Lessons Learned from Doing High-Altitude Ballooning with Novice Ballooning Students

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Abstract

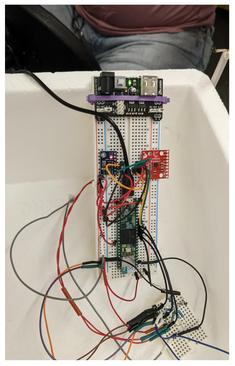
In an effort to establish a self-sustaining weather ballooning capability, Augsburg University has used a high-altitude ballooning project to engage physics majors taking a sophomore/junior-level electronics class in hands-on, real-world engineering and design projects and data analysis for each of the past two academic years. Members of the stratospheric ballooning team at the University of Minnesota provided advice about payload development (possible experiments to try, payload box construction, electronics component selection/mounting/operation, etc.), and also supported flight-day operations. Student payloads contained video cameras, and, most-importantly (considering the electronics class context), microcontroller-logger sensor suites which class members helped wire, program, and test. Inspired by the University of Minnesota's PTERODACTYL and based on these successful curricular experiences, in the summer of 2022 we designed a "standard" (but expandable) microcontroller-logged sensor platform and used it during a summer bridge program for incoming first year students, in which a stratospheric balloon mission served as an engaging central activity. The main goal of this two-week summer experience was to build community, STEM skills, and confidence among students entering college potentially interested in pursuing STEM. On this poster we share lessons learned about starting a high-altitude ballooning program, discuss similarities and challenges of doing ballooning with sophomore/junior-level physics majors versus incoming students, and comment on our experiences using a standard (but student-programmable and expandable) data-logging platform for payload development when working with novice ballooning students. Future directions for curricular development for the electronics class, as well as plans for additional engagement and support of the cohort of incoming (potential STEM major) students, are also described.

Introduction

Augsburg University wants to do a better job of retaining and serving students who are interested in careers in the physical sciences who might not start with the introductory calculus sequence.

Augsburg's Physics department is particularly interested in improving our retention efforts and has developed a pilot program to engage and support students as they begin their STEM degree path.

High Altitude Ballooning has formed the curricular/academic foundation of these efforts.



Incoming students assemble a standardized payload and incorporate their own light intensity experiment.

Previous HAB in Experiences: Electronics (PHY 261)

Electronics student celebrate the recovery of their payload.

For the past two years we have used a high altitude balloon as our culminating experience in our sophomore electronics course. Augsburg has always included a project in its Electronics Lab.

From these experiences we have learned the following lessons:

1. A common platform for each student project would help streamline the goals.
2. Students might struggle to think through the logistics of a launch –building a structure for students to fall back on would be important.
3. Student projects often are too technically ambitious

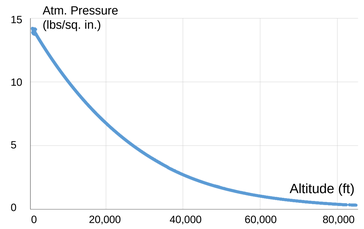
Timeline and Structure

Pre Workshop Activities:

Student Identification: Augsburg's academic advising identified students based on expressed interests and mathematical abilities.

Student Recruitment: Students were recruited during Augsburg's campus orientation.

Student Applications: Students filled out a short form to document their availability and to express their goals for the Project Launch process.



Baseline data collected by platform during balloon flight.

Project Launch Timeline (2 weeks –End of August)

Day One: Students build the common platform that includes pressure, temperature, and data logging capabilities. Device testing and lunch with Dean.

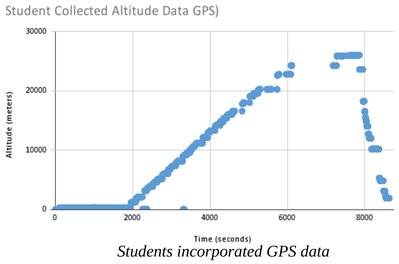
Day Two: Students were introduced to modifying their Arduino/Teensy code to incorporate analog sensors. Students also began working on payload construction.

Day Three: Students split into two teams to carry out two experiments: one to measure temperature around the box and another to measure light intensity.

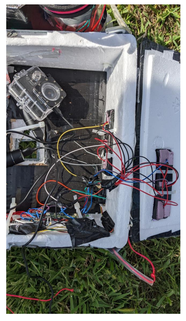
Days Four & Five: Continued work

Day Six: Launch Day

Day Seven: Recovery, Data Analysis, and Reflection



Students incorporated GPS data logging into their platforms.

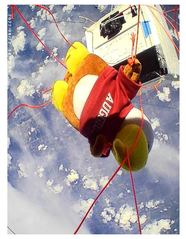


Payload returns to earth

Early Student Feedback

- *"For some improvements in the future, I was hoping for more people to be in the program, as well as more planning that would help make the process of construction easier in the future. A larger scholarship is something to consider, but I already find the amount provided more than enough currently."*
- *"This project was fun but the things that mostly made me join was that it was interesting and the scholarship money and I didn't have much to do."*
- *"So this whole experience was fun for me. The students I was working with were interesting and we all had interesting conversations. The project I thought was going to be hard ended up being simpler than what I was expecting. SO I had fun I would say."*
- *"I say the days were long enough to be able to get the project to work. "*
- *"I would absolutely do this again if the scholarship would still be involved."*
- *"More advertising to get more people."*

Creating Memorable Moments.



Following the students excitement and engaging in projects that drove their bliss. Students were excited by the chance for video… we went with it!

Getting ready for the launch

Hands on projects, learning to solder, breadboard electronics

GOAL: Create moments that give students confidence and memories.

Jaz Darden, 2013 alumni and 3D Printing Expert, provided a 1 Day Work on 3D printing.

Follow Up Steps

Project Launch Students have enrolled in an our algebra based physics course. This course is traditionally taken by Biology and Health and Physical Education majors to complete degree requirements. The instructor has set aside specific office hours for the Project Launch students to get homework help and attention. Additionally, a student assistant (senior physics major) provides support in the course.

Project Launch students have enrolled in the traditional first year seminar for physics students (AugSem) as well as a dedicated general physics lab.

Faculty and Academic Advisors are exploring how Project Launch students might bridge from to the traditional major sequence. We are also exploring additional summer activities for students to continue their pursuit of STEM degrees.

Acknowledgments

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University of Minnesota Professor James Flaten has provided expertise and encouragement has we have get our ballooning team up and running. The University of Minnesota team has also provided launch infrastructure for our flights.

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