VEX IQ STEM Career Readiness Online Challenge: A Future in Space
by Killian C. Babb

My brother Vance and I at Kennedy Space Center, 2016

Since I was young, I've taken an interest in space. From rocket launches, International Space Station (ISS) flyovers, to viewing the Andromeda Galaxy at John Glenn Astronomy Park, it's always sparked something inside me. Now the REC Foundation has given me the opportunity to research further into a potential career in STEM. With my love for mathematics, recently found enthusiasm for coding, and fascination in the growing field of aerospace, I thought a job in computer programming as a Simulation Systems Engineer with the Jacobs Space Exploration Group would be perfect!

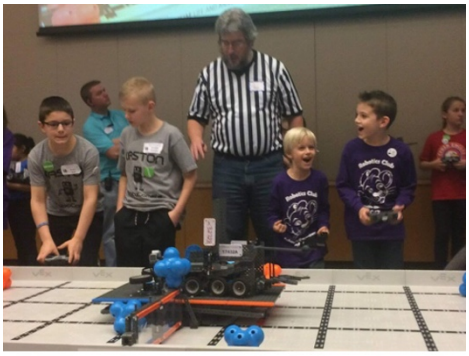
For this position located in Huntsville, Alabama, I would be involved with the simulated development, testing, and analysis for spacecraft. Some of the basic job requirements indicate a minimum of a Bachelor's degree (preferably from an ABET accredited university) in aerospace, electrical, mechanical, computer engineering, or related field. Prior experience working with space vehicles, and familiarity with programming languages such as C, C++, Python, SVN, and XML is beneficial. Traits such as teamwork and communication skills are necessary (Jacobs Space Exploration Group).

After identifying The University of Notre Dame as an accredited institution (ABET.com), I wanted to better understand the path necessary to becoming successful in this field of study. What could I do now and in the future to better prepare myself for a career in STEM? On 8/15/2020, I contacted Brooke Mumma, Project Manager, Notre Dame Rocketry Team (NDRT). She replied and kindly offered to have a Zoom session with me. On Wednesday, August 19th, 2020, I connected with the NDRT. Prior to our meeting, I drafted a list a questions and came with an open mind. Here were just several pivotal insights I gained while with them.

I was curious about what key skills are necessary to be successful in this program. They answered the "soft skills," which are the relatable and communicable aspects of the program, are extremely important. "The soft skills are the personable skills," stated Brooke Mumma, "No matter what job you choose, you will always be working in a team." I questioned about what new opportunities had opened up to them through their experience with the NDRT.

Zoom meeting with 2020-2021 Notre Dame Rocketry Team Leads

They unanimously returned that a large majority, or even all, of their opportunities came through the team, and a significant portion of time in interviews were spent discussing their experiences with the Rocketry Team. As a final interest of mine, I asked them what would be relevant technical skills. Estefania Castillo Villarreal , Payload Lead, replied, "My number one thing I would tell anyone going into classes is to take calculus. You will need calculus in the engineering field." Joseph Sutton, Chief Engineer, added, " For physics, chemistry, and aerodynamics [among others], focus on concepts, not the equations. Intuition for how things work is far more powerful."



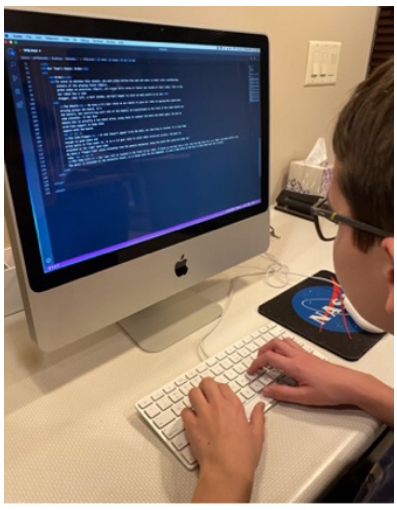
VEX IQ Crossover excitement at Indiana State 2017

My journey with VEX Robotics began in 2016 (2nd grade) as part of the inaugural Cedarville Elementary (Fort Wayne, Indiana) team. It taught me the importance of teamwork and the foundations of robotics.

While the first year set up the foundations for me, my second year, 2017-2018, is where I really gained interest and inspiration. We received our second bid to State, and our first to Worlds. This gave me a greater appreciation of STEM and its global impact. Those moments were the moments that sparked my love for robotics.

My teammates and I on the stairwell at VEX Worlds 2018

On the Leo Elementary team, 4th grade, I gained an interest in computer programming. I saw Aden, an older teammate, writing code for our robot. This fascinated me through its experimental side and specialized capabilities. The season, however, was not without its challenges. A week before our first competition our robot *completely broke down*. In the end, we persevered and ended up taking home Teamwork Alliance. Even though we obtained an early State bid, we sought new ways to improve throughout the season.



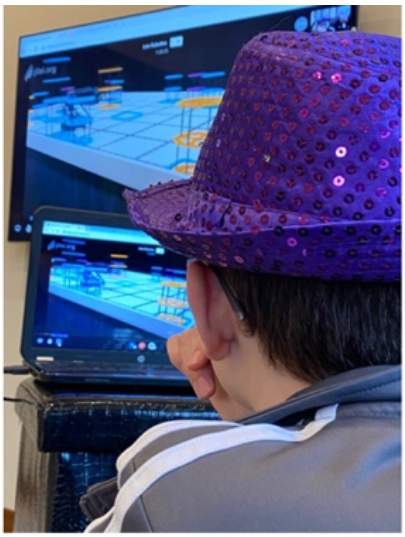
Programming our teams' website last year

Then came my fourth year in the program, which quickly became the most challenging, but rewarding, season yet, as I decided to step up to the MS Division. This was also the first year I was lead on the Engineering Notebook, learning a great deal about presentation and writing. Additionally, I took the opportunity to challenge myself by working on the 2019-2020 Team Website Online Challenge with Aurora, 141A team member. I learned a lot about computer programming, specifically the HTML and CSS languages. While we may not have won, I enjoyed it incredibly.

Both Leo 141 MS teams after 2020 Indiana State competition

After winter break we had few competitions left in the season. While in the final stretch to obtain a State bid, we were pushed to be better and stronger, but our team barely missed qualification each time. In the end, we earned our way to State through Skills. We received our 5th Design Award of the season and placed in the top five divisionally. We had doubled-down on bids! Our hard work had paid off. We were ecstatic!

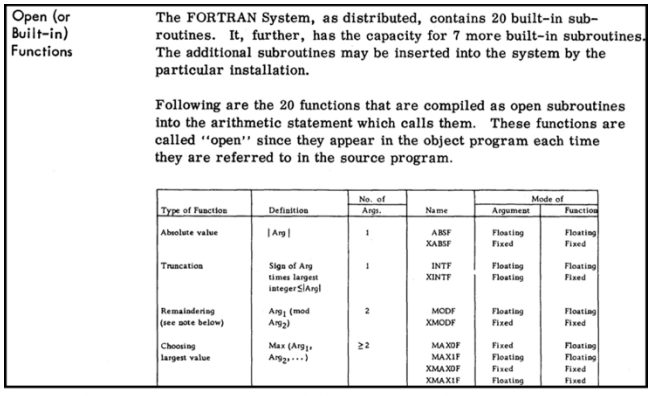
Then however, due to the COVID-19 pandemic (I'm sure you've heard of it), VEX Worlds was cancelled. However, through the Virtual Worlds Celebration, our team ranked 5th in the Technology Division. After it, I met with my teammates (virtually or in person) every Monday and Friday, teaching me a great deal about flexibility and adaptability. This year, I continue to advance my knowledge, as I pursue the Javascript programming language. I anticipate challenges this season, but along with them, reward for it.



Watching the VEX Virtual Worlds Rise Above game announcement with my teammates remotely

A photograph of Dorothy Vaughan, famed NASA mathematician

While researching famous people in aerospace, I found Dorothy Vaughan, a pioneer mathematician and programmer at NASA. She persevered in a time where she and her female co-workers were segregated. Her journey began as a child, taking interest in academics, following it until she came across a major in math. Afterward she worked various jobs until she applied to be a mathematician at Langley Memorial Aeronautical Laboratory. She was then promoted temporary section head in 1949, but wasn't given her full title until 1951. Then in 1958, West Computing, the segregated area where Dorothy worked, was put an end to, and all the once isolated groups at Langley were now unified amongst there fellow colleagues. Soon after, the day Dorothy had foreseen coming, came in the 1960's due to the huge leap in calculation technology over the last decade. These technologies would soon preform calculations better than humans preforming the same job. However, she had already been preparing with extra classes



Open (or Built-in) Functions

The FORTRAN System, as distributed, contains 20 built-in subroutines. It, further, has the capacity for 7 more built-in subroutines. The additional subroutines may be inserted into the system by the particular installation.

Following are the 20 functions that are compiled as open subroutines into the arithmetic statement which calls them. These functions are called "open" since they appear in the object program each time they are referred to in the source program.

Type of Function	Definition	No. of Args.	Name	Mode of Argument	Mode of Function
Absolute value	|Arg|	1	ABSF XABSF	Floating Fixed	Floating Fixed
Truncation	Sign of Arg times largest integer≤|Arg|	1	INTF XINTF	Floating Floating	Floating Fixed
Remaindering (see note below)	Arg_1 (mod Arg_2)	2	MODF XMODF	Floating Fixed	Floating Fixed
Choosing largest value	Max (Arg_1, Arg_2,...)	≥2	MAX0F MAX1F XMAX0F XMAX1F	Fixed Floating Fixed Floating	Floating Floating Fixed Fixed

A sample instruction page from the FORTRAN programming language manual used on the early IBM computing machines Dorothy worked with

taught on-site after her shifts, swiftly picking up the FORTRAN programming language used for the machine and got to work. Honoring her hard work and dedication, she was awarded a gold and ruby lapel pin after a twenty year career with Langley (Shetterly).

After finding this information, I found she inspires me in a variety of different ways. In a time where she wasn't noticed and respected by those among her, she proved her worth. When she saw industry was changing, she adapted to better fit it. VEX has taught me, like NASA taught her, the importance of perseverance, adaptability, and thinking outside the box.

From when Dorothy helped advance the space industry to recent history, one might wonder why STEM is having such a boom in popularity, so I immediately began investigating. Before I began research, however, I devised something comparable to a "hypothesis." Due to the rapidly accelerating growth and demand been shown for these fields, I foresee an increased appeal for employment in STEM. I also believe technological advancements will continue to automate an increasing majority of manual tasks worldwide.

Employment in STEM Occupations

Table 1.11 Employment in STEM occupations, 2019 and projected 2029

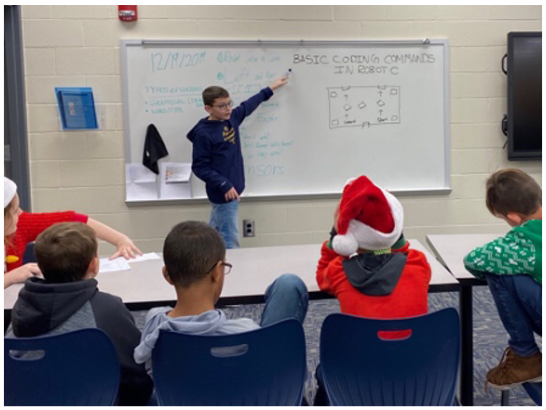
(Numbers in thousands)

Occupation category	Employment		Change, 2019–29		Median annual wage, 2019(1)
	2019	2029	Number	Percent	
Total, all occupations	162,795.6	168,834.7	6,039.2	3.7	$39,810
STEM occupations	9,955.1	10,752.9	797.8	8.0	$86,980
Non-STEM occupations	152,840.5	158,081.9	5,241.4	3.4	$38,160

Source: Employment Projections program, U.S. Bureau of Labor Statistics

After researching I found my theories considered probable by several other sources. STEM is indeed going to lead, as many of it's technologies will replace repetitive, moderate-skill capped jobs, which has been termed "job polarization," (Bharadwaj and Dvorkin). While the table above may make it seem as if non-STEM occupations will fair better than STEM, the two key data points are percent growth and annual wage. Within the next ten years, this growing career choice is projected to increase 42.5% more than it's opposite. The average annual pay is also about 43% extra than those of the contrary (bls.gov).

In conclusion, having drawn positive data into a potential career in aerospace and discovering the steps necessary toward it, I am confident in pursuing a course of study in STEM. Finally, I'd like to thank VEX and the REC Foundation for providing me with many educational opportunities through robotics, as well as my teachers, coaches, and family for encouraging my success. I would also like to recognize the NDRT for their insight into this challenge and look forward to what the 2020-2021 season has to offer.



In front of the Cedarville Robotics program members, teaching them ROBOTC coding, 2019

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141A & B group photo after 10/24/2020 Remote Skills Competition


Photo of The Notre Dame Rocketry Team from March 2020