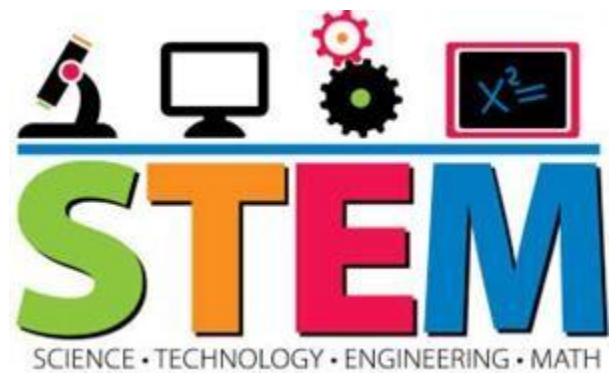


**Science, Technology, Engineering, and Mathematics  
(STEM) Summer Education Kit Grant Proposal**

**Santa Cruz County Secondary Education Coalition (SCCSEC)**



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## Organization Mission Statement

The mission of the Santa Cruz County Secondary Education Coalition (SCCSEC) is to educate students in grades 9-12 in multiple disciplines to better prepare them for professional careers.

## Grant

This grant aims to facilitate creative, hands-on learning to select students of grades 9-12 in STEM-related fields. Up to \$5,000 may be offered to undergraduate students in STEM fields attending the University of California Santa Cruz and Cabrillo College. The main objective of this grant is to create project kits for 6-week long summer programs that will demonstrate a unique specialization in the STEM fields. Such projects will not be the sole focus of these summer programs, but they will serve as a central component.

### A. Cover Page

**Applicant Name:** Tin Thurein

Partner's Name (if applicable)	Andres Aranda
Faculty Sponsor:	Professor Gerald Moulds
Project Title:	An Introduction to Engineering
Total Grant requested:	\$1450.00

### B. Project Title and Summary

#### I. Project Title: *An Introduction to Engineering*

#### II. *Project Summary*

In this 6-week long program, the students will have a theory class starting at 8 a.m. to 11 a.m. and take a break for 1 hour. At 12 p.m. noon, the students will go to computer lab to demonstrate their understandings of the today's topics. The topics will be varied but they will cover a brief introduction of what engineering is about, and a taste of different fields of engineering such as electrical, mechanical, industrial, civil, and software. The students will go through basics of programming and logics in their theory class, where each will learn aspects of Boolean logic gates, such as AND, OR, NOT, and learn to build more complex logic designs as well as completing final Arduino® project. The lab will run 3 hours as the students are asked to perform various tasks such as designing and programming small projects. The final project will be one week long, where the students will have to write a program using Arduino Uno board and available sensors to complete a project, which will be based on the student's idea.

### **C. Problem Statement**

The first three weeks will be focus on various disciplinary of engineering fields and students will learn introductory topics of each fields, including calculating forces on a truss, basics of microcontrollers, logic gates, reading engineering schematics, symbols, and some required math to do calculations such as voltage drop on a load resistor. The other three weeks will be heavily focused on mini microcontroller hands-on projects where students will be doing a few experiments using microcontroller and various sensors. They will also learn how to wire on the breadboard, how the sensors functions (Analog or digital output), and if time permits, the students will also learn a bit of physics behind some sensors such as potentiometers. Students will also learn to use the measuring equipment such as volt meter, and multi-meters in the lab. Knowing these basics of engineering will very helpful for students should they want to study more on their own or they just want to get a taste of what is engineering all about. These 6 weeks will be very beneficial to students to engage in engineering field and get started with programming skills, which they need for any kind of engineering field. They can choose to pursue more Arduino projects on their own since they will acquire basic understanding of programming language or they can choose to go more in depth with certain engineering field. This project is to get started with the basic of engineering and get a chance to see how engineers solve real-world problems.

### **D. Methods**

The main component for this program is the Arduino and the Arduino kit, which will run for \$44.27. A breakdown of the budget can be seen in section G of itemized budget. Since the software is free to download, students can explore more on their own. Note that Arduino and the kit can also be reused for future purposes. The logic gates will be ordered through Jameco® and each logic gate costs approximately between \$0.35 to \$0.39. Students will be using logic gates starting from the third week of the project and these logic gates will serve as a wiring component on the breadboard. Students will learn how to power up the chips, the layout of breadboard and reading data sheets. The Arduino microcontroller will be used from the 4<sup>th</sup> week till the very end of the week 6 project. Students will participate in in-class demonstration of the programming exercises using Arduino board. The microcontroller will serve as the brain of their final project, which they will present at the end of the 5<sup>th</sup> week.

### **E. Expected Deliverables**

At the end of the 6-week long program, the student will be able to:

1. Describe different fields of engineering and the work carried out by engineers.
2. Able to use the techniques and tools of engineering practice, including problem solving strategies, analytical skills, and standard software.
3. Work as an individual and in teams on both specified and open-ended projects.
4. Understand the impact of engineering solutions on society and the corresponding need for ethical professional behavior.

## F. Timeline

### I. 1st Week:

Exploring engineering disciplines, available careers in engineering.

### II. 2<sup>nd</sup> Week:

Problem solving strategies, Basics engineering such as reading schematics, Ohm's law, calculating forces on a truss, using excel and a mini project at the end of the weekend where the students will compete to design a paper tower that can support the most amount of weight.

### III. 3<sup>rd</sup> Week:

Introduction to microcontrollers, programming, and logic gates. At the end of the week, student will design on a breadboard. Understanding conversion of how logic gates can be made using other logic gates, i.e. how NOT gate can be made with NOR gate and so on.

### IV. 4<sup>th</sup> Week:

More examples of programming in C++, a few live demos of Arduino projects. In this week and following week, the student will learn to more programming skills required to complete the final group project based on microcontroller. Students will brainstorm and get started on their final project.

### V. 5<sup>th</sup> Week:

More examples of programming in C++, a few live demos of Arduino projects. At the end of the week, student will present their own design using microcontroller.

### VI. 6<sup>th</sup> Week:

Engineering practices and ethics, impact on society, available summer jobs and internships.

Week	Objective	Expected Completion
1	Understand various engineering disciplines, available careers in engineering.	Week 1
2	Be familiar with basic engineering knowledge, such as reading schematics, calculating forces on a truss, and the usage of Excel. The students will participate in a mini project of building a paper tower.	Week 2
3	Be familiar Basics of logic gates, introduction to micro controller and programming.	Ongoing
4	Participate in programming examples in C++. Students will begin using Arduino and Arduino IDE, and begin their final Arduino based project.	Ongoing

5	Complete their Arduino final project. At the end of the week, they will present their project.	Week 5
6	Explore engineering ethics, and available summer jobs and internships.	Week 6

## G. Itemized Budget and Budget Justification

Items	Vendor	Price	Quantity
<a href="#">Arduino Uno</a>	Sparkfun	\$ 24.75	1
<a href="#">Arduino Uno Kit</a>	eBay	\$ 22.98	1
<a href="#">Breadboard</a>	eBay	\$ 7.98	1
<a href="#">Quad 2 input NAND</a>	Jameco	\$ 0.39	3
<a href="#">Quad 2 input NOR</a>	Jameco	\$ 0.39	3
<a href="#">Quad 2 input AND</a>	Jameco	\$ 0.35	3
<a href="#">Quad 2 input OR</a>	Jameco	\$ 0.39	3
<a href="#">Hex Inverter</a>	Jameco	\$ 0.39	3
Total:		\$65.67	
Tax		\$5.91	
Total amount:		\$71.58	

This is an estimate for a single student. Assuming we have 20 students for the program, the estimated budget will be approximately \$1450. Note that all the logic gates will be order through Jameco®, with shipping fees of \$9.28 for 2 pounds. Under the assumption that we will be ordering for 20 students, the shipping fees can be combined in one package, thus reducing the shipping fees. Including the shipping fee, the total for 20 students will be \$1450. Arduino Uno, Arduino kits and the breadboard can be ordered through eBay with free shipping.

### Total Grant Amount Requested: \$ 1450.00

Arduino is a great platform to get started learning on the basics of hardware and software integration. It uses C programming which is intuitive and easy to understand. Also, the best part of this program is that all these microcontrollers and majority of its parts are reusable for future purposes. Students will get a great hands-on experience on programming and design experience. We will also assign a tutor during the 4<sup>th</sup> and 5<sup>th</sup> week to help out students with programming their project.

## H. Relevant Experience

Having taken a few introductory C programming and hardware courses, I believe I am qualified for teaching this pilot course that would serve the future engineers. As an added bonus, I have previous experience in tutoring 10<sup>th</sup> to 12<sup>th</sup> grade high school kids for math and science.