

Unsung Heroes 2016 Proposal

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Program Summary

Personally, I really enjoy building and programming various robotic contraptions. I want to share this passion with my students. To some extent I'm already doing this with a robot I designed specifically for use with my 8th graders (the Logo Mouse). Unfortunately, the resources I have at hand are limited, so I am only able to offer this opportunity to a handful of students. I would like to purchase the materials necessary for all of my students to have at least a few options to choose from as well as allow more advanced students to build robots and contraptions of their own design. The two main options I hope to add to my repertoire of projects include the construction and programming of robotic submarines and blimps. The end goal is for students to learn many of the skills and concepts expected of middle schoolers in an engaging and challenging manner (e.g.: buoyancy, electricity, engineering, etc.). Furthermore, I really want to expose students to sophisticated programming.

Project Description

This coming summer I will be working with Steven Kibler, a computer engineer in Fairbanks Alaska, to teach students to build and program robotic blimps as part of the Alaska Summer Research Academy (ASRA). We are currently developing the circuit board and I've already put together a few video tutorials that walk students through how to write a dynamic web page to remotely control such a robot. Students will solder the components to the circuit boards, and design and build the frames that hang under the helium balloons. Once students have built and programmed their blimp, we will push them to add an altimeter and a more sophisticated control system. I desperately want to use all the materials I develop for this summer camp with my students next year, but I currently lack the necessary funds.

I have also already developed a couple different robotic submarines that I have built with students. I am currently working on a new design and, similar to the blimps, would have students build and program the submarines by following a series of videos tutorials and instructional documents before adding functionality of their own design. Again, I lack the funds to bring this experience to my students.

In both instances, students will learn a variety of skills including electronics, buoyancy, mechanical design, programming, and web development. More importantly, students will see how to build really cool robots from basic components for less than \$100. By purchasing a

variety of additional components to have on hand for students to tinker with, I will be able to further encourage exploration and innovation. At the end of the day, I hope students leave my class with the skills and knowledge necessary to carry out projects of their own design outside of my classroom.

For a better idea of what I'm talking about, see the following videos:

Blimps: <https://youtu.be/GOup0kMmyEk>

Submarines: <https://youtu.be/41sDGXPMyl>

Benefit to Students

I am currently slated to be our school's computer teacher next year. As such, I will have approximately 30 students 6 periods a day each semester. In short, I will work with around 360 students per year, and will get to work with some of the same students for a couple years. While I expect only my older and/or more motivated students will be capable of building and programming subs and blimps, I do hope that seeing their peers tackle such projects will inspire my younger and less mature students to persevere when learning to code.

Adding both of these projects to my repertoire should increase student engagement substantially. Currently I teach students to build and program two wheeled robots, but they are not as interesting as something that can fly or dive. I also hope to see carryover between my classes and our Science Olympiad program as well as our Industrial Technology program. For example, many of the skills students learn would be useful when building a robotic arm or hovercraft for Science Olympiad or soldering and programming a wireless controller for a SeaPerch (an Industrial Technology project). I also expect a significant impact on the neighboring high school as more students go to them already having a lot of experience programming.

This project will have an impact that reaches far beyond my school for a couple reasons. First, I offer robotics workshops for teachers a couple times a year and generally spend a couple weeks teaching at various STEM camps during the summer. Second, I make all of the materials I develop freely available online. To see the impact one of my past projects has had, take a look at my freely available Artificial Intelligence with Arduinos course:

<https://www.udemy.com/draft/113568/>.

I will gauge success by looking at how many students are engaged, and how much they learn. My goal is for students to build 10 blimps and 10 subs and to have at least as many students (hopefully far more) writing programs for these robots.

Use of Funds

Currently I teach robotics using extra materials I've acquired over the years from the workshops I've offered and print frames using an old 3D printer from my former school. I've scrounged the computers I'm using this year, but thankfully our school's principal has promised me a computer lab next year, which is substantial given our school's limited technology resources.

Our industrial technology teacher has pledged support for these projects by giving me an old helium tank and letting my students drive our subs in the same cattle trough he uses for his SeaPerch project.

The funds from this grant would be used to purchase helium from Air Liquide, microcontrollers, headers, and wire from Adafruit, motor drivers from Pololu, solder and soldering supplies from SparkFun, printed circuit boards from OshPark, 3D printing filament, motors, and props from Amazon.com, mylar balloons from Bargain Balloons, and ABS pipe, fittings, and conduit clamps from Lowes.

Given the \$5000 award, I would purchase an Othermill and the raw materials that go with it. This would allow me to have students design and manufacture the circuit boards for this project and others. I would also purchase a variety of microcontrollers, motors, sensors, etc. to have on hand for projects that students devise.

Given the \$10,000 award, I would purchase items listed in the \$5000 grant as well as enough parts to build 10 more blimps, 10 more subs, and 30 of the robots I'm currently using with my students.

Given the \$25,000 award, I would purchase the items listed in the \$10,000 grant as well as an Epilog Zing laser cutter with a HEPA filter as well as materials to cut/engrave. This would allow me to engage more of my students in computer aided design as a laser cutter is easier to use, faster, and more versatile than a CNC machine or a 3D printer.

Award Budgets

Budget for \$2,000 award

Microcontrollers & related items	795
Motors, Props, & related items	834
Pipes, Fittings, & related items	198

Balloons & Helium	173
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Budget for additional \$5,000 award

Othermill	2200
Othermill Deluxe Bundle	300
Othermill PCB Blanks	500
More microcontrollers, motors, etc.	2000

Budget for additional \$10,000 award

Othermill & related materials	3000
More microcontrollers, motors, etc.	3000
Materials for 20 more blimps/subs	2000
Materials for 30 Logo Mice	2000

Budget for additional \$25,000 award

Epilog Zing Laser Cutter & materials	17000
Othermill & related materials	3000
More microcontrollers, motors, etc.	1000
Materials for 20 more blimps/subs	2000
Materials for 30 Logo Mice	2000