2015 Outreach Initiative Report

Even though circuits and systems are embedded in almost everything we use today, the widespread use of circuits and systems hardly translates into an overwhelming interest in studying circuits and systems. Here at Sonoma State, an undergraduate institution with 9,297 students located one and a half hours away from the world renowned Silicon Valley, the top undergraduate majors are Business, Psychology, Communications, Liberal Studies, and Sociology. Despite a 60/40 percent female to male student ratio in undergraduate student population, the female to male student ratio in the electrical engineering program is 5/95 percent.

With an outreach grant from circuits and systems society, we take the first step to change the general perception of circuits and systems in North Bay. A total three workshops were held at Sonoma State University (Rohnert Park, California) and Twin Cities Cooperative Preschool (Marin, California). All of the workshops and outreach events meet four days a week and three hours each day. Circuit 101 Workshop was offered from 6/8 to 6/11. The Wearable Circuit Workshop for Female High School Students was offered from 6/15 to 6/18. The Twin Cities Coop Workshop was offered from 6/22 to 7/3.

The participants include 25 high school students from five local high schools (Sonoma Valley High School, Credo High School, Petaluma High School, Piner High School, and Orchard View High School) one student from Santa Rosa Junior College, 24 preschool students between the age of 3 and 5 from Twin Cities Coop, and four undergraduate student teachers from Sonoma State.

A variety of learning platforms were used to for the workshops. For the Circuit 101 workshop, we use Snap Circuits to help students grasp basic circuit concepts before switching to breadboard. For the wearable electronics workshop, we use Flora, an Arduino compatible microcontroller, to demonstrate the integration of circuits and systems in everyday life. For the preschool student workshop, we chose Squishy Circuits and Little Bits.

We received several positive feedback from long time educators in the area. Steve Carpenter, a science teacher at Piner high school, commented positively on the effective use of “hands-on exploration experiments to demonstrate concepts that would have taken students a year to learn in a regular high school science curriculum”. Maureen Johnstone, a long time director at Twin Cities Coop commented positively on the surprising seamless and natural incorporation of Squishy Circuits and Little Bits in a play based preschool curriculum and has expressed interest to incorporate the exercises developed for the workshop as part of the permanent science curriculum.

In conclusion, we thank the CAS outreach program for its support of the workshops. We could not have produced the workshops without the generous support from the CAS society. All of us involved in preparing for the workshop have learned tremendously in the process. We think we
have taken an important first step in spreading the awareness of circuits and systems in the lives of many and we are grateful of the opportunity.

**Project name**: Circuit 101 for High School Students  
**Date**: June 8 to June 11, daily from 9 a.m. to 12 a.m.  
**Place**: Sonoma State University, Rohnert Park, California, United States.  
**Attendance**: 16 students, 2 teachers, 2 visitors.  
**Budget**:  
- Salary for 2 student teachers: 775
- Electronic kits: 345
- Snacks/Lunch: 320
- Subtotal: **1,440**
Circuits 101
Class Schedule
Richard Duong and Jarrett Baglietto

Day 1

● 9:00-9:20
Syllabus, Introductions, Assign Groups, Assign Snap Circuit Kits

● 9:20-9:45
Basic Components Lecture (wires, batteries, and switches)
Basic Components Activity (Project 1)

● 9:50-10:00
Break

● 10:00-10:20
Series vs. Parallel Lecture
Series vs. Parallel Activity (Project 152, Project 153)

● 10:20-10:50
Motors and Current Lecture
Motor and Current Activity (Project 2, Project 5, Project 6, Project 262, Project 13)

● 10:50-11:00
Break

● 11:00-12:00
Resistors and LEDs Lecture
Resistor and LEDs Activity (Project 7, Project 102, Project 175, Project 172, Project 272)
Day 2

- 9:00-9:30
  Review Day 1 (Basic Components, symbols, Volts, Amps, Series, Parallel)

- 9:30-9:50
  Equivalent Resistance Lecture
  Equivalent Resistance Activity (Board work and solve problems)

- 9:50-10:00
  Break

- 10:00-10:50
  Capacitor Lecture
  Capacitors Activity (Project 203, Project 235, Project 165, Project 164)

- 10:50-11:00
  Break

- 11:00-12:00
  Transistors Lecture (NPN and PNP, Base, Emitter, Collector)
  Transistor Activities (Project 171, Project 125)
Day 3

- 9:00-9:50
  Review Day 2 (Equivalent Resistance, Equivalent Capacitance, Transistors)
  Review Activity (Project 252)

- 9:30-9:50
  Introduction to ICs Lecture
  IC Activities (project 17, Project 46)

- 9:50-10:00
  Break

- 10:00-10:30
  Gate Logic Lectures (AND vs. OR)
  Gate Logic Activities (Project 47, Project 48)

- 10:30-10:50
  Introduction to Breadboard
  Breadboard Project (Continuity Test)

- 10:50-11:00
  Break

- 11:00-11:30
  Breadboard Project (Battery, Resistor, Led Project #2 on Breadboard instead of snap circuit)

- 11:30-12:00
  IC chip introduction (555 timer, AND/OR ICs(7408,7432))
Day 4

- 9:00-9:30
  Week in Review (Practice Problems on board)

- 9:30-9:50
  Intro to breadboard review (rebuild circuit #2 on breadboard)

- 9:50-10:00
  Break

- 10:00-10:45
  Group Breadboard Project (Led flasher using 555 IC chip)

- 10:45-10:55
  Break

- 10:55-11:45
  Group Breadboard Project (Led Flasher using transistors)

- 11:45-12:00
  Goodbye Pizza Party
Survey Results

Question: What did you like about this course?

“Learning the basics of circuits by using hands-on material”
“The hands-on circuit building”
“Learning about how to use a bread board, multimeter, and learn about capacitors, resistors, transistors, IC that make a LED light up”
“Having hands-on activities”
“It was a good summary of what engineers know”
“The instructors went into great depth about how and why circuits work. Also, creating the project made the flow of electrons easier to comprehend.”
“I liked how we learned what all of the tools needed to complete each circuit did and how they worked which gave us a basic understanding of circuits”
“I enjoyed the whole entire course”
“I liked that we were able to learn about different parts of a circuits using snap circuits”
“I liked learning more about electronics and working with breadboards”
“I liked how it was very hands-on and interesting”
“What I liked about this course was the freedom we had the mentor. They said what needed to be said and nothing more. It was very enjoyable environment. Snacks!”

Question: Was there anything that you wanted to know that we didn’t cover?

“No, I was just hoping to learn any new things/information”
“I went into the program not knowing much. I was open for any new information”
“More about bread board and ways to connect certain components more efficiently”
“Just a little bit of detail put toward using the equations”
“No”
“No”
“Nope”
“No”
“Nope”
“Only compound circuits”
“No, not really”
“No”
“I feel like I learned more than I thought I would. I feel satisfied.”

Question: How did you feel the overall difficulty of the course was?

“The course was mildly difficult.”
“The course was simply enough to understand”
“It was a very easy laid back and fun class”
“It wasn’t difficult because they knew what they were doing and were able to demonstrate in an understandable way.”
“good”
“The first three days weren’t too difficult and the math component were fairly simple. However, the breadboard was very hard to understand.”
“When we were working with snap circuits it was very easy but the bread board were difficult”
“Easy”
“I didn’t think the snap circuits were that difficult and kowing how to transfer from a drawing but the breadboard were difficult in my opinion”
“It was pretty easy with the snap circuits but got more difficult with the bread board.”
“moderate”
“The course was semi difficult/tedious”

Question: Would you have preferred us going more into the physics of each device and having fewer projects to build?

“I think it was a right balance between both.”
“No, because I feel that I would have lost interest in the circuits.”
“Yes but learning basic skills on using breadboards would be very helpful.”
“No, because it makes it more interesting to be hands-on, just like we were doing.”
“No”
“No, I think there was a good balance of each”
“No, I liked building and learning the physics, both”
“No, I thought it was OK.”
“I think the amount of snap circuit project was just right because the device was explained and then we would see how it is used”
“Sure, I liked building with the snap circuits though”
“Yes”
“The snap circuits held my interest the most, as well as the breadboarding. They were both major components so I would keep it like it was.”

Question: If you have to teach this course, how would you teach this course differently?

“I think the teaching method for the course was good.”
“I think there was a good balance between work and fun”
“Put more details towards placement on wires on breadboard along with capacitors as well”
“I wouldn’t change anything”
“Maybe more focus on basic things”
“I would have had a few more quizzes”
“No, everthing looked organized and planned well”
“Not much differently”
“Nothing different”
“I would go a bit quicker.”

**Question:** What were some of your favorite activities from this workshop?

“snap circuits, project based”
“When we worked in the bread board and snacks”
“Breadboards, snap circuits”
“Everything because I was able to learn what I didn’t learn in my physics class”
“Using motors”
“Building the snap circuits and figuring out the Ohm of resistance using the color code”
“My favorite activity was building the snap circuit with the fan”
“I enjoyed the snap circuits”
“Working with snap circuits”
“Building the blinking LED”
“breadboards”
“The fan was entertaining, but the last project with breadboard interested me the most.”

**Question:** Any other comments or suggestions?

“Maybe it would be better if every group had components at beginning of each class.”
“The instructors were very knowledgeable and helpful. I had a lot of fun and I am really glad I take this course.”
“You made everything easy to understand and very fun”
“Y’all are great”
Group picture at the end of the workshop.
Wearable Electronics for High School Girls

Event name: Wearable electronics for High School Girls
Date: June 15 to June 18, daily from 9 a.m. to 12 a.m.
Place: Sonoma State University, Rohnert Park, California, United States.
Attendance: 12 students, 2 teachers.
Budget:

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<td>Salary for 2 student teachers</td>
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Schedule:

Day 1

- Introduction to materials (alligator clip, sewable snaps, conductive thread, sequin LED, Flora Microcontroller, battery holder)
- Mini project
- Project 1: LED badge
Day 2

- Introduction to materials (breadboard, RGB LEDs)
- Mini Project
- Project 2: RGB LEDs

Day 3

- Introduction to materials (speaker, resistor, PN2222 transistor, multimeter, solder and soldering gun)
- Mini Project
- Project 3: Sounds

Day 4

- Introduction to materials (LSM303 accelerometer)
- Mini Project
- Project 4: Motion Detecting LEDs
A student teacher working with a workshop participant.

Left: a buzzer triggered by a zipper. Right: LED badge.

Teachers interacting with students during lecture.
A microcontroller embedded on the back of a sweat shirt.

**Event name:** Circuit Workshop for Preschool Students  
**Date:** June 22 to July 3, daily from 9 a.m. to 12 a.m.  
**Place:** Twin Cities Coop, Corte Madera, California, United States.  
**Attendance:** 24 students, 2 teachers, 1 faculty observer.  
**Budget:**

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**Schedule:**

Day 1: Gather information about the students.  
Day 2: Make conductive dough for Squishy Circuits with students  
Day 3: Use Squishy Circuits to illustrate basic concepts of electricity with students between ages of 4-5.
Day 4: Use Squishy Circuits to illustrate basic concepts of electricity with students between ages of 3.


Day 7: Introduce basic concepts of sound synthesis using Little Bits.

Day 8: Wrap up