narrative text, images, and multimedia. Students were tasked with considering the best format and flow for factual and effective communications of their data synthesis and research. Near the end of the session, student teams were required to present their story map to the entire class. They were asked to discuss the greatest risks posed by the sea-level rise to the specific group study's area, the most interesting and challenging part related to creation of a story map, and some possible solutions for migration of identified problems that were identified in the area of their group. The participants' final story maps (Figure 9) were made publicly available on live web URLs so that the students could share them with their teachers, friends, and family upon completion of the ODU BLAST program.

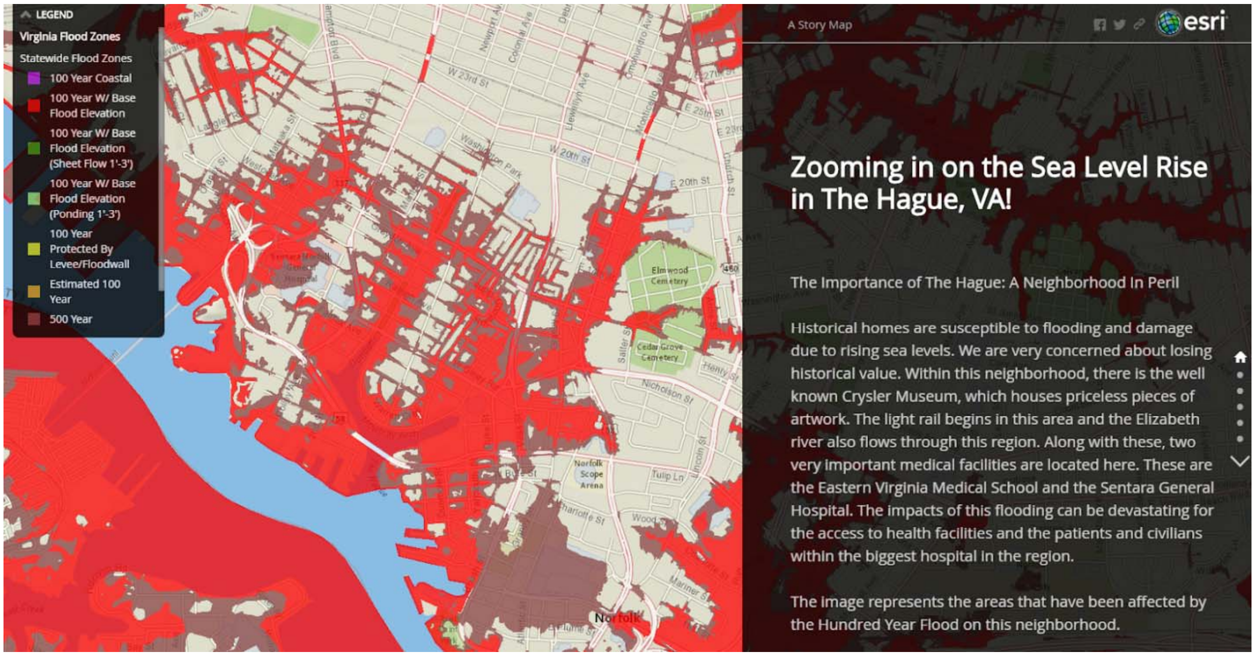

Figure 9. Front page of story map created by BLAST students (Esri, 2018)

Special Evening Event 2: Preparing for College STEM Career - STEM IT!

Faculty: C. Tomovic and V. Jovanović

This special evening event was designed by staff in Student Advising, and by faculty in the Department of STEM Education and the Department of Theatre and Communications. The purpose of Part 1—STEM IT! was to provide students a foundation about college life, what it takes to be successful in STEM majors, and opportunities that they should take advantage of during their time in college. The purpose of Part 2—STEM IT! was to provide students an opportunity to experience the opportunities and challenges that scientists and engineers experience when working together as a team.

Part 1—STEM-Related Advice and Panel

STEM It! was introduced by the dean of the College of Education. The audience was given a brief presentation about success in college and STEM majors from the perspective of an academic advisor. In the remaining hour, a panel of two female students and two male students, representing biology, modeling and simulation, chemistry, and mathematics, presented their perspectives on what it was like to be a STEM major and afterwards invited participants' questions. The facilitator's outcomes during the workshop were to familiarize the participants with college life and the differences between high school and college expectations, understand what it means to pursue a STEM major and how to take advantage of on-campus opportunities to expand their professional growth, to be able to see and hear what it is like to major in a STEM field from other students who have been through the college experience, and, finally, to introduce students to success strategies specific to STEM majors.

Part 2—Rockets to the Rescue!

Faculty: C. Tomovic and V. Jovanović

This activity led students through the scenario after a flooding disaster. Students discussed issues related to the logistics needed by the emergency responders and the people affected by the flooding. In severe storms, for example, roads, bridges, ports, and runways may not be usable; thus citizens become isolated. In this interactive session, students built and flew paper rockets that were used to simulate an alternative means of transportation. Each team of five students was provided plain and colored paper, string, and tape, bottle stopper, and cotton balls (Dunbar, 2016). All teams were assigned the same goals, requirements, and work constraints.

In all cases, teams experienced design challenges when building and testing their rockets. After about 1½ hours, teams competed with each other to determine which had built the rocket that could fly the furthest and land in designated areas marked by hula-hoops. Propulsion for the rockets was built from tubes and coke bottles; air was forced from the bottle, through the pipes, and into the rockets for liftoff. During the debriefing sessions, all participants indicated that they had enjoyed the exercise but that working together was challenging, thus demonstrating the major purpose of this activity, the challenges associated with team building and resolving conflict to achieve a purposeful goal.

Special Evening Event 3—Closing Night: Adventures at the North Pole

Faculty: C. Tomovic, V. Jovanović, and V. Hill

This special evening event was conducted by one of ODU BLAST's workshop faculty who is, herself, an Arctic scientist. In this closing event, participants were regaled by fun-filled stories about living and working in -40º, the Arctic conditions. Following a picture-packed PowerPoint presentation, the faculty member entertained a multitude of questions by students who, afterwards, could be heard saying that they wanted to become a science explorer. This special evening was capped off by a challenge between the girls and boys that was designed to test who could dress the faster in sub-zero clothing and get into a specially designed sleeping bag before the other. At the end of this special event, each student was called to the front of the room and awarded their personalized ODU BLAST 2016 Certification of Completion. After leaving the auditorium, students were invited to "chill-lax" in the student union where they played ping-pong, pool, chatted with each other, and topped the night off with some refreshments.

Demographics and Evaluation

Seventy-four students participated in the survey. Eight students were 13 years old, 43 students were 14, and 24 students were 15. Forty students were rising 9th graders, and 35 were rising 10th graders. When asked about their tentative majors in college, participants responded as indicated in Figures 10 and 11. While there was likely a selection bias as to whom would want to attend a STEM-related event like ODU BLAST, even with this group it was clear based on the results of the pre/post ODU BLAST 2016 surveys, in the short run, ODU BLAST was effective at changing the attitudes of many of the participants. A number of students who voiced a “don’t know” or “definitely not” interested in majoring in science, technology, engineering, or math moved to voicing an increase in their responses to being “maybe” or “probably” interested in majoring in science, technology, engineering, or math.

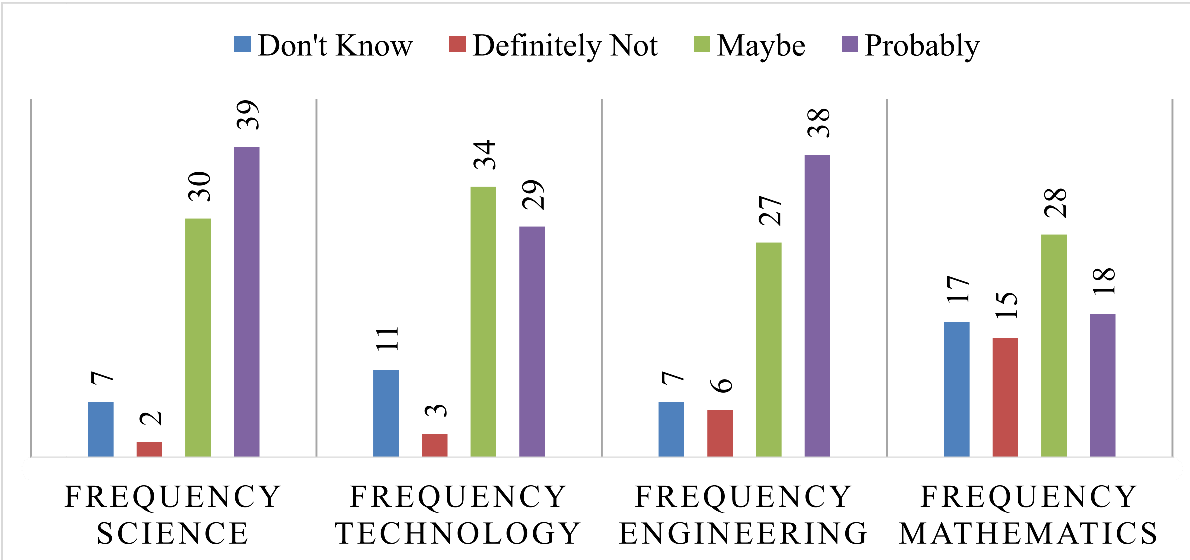

Figure 10. Frequency table for a question related to the major choice, pre activity.

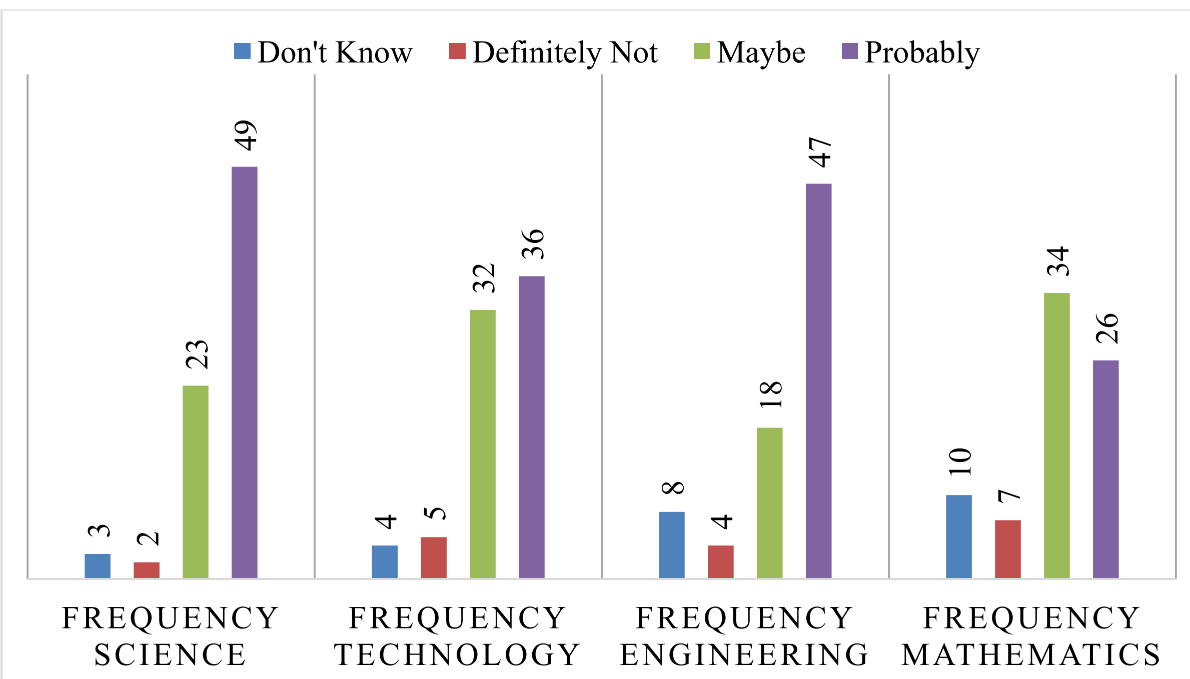

Figure 11. Frequency table for a question related to the major choice, post activity.

The main focus of NASA's Space Grant program through the VSGC is to develop and deliver aerospace-related programs aimed at sparking interest in high-tech professional and educational fields across the Commonwealth of Virginia. Our sessions were related to two of the main NASA missions, sea-level change (NASA, 2018a, 2018b). Students in this program were exposed to four different sessions related to the STEM areas. The activities focused on interdisciplinary learning and not only on specific majors offered in each one of the colleges. Administration faculty who organized the program were from the Department of STEM Education and Professional Studies, the College of Education, and the Department of Engineering Technology, Batten College of Engineering and Technology. The main workshop sessions in ODU BLAST 2016 were designed and delivered by faculty, staff, graduate, and undergraduate students from the College of Sciences and the Batten College of Engineering and Technology.

Conclusion

ODU BLAST 2016 presented in this paper was first one of the sessions delivered to high school students at the Old Dominion University campus. Each year ever since, another session is held, sometimes even two. Various collaborations were formed among the participating faculty, and the funding agency liked the overarching theme approach to the design of such a residential educational program. Many undergraduate student researchers became graduate students in the following year, and faculty, staff, and students continuously wanted to participate in this community and deliver this program to the high school students interested in the STEM careers. Feedback from students and the funding agency was very constructive and various improvements were implemented in subsequent sessions.

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