



SOCIETY OF PHYSICS STUDENTS

An organization of the American Institute of Physics

Future Faces of Physics Award Proposal

Project Proposal Title	SSU SPS/MESA Skills Lab: RedBoards, Soldering, PCBs, Oh My!
Name of School	Sonoma State University
SPS Chapter Number	6474
Total Amount Requested	\$300

Abstract

Sonoma State University's SPS chapter proposes an extension on an existing project held in conjunction with the MESA program at SSU. In covering microcontrollers, the Arduino language, and soldering on a printed circuit board, SSU SPS hopes to bridge the gap underrepresented students face upon entering a STEM major.

Proposal Statement

Overview of Proposed Project/Activity/Event

The Society of Physics Students at Sonoma State University have held Skills Labs in conjunction with the MESA (Math, Engineering, Science Achievement) Engineering Program at SSU for the past year. We seek to continue this partnership. SSU MESA supports educationally disadvantaged students by providing weekly tutoring, study sessions, and career workshops. The proposed SPS/MESA Skills Lab will provide an overview to soldering and printed circuit boards to these underrepresented students. This will build upon last year's Future Faces Award with which we taught microcontrollers with RedBoard Starter Kits. We plan to include the RedBoards in the Skills Labs.

SSU SPS Skills Labs were established a year ago as a peer-led teaching program with a twofold purpose. First, it provides a structured method to teach lower-division Physics/Astronomy students along with other interested SSU students basic research and lab techniques to help with students just starting their research in the department. Second, it provides a conducive environment to build the peer-leaders' teaching methods and content knowledge. Current semester's Skills Labs topics include: learning how to operate the Scanning Electron Microscope (SEM) and Energy-Dispersive X-ray spectroscopy (EDX), telescopes at the on-campus observatory, and learning surface mount soldering. Senior club members identify their best skills and volunteer their time and energy towards putting together a presentation and lesson plan for each Skills Lab.

This can be extrapolated to all STEM majors; many of the skills we cover can be very helpful in other science and technology fields. Targeting the lower-division MESA students helps to address the issue of underrepresented students who are not typically exposed to many of the topics SSU SPS presents in Skills Labs. Current MESA enrollment numbers are at ~50 students. Based on prior attendance and available resources, we anticipate reaching 10-15 students over the course of this Skills Lab series.

The SPS/MESA Skills Lab will consist of four labs, each an hour and half long. The first will be a detailed explanation of circuits and programming in Arduino with practice circuits from the SparkFun Inventor's Kit (SIK) Guide provided with RedBoard Starter Kits. The second lab will focus on soldering with printed circuit boards (PCBs). We will provide some practice solderable breadboards; for example, a blinking LED circuit to be hooked up to the RedBoard. Building upon their understanding of circuits from the previous lab, students will learn how to solder on PCBs. In the third lab students will be provided with a PCB and a sensor of their choice. They will solder all the appropriate parts and write a simple program to take input from the sensor and output it to the computer. The fourth lab is reserved as a time for students to informally present their unique circuits and programs to the group. This is planned to be a time for participants to talk to one another and perhaps establish groups outside of the Skills Labs to work on projects with the RedBoard Starter Kits on loan until May 1, 2015.

Funding to grow the MESA/SPS Skills Lab would mean the SSU chapter of SPS would be able to reach more underrepresented STEM students and provide a more in-depth labs on circuitry and soldering, in addition to programming microcontrollers.

How Proposed Activity Promotes Physics Across Cultures

MESA/SPS Skills Lab will be inclusive to the needs of underrepresented students in STEM fields. In the past year, we have seen a group interested in more advanced circuitry and programming. With the last Future Faces Award, SSU SPS sees room for improvement. Showing the students how to solder and what PCBs are in addition to the programming and circuitry, pulls back the “curtain.” This chapter has gathered that many people believe these to be skills outside of their capabilities. We endeavor to convince these students that these are simple skills that will be very helpful to have in their tool belt for their future as a STEM major, whether that be in industry or graduate studies.

By giving the RedBoards starter kits on loan to the students after the four-part Skills Lab is over, we hope to give them time to really explore the circuitry and programmability of the RedBoards and bring back questions at each new lab. We will make ourselves available for questions and for more help long after the initial labs.

Keeping the target students in STEM is a big goal of ours; many students drop out when they feel overwhelmed with classwork. Skills Labs are a great way to engage students and show them there is more to STEM majors than difficult classes. We get to play with things!

Plan for Carrying Out Proposed Project/Activity/Event

- Club members: Stephanie Church, Aman Gill, and Wes Watson will be in charge of planning and executing the four part Skills Lab. Each presenter has prior Skills Lab teaching experience and will be in charge of a particular day each, with all sharing the fourth and final lab.
- Mentorship in the project will be provided by Dr. Carolyn Peruta, MESA Director, and Dr. Hongtao Shi, chapter advisor; they will also monitor progress to keep us on track. Additionally support will be provided by the Physics-Astronomy lab tech, Steve Anderson.
- Promotional materials will include posters targeted at MESA students, as well as, face-to-face marketing at MESA study sessions and SPS chapter meetings for volunteers as the time comes closer.
- Wes W. is well versed in all things Arduino programming so he will start the series off with the circuits and programming overview. He has also presented a SPS Skills Lab on the same topic. Stephanie C. will provide the soldering presentation as she has a special interest in soldering. Aman G. will be in charge of the design and fabrication of the PCBs for use in the third lab as this is her expertise. The members for each presentation were chosen for their prior demonstration of excellence in the topic.
- We will use an online survey when students sign up for the four-part MESA/SPS Skills Lab. This will include a pre-lab survey to gauge the average skill level. Post-lab materials will include the same survey, to gauge the change in understanding due to the labs, and a questionnaire for feedback from the attendees. Our final report will include data from both surveys to be a complete presentation of our project.

Project/Activity/Event Timeline

Date	Goal
May 31, 2015	Final report will be sent in before this date.
May 1, 2015	RedBoard Starter kits will be collected and final surveys administered.
March 11, 2015	Fourth and final Skills Lab, students will present their functional circuits to the group. Students will also take the RedBoard Starter Kits home, on loan until May 1.
March 4, 2015	Third Skills Lab, students will solder parts onto an unique pre-made PCB and will work on their programs.
February 25, 2015	Second Skills Lab, on basics of soldering, practice solder-able breadboards will be provided.
February 18, 2015	First Skills Lab, on circuitry and basic programming with RedBoards.
January 19, 2015	Promotional materials will go up, posters and emails to all MESA and SPS students.
January 12, 2015	Finalize presentations, PowerPoint will be created at a presenter's meeting for continuity and clear communication between presenters.
December 2014	Order parts and create general lesson plans. When the parts arrive, we will play around with them to decide how to best present each element.

Activity Evaluation Plan

The pre-lab survey, administered when each student signs up online for the MESA/SPS Skills Labs, will include questions like:

- What is your major (minor)?
- What do you hope to get out of this Skills Lab series?
- What is your programming level? On a scale of 1-10, 1 is “None, I use the computer for FaceBook.” and 10 is “I know 1337 speak.”
- What is your level of understanding in circuits? On a scale of 1-10, 1 is “What is a circuit?” and 10 is “I understand mesh analysis.”
- In your own words, what is a microcontroller?

At the end of the series, we will administer the same survey to best gauge improvement in understanding. At the end we will also have a questionnaire/suggestions survey for feedback. We hope to see a marked improvement in understanding of these topics across the board.

Budget Justification

SSU SPS requests the full amount of \$300 to fund the purchase of four soldering irons from SparkFun, as well as one roll of lead-free solder, six solder-able breadboards, and a sensor kit. These parts will provide an excellent learning experience for MESA students.

Additional parts, lab space, and computers with Arduino will be provided by the Physics-Astronomy Department at no cost to the project. Additional costs for promotional materials and incidentals will be covered by the club. All the presenters are participating on a voluntary basis. They expect no compensation, other than to help a group of interested, underrepresented STEM majors see just what they are capable of.

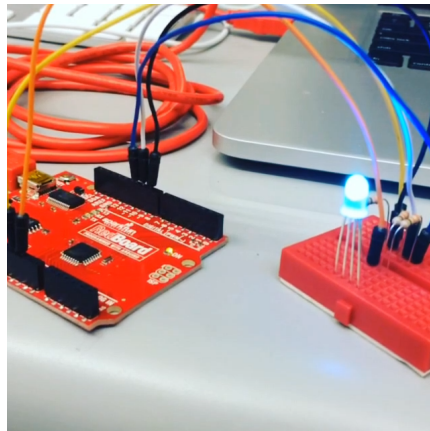
Additional Materials

Current MESA/SPS Skills Lab poster.



Microprocessor: An integrated circuit that contains all the functions of a central processing unit of a computer.

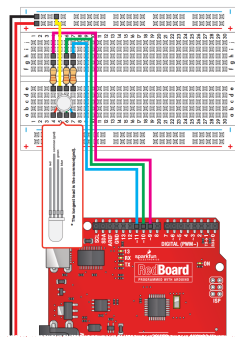
Oxford Dictionary



SparkFun Starter Kit!

Come learn about microprocessors!
No prior knowledge required.

Example circuit with a color changing LED.



Learn circuitry!

WHAT
SPS/MESA Skills Labs
WHERE
Darwin 311
WHEN
7 pm

CONTACT

Dr. Carolyn Peruta
carolyn@universe.sonoma.edu

Dates:

SEP 24th
OCT 8th
OCT 22nd
NOV 5th

More info & Signup at:

mesa.sonoma.edu

MESA/SPS Skills Lab (9/24/14):

