BUSAT Near-Space Education

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Introduction

I completed my first Research Experience for Teachers (RET) through Boston University this summer. The task was to with revise a series of 6 labs, which would culminate in a High Altitude Balloon launch in early August. It was important to our laboratory, BUSAT, that the laboratories align with current standards for instruction. Most of my work was completed in the Photonics Center, where I was able to learn about Photonics and develop sensors used on the High Altitude Balloon.

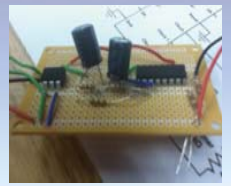
Clean Room Session

Photonics Building
<http://www.avss2010.org/images/Photonics1.jpg>

Laboratory #1 Introduction to Electronics

The Introduction to Electronics laboratory was designed to teach students about basic electrical circuits, while having the students use breadboards to create a circuit with a light-emitting diode. The lab also utilized a 555 timer chip. This lab was important to the success of the High Altitude Balloon as it lays the groundwork for building the cut-down mechanism.

Lab 1 Materials



Cut-Down Mechanism

Laboratory #2 Temperature Sensors

The temperature sensor laboratory was designed to teach students about the limitations of typical thermometers, and how thermocouples can be used in extreme conditions to measure temperature. It took some time to become familiar with the computer code, but I programmed an Arduino that could read 4 temperature sensors. Ultimately, we worked with the other RET participants and created the temperature sensors that were flown in the Science Payload of our High Altitude Balloon.

Temperature Sensors
with Arduino

Teachers building
temperature sensors

A picture from around 90,000 feet

The Crew before launch

Laboratory #3 Cosmic Rays

The Cosmic Rays laboratory was designed to teach students about subatomic particles and the energy of light. A cloud chamber was created in the laboratory and the movement of particles was observed. We didn't fly any Cosmic Ray detectors on this iteration of the Science Payload, but it is a possibility for the future.

Materials for Cosmic Ray Lab

Cloud Chamber in Dry Ice

Laboratory #4 Earth's Magnetic Field

The Earth's Magnetic Field laboratory was designed to teach students about the role of the magnetic field of Earth. Students build a magnetometer and are able to graph the Earth's magnetic field using the reflection of a laser. This summer, we chose not to fly a magnetometer, but that possibility exists for future Science Payloads.

Null Setup

Homemade Magnetometer

Laboratory #5 The Monte Carlo Method

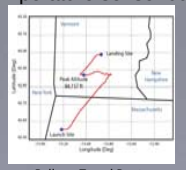
The Monte Carlo Method laboratory is designed to teach students about predictions using mathematics, and can inform students how to use Microsoft Excel. The second half of this laboratory focuses on predicting potential landing sites using a web application, which serves to pick an appropriate launch site to ensure High Altitude Balloon recovery.

Liz and James plot landing sites

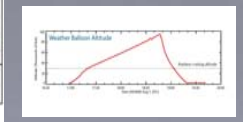
Completed Landing Site with pushpins

Laboratory #6 High Altitude Balloon Launch

The High Altitude Balloon Launch is the culmination of the five other laboratories. Students learn to construct payloads out of foam and foam core while integrating sensors that were built from the previous laboratories. We retrieved our payloads and temperature sensor data.



Balloon Travel Route



Balloon Altitude

Payloads stuck in trees...

Final Thoughts & Reflection

The work that I completed here at Boston University is important, as it provides a series of well-documented laboratories, aligned with Massachusetts and National Frameworks, to teachers. These laboratories can be used to make science meaningful and create interest in space.

It was quite an experience to work with a partner in an active college research laboratory during the summer. I learned many lessons, both professionally and personally, and will carry them with me for the rest of my life.

Application to Teaching

Research is a large part of science, and I will be taking many aspects of the RET program and applying what I learned to the classroom. I am going to allow more self-directed learning in the form of a research project. The research project will focus on students picking a biological topic of their own interest and ultimately culminate in a presentation to the rest of the classroom about what the student learned.

From my own research, I will also be running the Cosmic Rays laboratory with my students during the 2012-2013 school year. Many students have trouble understanding tiny particles, and it would be beneficial for students to see these particles move as my class works to understand Biochemistry.

Acknowledgements

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