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Self Perpetuating Robotics Lab gifted to Our's Sister's School by No Starch Press Foundation & Tech Teachers Travel Grant Report 2021



In 2021, through the gracious donation from No Starch Press Foundation, an all girl's school for scholastically talented middle schoolers in New Bedford, MA received hardware and training that brought their teaching efforts to a whole new level in the areas of robotics and electronics hardware. Tech Teacher's Travel is proud to continue to support the teachers and students as together we move towards the goal of building the electronics necessary to gift a DIY robotics lab to another educational organization.

Additional donations & gratitude includes iRobotics, QuestBotics, & Microchip Technology.

Tech Teachers Travel Inc.

EIN: 83-4689050



Grant goal and mission statements

The No Starch Press Foundation is a foundation built to provide global support to those with a hacking mindset who have yet to find a supportive community of hackers.

The No Starch Press Foundation:

- Offers financial support to STEM initiatives such as robotics clubs and research projects, and to promising software or product development projects conducted by public charity nonprofit corporations.
- Supports contests, educational, and cool tech development programs and will work to connect hackers with recognized leaders and experts who can help them to further their knowledge and interests.
- Sponsors educational presentations and resources geared towards technical people learning about hacking and to help introduce the public to the hacking community.
- Supports for hackers of all ages. Offer financial support to allow hackers to pursue their creative, hacking-oriented goals.

Tech Teachers Travel- Technology and training for people who want to help themselves. Travel opportunities for those who make the tools available.

Grant activities overview:

Tech Teachers Travel applied for a grant from No Starch Press Foundation in order to equip and train an existing tech education organization in microcontrollers, prototyping and electronics fabrication. The original plan was to find a school that currently offers Arduino and C++ in their curriculum, with the grant providing the opportunity to add a Computer Numerical Control machine and skills to the pre-existing infrastructure.

Several local schools, libraries and MakerSpaces were approached, but with no interest, or interest but an inability to sustain usage of the hardware for the foreseeable future. One MakerSpace suggested contacting an art museum. The art museum declined, but put Tech Teachers Travel in touch with the STEAM coordinator for Our Sister's School.

The training and hardware donation is almost complete at the time of this report, with additional support to be supplied in early 2022 in order to maximize the potential for electronics fabrication and prototyping at Our Sister's School. The hope is that this pilot will serve as a model that will entice other schools to adopt similar hardware and curriculum. Some of the teachers at Our Sister's School have also agreed to explore the possibility of playing a supportive role in future trainings for other schools.

Robotics labs traditionally have a high cost in the minds of administration. This effort shows that it is possible to create a scaffolded curriculum, with teacher training, from the ground level to robotics prototype fabrication with far less funding and at a younger age than anticipated, given the right pre-existing conditions.

Our Sister's School (final receiver of grant efforts by Tech Teachers Travel)-

Our mission, as an independent, tuition-free, non-sectarian middle school, is to educate and inspire economically disadvantaged girls from the New Bedford area. Our Sisters' School empowers students to step into the future with valuable life skills and a mindset of achievement and excellence by providing a safe, supportive and academically challenging environment.

In 2006 a group of concerned citizens began to ponder the limited educational success and opportunities for girls in the greater New Bedford area. Encouraged by research that positive educational opportunities for girls in the middle grades contributes to reduced teenage pregnancy, higher rates of high school graduation in four years, greater possibility of post-secondary education and an overall interruption of the poverty cycle, this group formalized and began the challenging task of starting a tuition-free middle school serving New Bedford's girls.

Since opening its doors to students in the first two grade levels in September 2008, the School now has a capacity of 72 girls in grades five through eight (5-8) from diverse races, cultures and faiths — whose families qualify for assistance based on Federal Poverty Guidelines. Since the first graduating class in 2011 our graduates continue to pursue academic excellence and professional satisfaction while continuing to contribute to their communities.

The School remains as fervently committed to its mission today as when it was founded.
We steadily graduate positive and empowered young women.

The Instructor Team



Tobey Eugino
Creativity Director, STEAM & Art



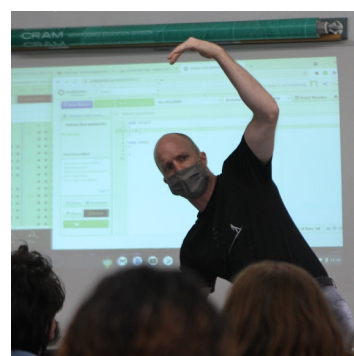
Angel Diaz
Fitness, STEAM, Music, Audiovisual Storytelling



Katie Mosca
STEAM & Health



Kim Francis
Volunteer Teacher & Engineer



Lindsay Craig
Tech Teachers Travel Instructor

Summer time teacher instruction & obstacle course



Additional activities:
Silly If Statements
Intro to Prototypes
ICs for teachers
H2O fight w/logic
Path branching
Intro to Arduino
QuestBotics
PCB design
Soldering
Rework
CNC



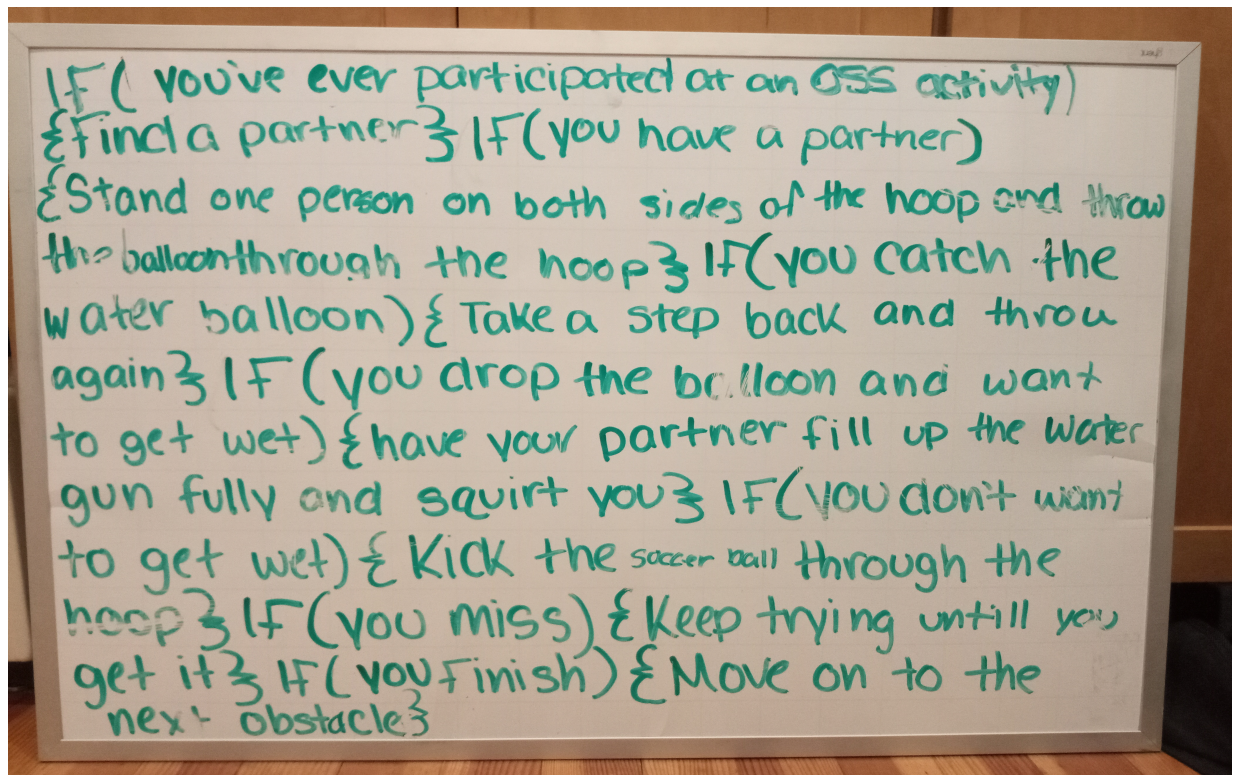
In the summer of 2021 Tech Teachers Travel began working with Our Sister's School teachers and students to learn technological concepts through kinesthetic activities and and obstacle courses.

Boolean and branch logic, if statements, variables, while and for loops were explored through small initial activities and a large overarching obstacle course. The two groups of 7th and 8th graders spent the first day learning how to understand pseudo-code and logic paths to make their way through a small obstacle course.

Summer time teacher instruction & obstacle course (continued)

The next day the students themselves designed a larger obstacle course with their own mini-stations and if statement instructions. Water balloons, scooters, basketball hoops, a balloon launcher, a xylophone, tennis rackets, hula hoops and other gym equipment made the day a huge blast for everyone involved. (One or two admin people in the otherwise empty school joined us.) The students themselves created the pseudo-code for each stations, as well as the logic paths that directed runners through out the obstacle course. A smaller number of students attended the summer time camp than the school year's regular 15 – 20 student classes.

Through out the summer and fall three full time tech teachers without prior text based coding experience, and one volunteer retired engineer, received four days of teacher training w/Arduino. The school, specifically Angel Diaz was adroit in tackling the hurdles inherent in hardware adoption, specifically a lack of compatibility between Chromebooks and Arduinos.



Example pseudo-code written by a student. This was one of the more complex pieces of pseudo-code written, but all obstacle course stations used C++ format with an "if," conditionals in parenthesis, and executional statements in curly brackets.

October prep and November/December classes

During the months of November and December the entire 7th and 8th grades participated in Arduino classes, with a prototyping overview. The 5th graders were introduced to coding and math concepts through game play and exploration with QuestBotics.

Topics with QuestBotics include: metrics (centimeters and degrees), variables, functions and parameters, multi-variable functions, if/else statements, while loops, for loops, creating and using functions, debugging and swarm robotics.

Some responses from students:

"I learned how to set up a breadboard and an arduino together so that I can code an LED to be dim, bright, shut off or shut on. I also learned how to make the arduino "speak" and say two different things at different times depending on whether I release or press a button." -Anyis

"I love learning about coding. I was thinking of signing up for a coding class in high school. Taking this class for a short period of time made me consider it even more." -Priseis

"One glow I have is that now I know how to code and I know that things that I need to code with (INPUT, OUTPUT, analogWrite, digitalWrite, etc). Another glow is that our table mates helped you whenever you needed help. A grow is that now I know how to code and 3 weeks ago I couldn't say the same." -Giselle

"One thing I learned while prototyping is that you should be patient with yourself because sometimes you might not get some of the codes correctly while prototyping but in life you will also not get everything right the first time while learning something new. I also learned while prototyping that you have to be careful while coding because you could confuse some codes like OUTPUT and INPUT and HIGH and LOW and you will have to know what you want to be output or input and high or low to know what you are coding and how you want your coding to look like."

"One of my glows while coding is making mistakes because when I made mistakes I feel like I learned from them and helped me improve my coding skills. Another glow I have while coding is helping out my peers because I got to help them with their coding skills and help them improve with there skills." -Sophia

"During this coding experience I learned all about how machines and things around me work. I learned so much about things like analog,digital,setup, loop and so much more about coding.I learned about definitions and aspects of robots that I had never even heard of before. Something that I found especially interesting and valuable is analog and digital devices. I learned more about how a digital object is one way or the other and analog is more flexible and has space in between. I now understand these definitions to a deeper level and am capable of recognizing things around us and its relationship with analog and digital."

"Something I learned about prototyping is the minimum viable product (MVP) . I have thought about engineering and what it takes to make a innovative product before but never learned about mvp or really knew what it was. Now I have a better understanding of what one really needs to focus on and think about before building something.I know what I need to do before building something. I can now think about and categorize what a product needs before thinking of the accessories and extra things a product might have additionally. I have more of the knowledge on what I can do now or in the future to build a product or a potential business."

"One glow from this experience is learning more about something I have heard about but never tried. I have heard about coding and some of the things you can do with it but never really took the time to learn completely about what it is.This experience gave me the chance to explore it and find it out it is interesting thing that I want to learn more about. I think coding is a really cool thing and I want to continue to explore it and find out the possibility's it has." -Daishaly

"It was very helpful. Coding is important in the modern world and I'm glad we could have it explained to us at such a young age." -Mischa

The rest of the responses and teacher feedback are attached as separate files.

The Curriculum

8th & 7th Grade Arduino Nano: Electrical engineering & programming in three days.



Three days in class lead role for introduction to Arduino, C++, electrical engineering and prototyping with 7th and 8th grade. Each child and teacher had their own Arduino and Chromebook. The team used a server based application and the Tech Teachers Travel instructor used a plugin to project a breadboard in Fritzing to lead the classes while OSS instructors supported anyone who experienced errors or needed troubleshooting.



In the beginning of next year the school's electronics fabrication club will learn how to design and assemble their own microcontroller after a brief refresher with Arduino. Soldering, rework and troubleshooting, in addition to board design and fabrication skills will be taught to students. Teachers and students will learn how to create boards from idea to prototypes with potential for small batch production. Durability, enclosures, QC, part sourcing, supportive documentation and other aspects of productization will be discussed briefly.

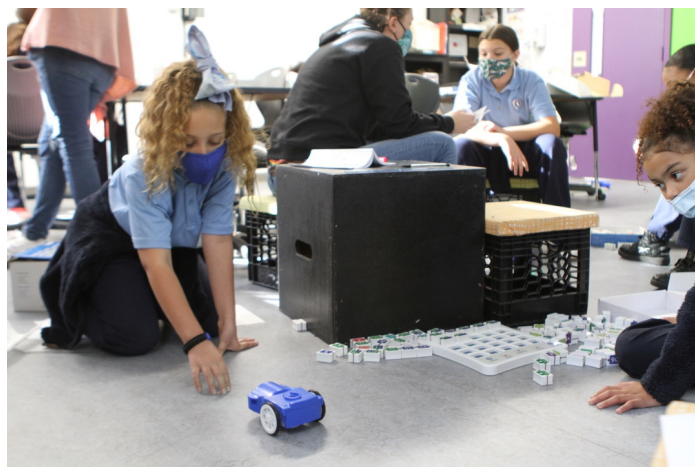


5th Grade QuestBotics: Executional statements, parameters, variables & algebra, recursion, debugging, multi-variable input, metrics (centimeters and degrees), functions and parameters, multi-variable functions, if/else statements, while loops, for loops, creating and using functions, debugging and intro to swarm robotics in three days. (These kids are awesome.)

OSS teacher, Katie Mosca, led three days of math, logic and robotics using QuestBots. TTT instructor Lindsay Craig played a supportive role for one of those days and took a lead role on the last day to introduce recursion, while and for loops, as well as swarm robotics.



Both educational organizations involved give students of all ages tools to problem solve on their own before asking an adult for help. Through QuestBotics, fifth graders were introduced to debugging tools and flags while programming a robot, many for the first time.



Testimonials/feedback

Without the funding provided by No Starch Press Foundation this training would not have been possible. The grant provided paid for all hardware used and most of the instruction by Tech Teachers Travel. It also allowed TTT to reach out to MicroChip Technology and iRobotics for additional donations.

Total number of instructive hours with teachers and students: ~41.5 hours

Total admin hours: ~45.3

Students and teachers were asked to give feedback about what they learned. (Attached)

Excerpts from teacher feedback:

Summer obstacle course: "Students were excited about coding, the obstacle course, and working with Lindsay. They looked forward to our fall program with Lindsay. Graduates who were part of the summer program said that finally coding makes real sense. They wish that they had been taught that way in the past." "We will continue to teach these lessons in future programming. Student and staff that partook can be/have been mentors and coding advocates for future programs."

Robotics club: "Our (robotics) team went from all time team high of 81 points to 240 points."

QuestBotics: "Students learned how to operate QuestBot and learned basic coding language/programming. They practiced writing If/Then statements, created functions, and watched swarming tech in action."

Teaching text based coding: "We did not have a formal Coding program before and now have a team of teachers- 4. Class sizes allow 1-5 ratio of staff to student, so competencies play an important part of impact."

Teacher training: "Teachers were able to see lessons executed so they can replicated in the future. This gave the ability to ask questions in real time and be able to follow steps along with students."

Overall: "Lindsay was flexible with teacher schedules, learning styles and curriculum needs. We received the just right fit for our program."

School personnel were pleased with the results and have plans for future collaboration.

Success is measured by Our Sister's School's ability to continue to teach microcontrollers, prototyping and electronics fabrication. The incredibly high teacher to student ratio at the school (1:5) and offering the more advanced IC and fabrication classes only to students who express interest in going further with electronic technology means that we will be able to move quicker in the second half of instruction.

In the third and final part of the curriculum, the club is a smaller group of students (5 total) with one OSS teacher. The main goal will be to create multiple small batches of student designed PCBs to be built and used as microcontrollers. Final tested and functional electronics will be strengthened with locally available polymers and adhesives.

Lessons learned:

Admin fee should be increased, as total number of hours spent on budget, communication and grant report exceeded the \$200 budget line.

Chromebooks represent a difficulty in that software available for non-cloud based CPUs is not always readily available. Work arounds were found, but currently the solution for Arduino (CodeBender application) is a pay-to-play solution with an annual subscription fee. This was not accounted for in the initial budget.

Budget (initial)

Self Perpetuating Robotics/EE/Manufacturing Labs (pre-K thru high school)

-Budget is for 1 location, with additional travel costs to be adjusted depending on location

Hardware	Cost per unit	Amount	Total cost	Links
CNC router	\$250.00	1	\$250.00	https://www.se
Additional drill bits (drill)	\$10.00	3	\$30.00	https://www.ar
Additional drill bits (carve)	\$18.00	5	\$90.00	https://www.ar
FR4 PCB substrate (10 pieces 10x20 cm)	\$15.00	10	\$150.00	https://www.ali
Soldering iron kit	\$15.00	5	\$75.00	https://www.ar
Multimeter	\$7.00	15	\$105.00	https://www.he
Arduino build kit	\$10.00	25	\$250.00	https://www.jai
Arduino, sensors & motors kit	\$45.00	5	\$225.00	https://www.2c
Additional parts \$ \$ (LEDs, capacitors, resistors, buttons, switches)	\$100.00	1	\$100.00	
DIY CNC router build	\$200.00	1	\$200.00	
QuestBotics student kit (24 students)			\$2,150.00	https://questbc
Total hardware cost:			\$3,625.00	

Tech Teachers Travel costs	Cost per hour	Total hours	Total cost
Payroll, 1 educator teacher training hours	\$60.00	50	\$3,000.00
Travel cost (estimated)			\$200.00

Total personnel costs \$3,200.00

Total cost per site \$6,825.00 *175.00 slack

Admin 1 time cost, all sites inclusive	\$60.00	20	\$200.00
Curriculum materials cost		free	
Software cost		free	

*Slack in budget (minus 1 time admin cost as divided by number of sites)

*Slack intended for overage in travel, funds buy additional support time/hardware

School has less experience with microcontrollers than initial proposal assumed. TTT must offer additional hours to complete the stretch goal of producing functional microcontrollers using the CNC machine with the school's robotics club.

The school uses Chromebooks exclusively so it was necessary to purchase a laptop for the CNC machine.

Budget (actual)

Activity	Hardware	Time	Unit rate	Units	Total
4/12/21 first meeting with OSS		1.5 hours	\$60.00	1.5	\$90.00
4/13/21 Prep		0.5 hours	\$60.00	0.5	\$30.00
4/26/21 prep		1.5 hours	\$60.00	1.5	\$90.00
4/26/21 laptop purchase and installs		3 hours	\$60.00	3	\$180.00
	Laptop		\$233.74	1	\$233.74
04/28/2021 teaching teachers		4.5 hours	\$60.00	4.5	\$270.00
4/29/21 teaching teachers		4.5 hours	\$60.00	4.5	\$270.00
4/30/21 CNC & bits ordering		.5 hours	\$60.00	0.5	\$30.00
05/12/2021 Built CNC router		2.5 hours	\$60.00	2.5	\$150.00
5/17/21 CNC installs		1 hour	\$60.00	1	\$60.00
05/18/2021 ordering parts		1 hour	\$60.00	1	\$60.00
5/20/21 OSS meeting & parts order		1 hour	\$60.00	1	\$60.00
July 11 th obstacle course prep time		30 minutes	\$60.00	0.5	\$30.00
July 13 th obstacle course		7:30 – 4:15	\$30.00	8.75	\$262.50
July 14 th obstacle course		7:30 – 4	\$30.00	8.5	\$255.00
July 24 th CNC prep at OSS		1.5 hours	\$60.00	1.5	\$90.00
July 28 th curriculum dev		10:45-12:15	\$60.00	1.5	\$90.00
July 29 th curriculum dev		4:20 – 5:20	\$60.00	1	\$60.00
August 26 th prep/check instructions		12 – 5	\$60.00	5	\$300.00
Oct 18 installs/prep/Qbots		6:30 - 11	\$60.00	4.5	\$270.00
Oct 25 th outline prep		30 minutes	\$60.00	0.5	\$30.00
Nov 3 Intro to Arduino		7:45 – 1:30	\$60.00	6.25	\$375.00
Nov 10 th Intro to Arduino & Quest Bots		8:15 – 3	\$60.00	6.75	\$405.00
	QuestBot Kits (6 kits)		\$358.33	6	\$2,150.00
	1 Root robot (donated)		\$199.00	1	\$199.00
December 8 th QuestBotics		12:45 – 3	\$60.00	2.25	\$135.00
TTT Admin fee			\$200.00	1	\$200.00
Additional inventory					
Alibaba	breadboards 20x		\$38.05	1	\$38.05
Alibaba	FTDI serial adapter 20x		\$43.17	1	\$43.17
Alibaba	Copper Clad FR4 40x		\$32.99	1	\$32.99
Janco	Arduino DIY kits 30x		\$256.64	1	\$256.64
Amazon orders attached as PDFs	Amazon order 1		\$61.12	1	\$61.12
	Amazon order 2		\$661.95	1	\$661.95
	Amazon order 3		\$39.28	1	\$39.28
	Amazon order 4		\$43.52	1	\$43.52
Attached as PDF	Genmitsu CNC		\$249.99	1	\$249.99
2022 Teaching hours (estimated) (Necessary to complete CNC portion)			\$60.00	15	\$900.00

Budget (actual, continued)

Grand total TTT contractor
\$4,892.50
(Includes admin fee)
(Includes 2022 hours)

Grand total Hardware
\$3,810.45

Grand total
\$8,702.95

Total TTT contractor hours
86.835

Teaching
41.5015

Admin & prep
45.3335

July 13th & 14th hours valued at \$30 as OSS paid for \$30 per hour

Budget was exceeded by \$1,702.95. This will be absorbed by Tech Teachers Travel or paid for by Our Sister's School.

This effort has significantly increased the ability of Our Sister's School tech teachers and given their students an introduction to industry ready skills, as well as a deeper understanding of the technology in their lives. It has also been an informative pilot program for Tech Teachers Travel, and will be the foundation of a comprehensive tech education package in the future.

Thank you No Starch Press Foundation!

Without your kind donation this class and the connection between Tech Teachers Travel and Our Sister's School would never have happened. The robotics tools you have gifted will continue to be used for years, and the two organizations will continue to work together to support girls in STEAM and technology literacy.