

Overcoming Disaster and Becoming Successful in the 2017 Solar Eclipse High Altitude Ballooning Project

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Abstract

Mt. Edgecumbe, a predominantly native residential high school, participated in the collaborative 2017 Solar Eclipse Ballooning project to film the moon's umbra during the total solar eclipse. This project provided an educational experience for students that allowed them to develop STEM skills. The project engaged sixteen high school students through the academic year, six of those students traveled to Corvallis Oregon to deploy the High Altitude Balloon, and four have gone on to college pursuing STEM related fields. The common eclipse payload developed by Montana Space Grant was integrated into the high school's science and technology class. The construction and testing of the payload provided a conduit to teach topics related to the eclipse such as the solar system, engineering design process, electrical engineering, robotics and GPS tracking. The students developed technical skills such as soldering, programming and troubleshooting and experienced system integration as a team while testing the common payload and ground station. These newly developed engineering skills were put to the test in Corvallis as the team resolved un-anticipated problems with payload and ground station failures as well as a launch mishap. The students' demonstrated resiliency in the face of disaster, came together as a team, and ultimately had a successful launch.



Figure 1

- Figure 1: Students building Ground Station in class.
- Figure 2: Testing of the ground station in Mt. Edgecumbe gymnasium.
- Figure 3: First test inflation of balloon in Mt. Edgecumbe gymnasium.
- Figure 4: Students displaying their excitement for the Solar Eclipse Project.
- Figure 5: Assembly of ground station after arrival to Oregon State University in Corvallis, OR
- Figure 6: Students Prepare for launch at the Solar Eclipse .
- Figure 7: Students carrying important ground station hardware to ground station location.
- Figure 8: Preparing for launch, payloads lined out to attach to balloon.
- Figure 9: Students displaying Mt. Edgecumbe spirit before Eclipse.
- Figure 10: Mt. Edgecumbe team gathered at OSU before launch on eclipse morning.

Payloads and Preparation

The payloads were built as part of Mt. Edgecumbe's science and technology class. The class was broken up into 6 units and each unit divided into three parts: introduction, research, and application to balloon project. The different units consisted of the solar system and eclipses, engineering design process, robotics, electrical engineering, computer programming and GPS tracking. To expand on a specific unit, the electrical engineering unit was taught in the three stages. Students learned what electrical engineers do, circuit basics, and related equations. In the research portion the students designed simple circuits, calculated the theoretical current and voltages in the design. The circuits were then built and the theoretical calculations were compared to measured values. The unit concluded with the students built up the eclipse hardware and software.

To prepare for the eclipse the students developed a preparation guide to setup the ground station and payloads. This testing guide provided step by step instructions to set up, turn on and turn off each system. The first integration of the balloon and payload were tested in the Mt. Edgecumbe gym. The students got to fill their first balloon and test the whole system working together.



Figure 2



Figure 3



Figure 4

Eclipse Day and Launch



Figure 5

The team arrived at Corvallis the night before the eclipse and began setting up their ground station. The team quickly found out that parts of the ground station broke during travel. The servo wire connections was severed and it had to be repaired. The students also determined that they needed extra equipment for their commuter to connect to the Ethernet. The students borrowed a USB splitter from Oregon Tech and an Ethernet to USB port adapter from Portland State to get the ground station up and running. Once the ground station was connected, the GPS tracker was operational but was not showing up on the ground station website. It was determined that the bill was not paid so that it was actually offline.



Figure 6

On the morning of the eclipse the iridium modem re-activated and every thing was set up smoothly. At launch, as the balloon was let go the cut down string snapped, freeing the balloon from the payload. PSU came to the rescue with a 3000 gram balloon and hydrogen gas and we launched 10 minutes after the scheduled launch time. We were on a rooftop on the OSU campus monitoring our ground station for about an hour. Finally it had reached totality and it was the craziest sight seeing a sunset and the stars in the middle of day. After the eclipse the ground station stopped getting updates on the balloon. It was later suspected that our tracker failed due to the battery dying. Once the tracker got working we were too excited that we forgot to turn it off to preserve the battery. The tracker was on about 4 1/2 hours before launch and died midflight.



Figure 7



Figure 8



Figure 9



Figure 10

Conclusion

This project was designed to be an education outreach to Mt. Edgecumbe high school. Through this project students gained many skills and real life lessons which are not always taught in the class room. The skills gained from this trip are endless because of the many problems that were ran into. The ground station had the most problems. Student's learned that you won't always have access to what you need all the time, the students should bring extra hardware like the Ethernet adapter and USB splitters even you think you won't need it. The students also learned that it is important to have a checklist for projects like this to make sure that you have everything that is needed, having the check list was critical in figuring out what was wrong with the ground station when wires on the ground station and one of the payloads were broken were able to identify where to look based on what worked as the check list was gone through. The last lesson learned that will always is apply is to check if the bill is paid.

Personal Reflection: This project has impacted me to be apart of the STEM field. I come from a family of engineers and it has always been a dream of mine to become an Alaska Native engineer too. This project has given me a taste of what it would be like to become an engineer and I plan on going to college to achieve that goal. At this point I do know if I want to go in or out of state to experience life outside of Alaska. If I were to go to college in state UAF would be my first choice because of the engineering program and loads of opportunities there. Going into the STEM field is very important to me because I have a great passion for math and science. Working in the STEM field would not feel like a job because it is simply doing what I love. This project has shown me the importance of being very thorough with my work so I can avoid such problems. I will never forget the experience I gained with this project.

