Overcoming Murphy's Law: Lessons Learned By a Novice High Altitude Ballooning Team

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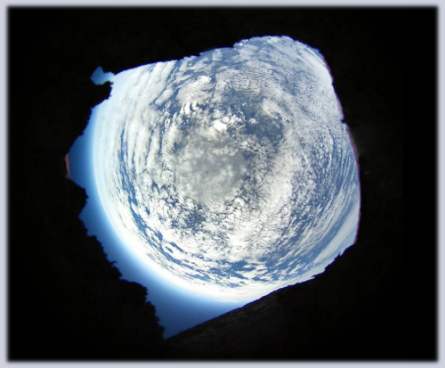
Abstract:

Over the course of 15 months, a high altitude ballooning (HAB) team comprised of middle school, high school, and college students designed, built (and rebuilt), practiced, and prepared to launch payloads to collect data during the total solar eclipse on August 21st, 2017.

After five launches (including August 21st) East Tennessee High Altitude Ballooning (ETHAB) presents the best practices and lessons learned for coordinating a large and diverse team to be successful in stratospheric ballooning.



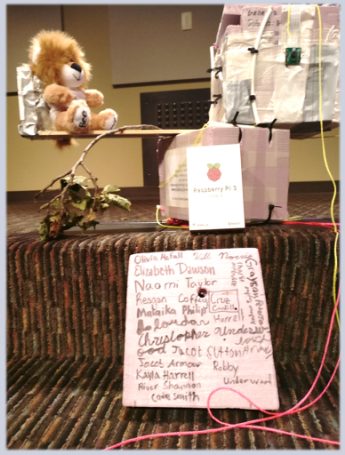
The Eclipse Ballooning Project (EBP) was a complex and extremely visible project to leap into as a first time ballooning team; as a result, the insight gained from challenges faced and solutions devised and best practices will save valuable time, energy, and effort of other novice teams seeking explicit guidance for successful launches.

Challenge:

Novice team comprised of various ages, levels of experience, and educational backgrounds tasked with launching balloons and building/troubleshooting experiments and payloads.

Solution:

Development of an inexpensive, "universal" high altitude payload that could be easily reproduced, allowing for the customization of tools and experiment complexity based on the level of experience of project participants. [HabPi]



Participation in the EBP **directly** resulted in Pellissippi State Community College leveraging resources with many new academic and community partners.

Challenge:

Stratospheric ballooning in challenging terrain, affectionately termed "Appalachian ballooning".

Solutions:

Coordinated with locals to improve recovery efforts and educated community members about this scientific research. Additionally, new methods and tools were developed, including: fabrication of a 100' titanium pole, a dummy launcher, new application for a cut-down system designed by BOREALIS, and a relay system for launch and recovery teams to work in parallel.

Challenge:

Equipment issues and human error leading to catastrophic launch failure during the total solar eclipse.

Solutions:

ETHAB team handbook is being produced to organize and clarify the tested standard operating procedures (SOPs) to become required reading for all future members.

Supplies are tested prior to launch to standardize consumables and equipment which ensures potential for failure is reduced or eliminated. Any subsequent equipment and system failures are dissected and analyzed. Parts and automated processes designed, developed and prototyped will then be shared amongst the wider ballooning community.

Future:

- Design and develop new experiments and payloads for stratospheric research, including:
  - Internally stabilized payload for photography, using a flywheel and Stirling engine
  - Post-flight cut down system
  - Biological experiments
  - Passive methods for stabilization of payloads
- Deploy HabPi project to 5th grade classes and students at area magnet school; potential to expand throughout entire Knox County school system for STEM education.
- Incorporation of stratospheric ballooning into Engineering Science Fundamentals II, Engineering Technology Capstone, and Computer Information Technology Wireless Networks courses; Special Topics courses are being planned for upcoming academic years.
- Continued participation with the Tennessee Space Grant to build enrollment in STEM fields through student club activities as well as developing opportunities with government agencies and industry sponsors.

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