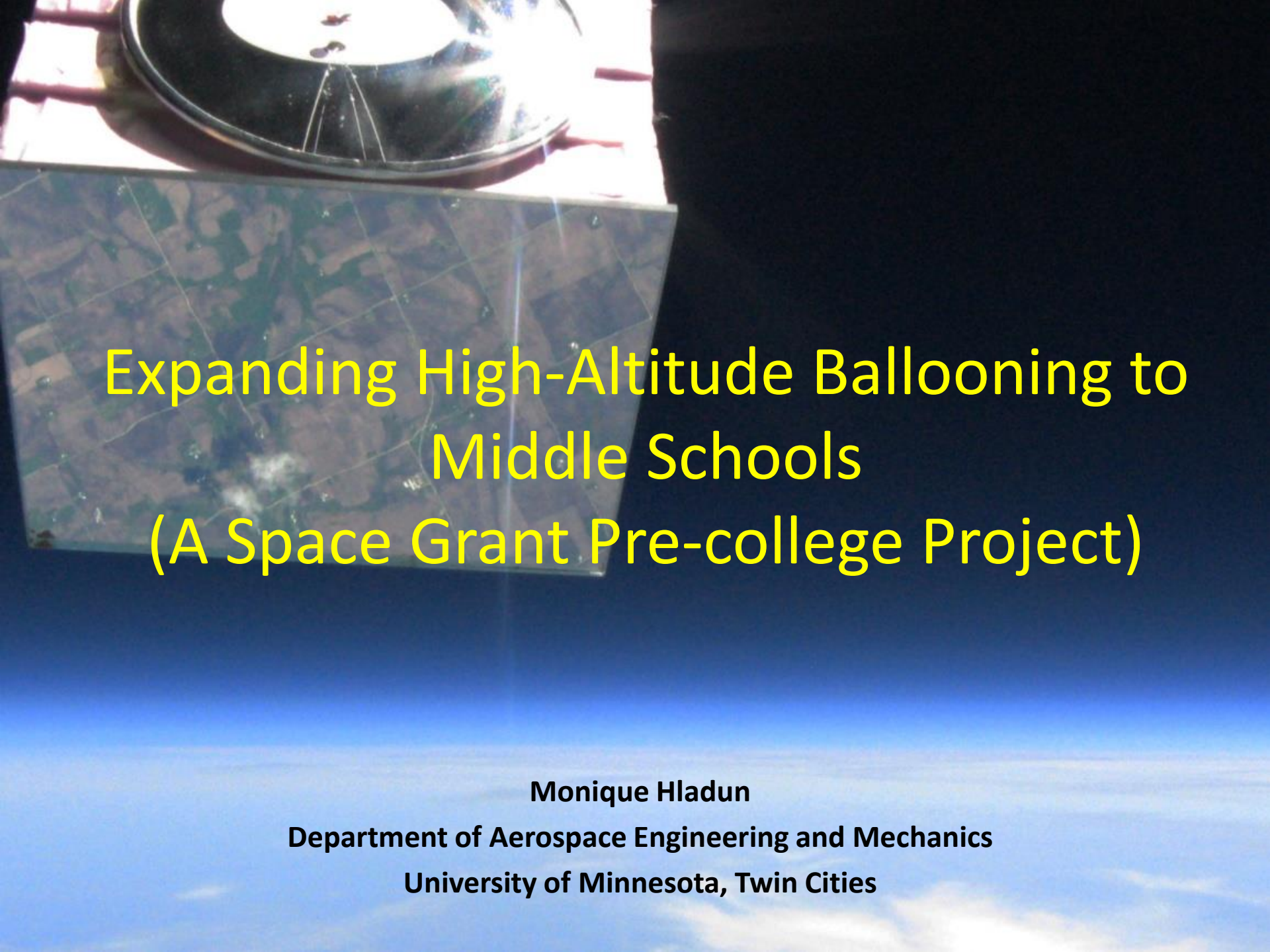

Expanding High-Altitude Ballooning to Middle Schools (A Space Grant Pre-college Project)

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Introduction

Engaged middle school teachers and students in high-altitude ballooning activities.

- Provided training to teachers in curriculum and techniques.
- Also provided follow on flight opportunities for student-built payloads for the next 2 academic years.

Mission Overview

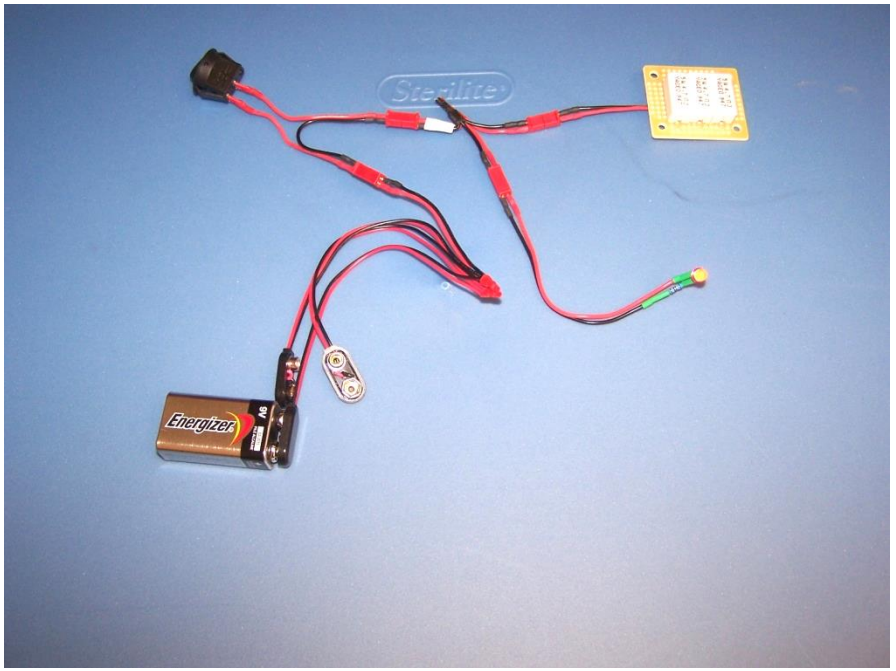
Summer 2010- Teacher's Workshop

- 9 Twin Cities science and technology middle school teachers participated.
- 3 more schools were added later.
- Discussed standards-alignment of ballooning activities, generated ideas of how to implement high-altitude ballooning into their classrooms.
- Designed, built, tested, flew, and analyzed data from their flight payloads.

Payload Materials*

These payloads contained cameras (still and video) as well as sensors that measured:

- Temperature
- Relative Humidity
- Pressure
- Radiation levels
- Solar panel output
- Acceleration



*Funded by The Pentair Foundation and MNSGC

Middle school teachers with their created flight payloads.

Middle Schools that Participated in the Program

- Battle Creek (Saint Paul)
- Metcalf (Burnsville)
- Calvin Christian (Edina)
- Columbia Heights (Columbia Heights)
- Farnsworth Aerospace (Saint Paul)
- Field Community- GEMS & GISE (Minneapolis)
- Hastings (Hastings)
- Shakopee (Shakopee)
- South View (Edina)
- Stillwater (Stillwater)
- Saint Anthony Village (Saint Anthony Village)

Program Overview

- Curriculum and Educational Documents
- Approaches to teaching high-altitude ballooning in the classroom:
  - Columbia Heights Middle School
  - Stillwater Middle School
  - Field Community Middle School (GEMS & GISE programs)
- Data Analysis from Middle School Stacks
- Conclusions

Curriculum and Educational Documents

Examples of the documents:

- *Teacher Overview to High-altitude Ballooning*
- *Snap-together Heater Activity*
- *Building a Basic Payload Box*
- *Testing Payloads*
- *Interpreting Graphs from a Balloon Flight*
- *How-To documents about data analysis*
- *How-To documents about using flight hardware*
- *Photo documents for soldering components*

http://www.aem.umn.edu/people/faculty/flaten/ballooningteacherworkshop2010/

Columbia Heights Middle School

Created their own curriculum that included 18 lesson plans. These lesson plans provided insight to:

- The history behind the space program
- Interviewing skills
- How to run a business
- Designing a scientific experiment
- Data analysis of the experiment
- And making presentations

Columbia Heights Middle School

- Chose to have the program integrated into a classroom setting (specifically the Engineering Science classes)
- Participants included only 7th and 8th graders
- 1 central small group of students who built the flight payload

Columbia Heights Middle School

Some of the student benefits included:

- The ability to work with a real client (Dr. Flaten) and making sure the client needs (the supplies for the payload box, floating ability, durability; etc)
- Review the concepts of series and parallel circuits
- Evaluating the documents and applying the data found when writing a “the letter to the president”
- Writing science lab reports for testing the ability of the box to float, withstand a fall, and to maintain its temperature in near-space

Columbia Heights Middle School

Some of the students traveled to the launch site and were able to participate with the final preparations of their payload .

Stillwater Middle School

- Mainly focused on the documents created for the program.
- Chose to create an after-school club for this program.
- Participants were only 8th graders
- 1 central small group who built the flight payload.

Students Building the Flight Payload in Burnsville

Field Community Middle School (GEMS & GISE programs)

- GISE chose to not create additional curriculum for their students.
- GEMS chose to create additional curriculum for their students.
- High-altitude ballooning activities was implemented into their existing GEMS & GISE after-school program.
- Participants were included only 7th and 8th graders.

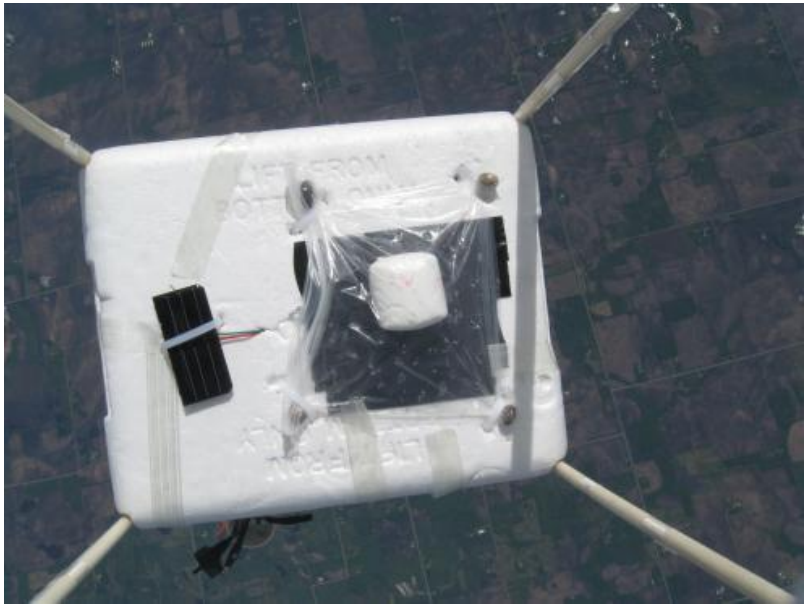
Field (GEMS & GISE program)

Additional experiments were added to their flight payloads.

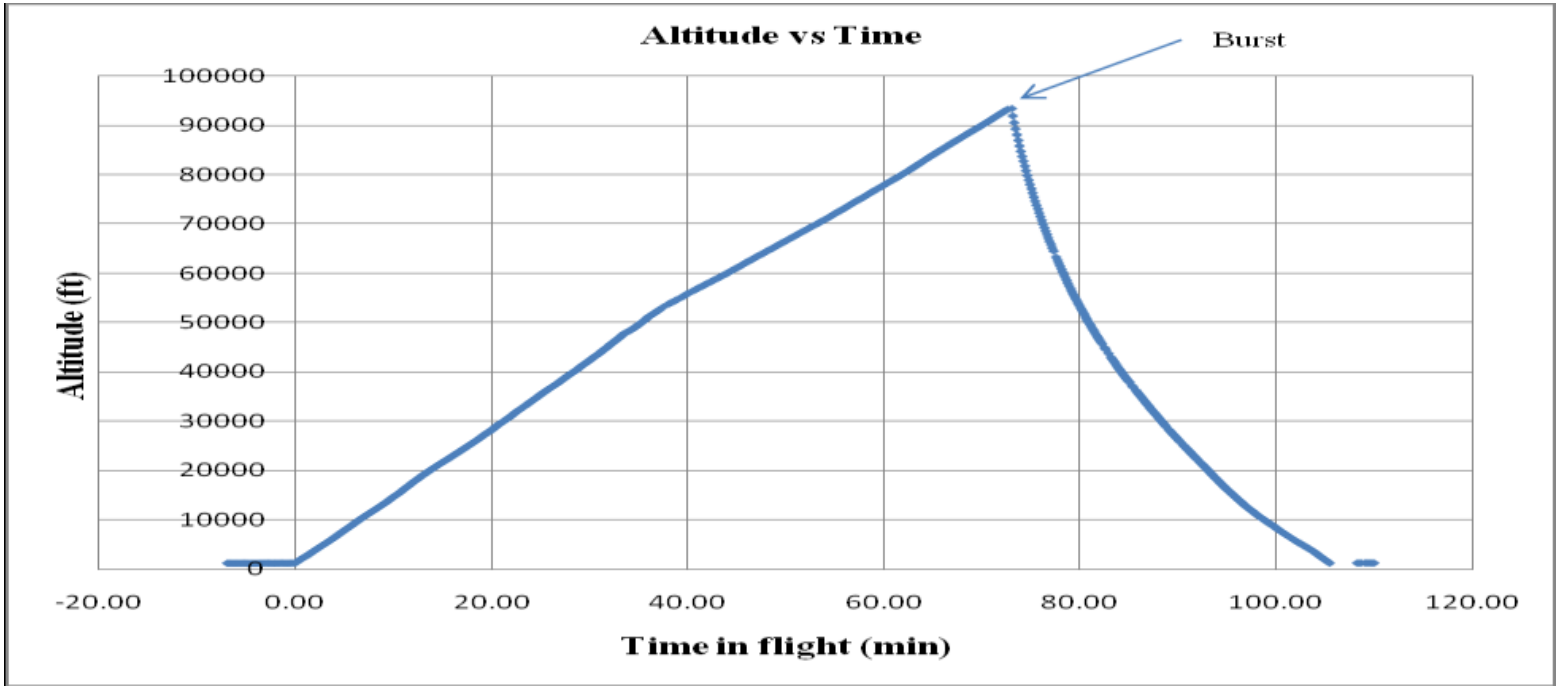
- GEMS- flew sterile agar plates for future experiments.
- GISE- flew marshmallows to observe with a camera.

Data Analysis from Middle Schools Stacks

Marshmallow experiment with the view of the ground below from Field (GISE) payload.



Data Analysis from Middle Schools Stacks (continued)

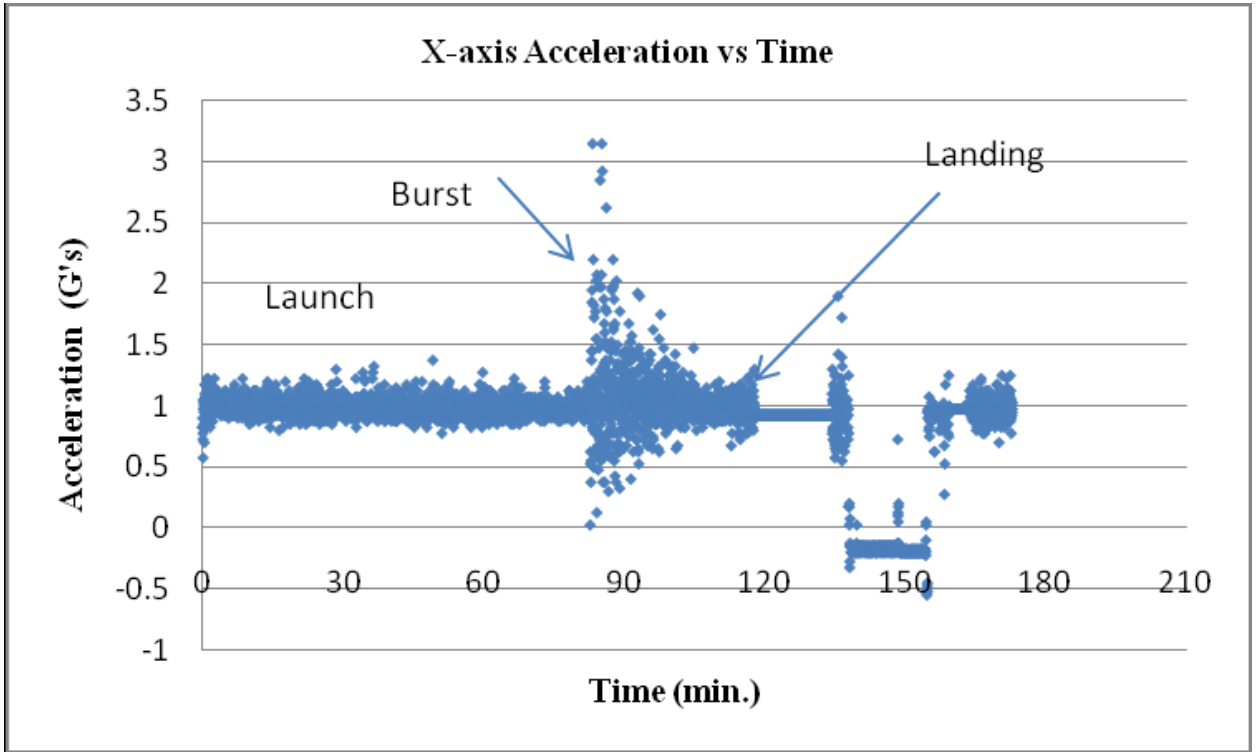


The Altitude (in feet) versus Time (in minutes) graph of the balloon flight for stack A2.

Data Analysis from Middle School Stacks (continued)

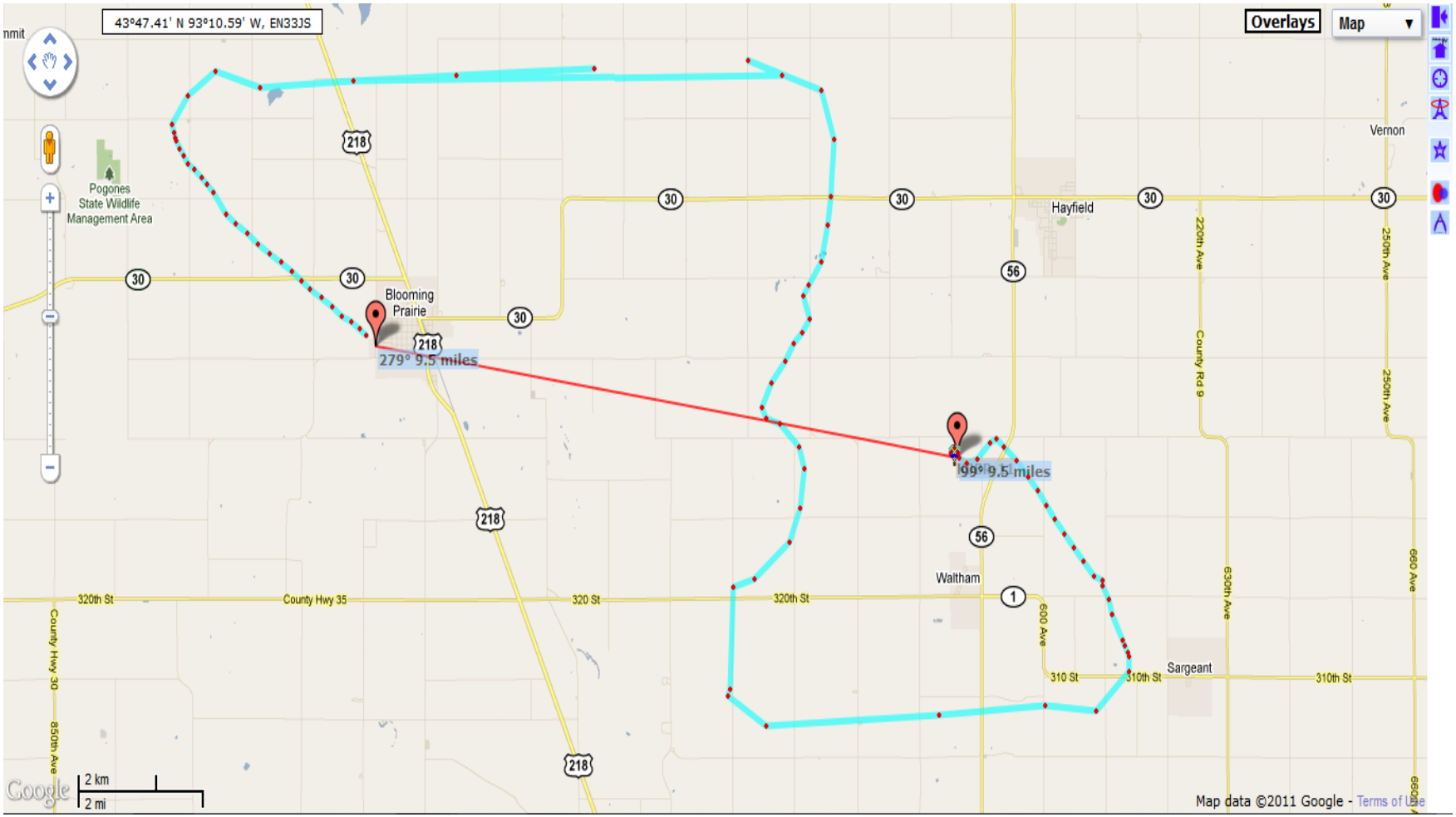
A photo facing outward viewing the horizon at 92,000 ft.

Data Analysis from Middle School Stacks (continued)



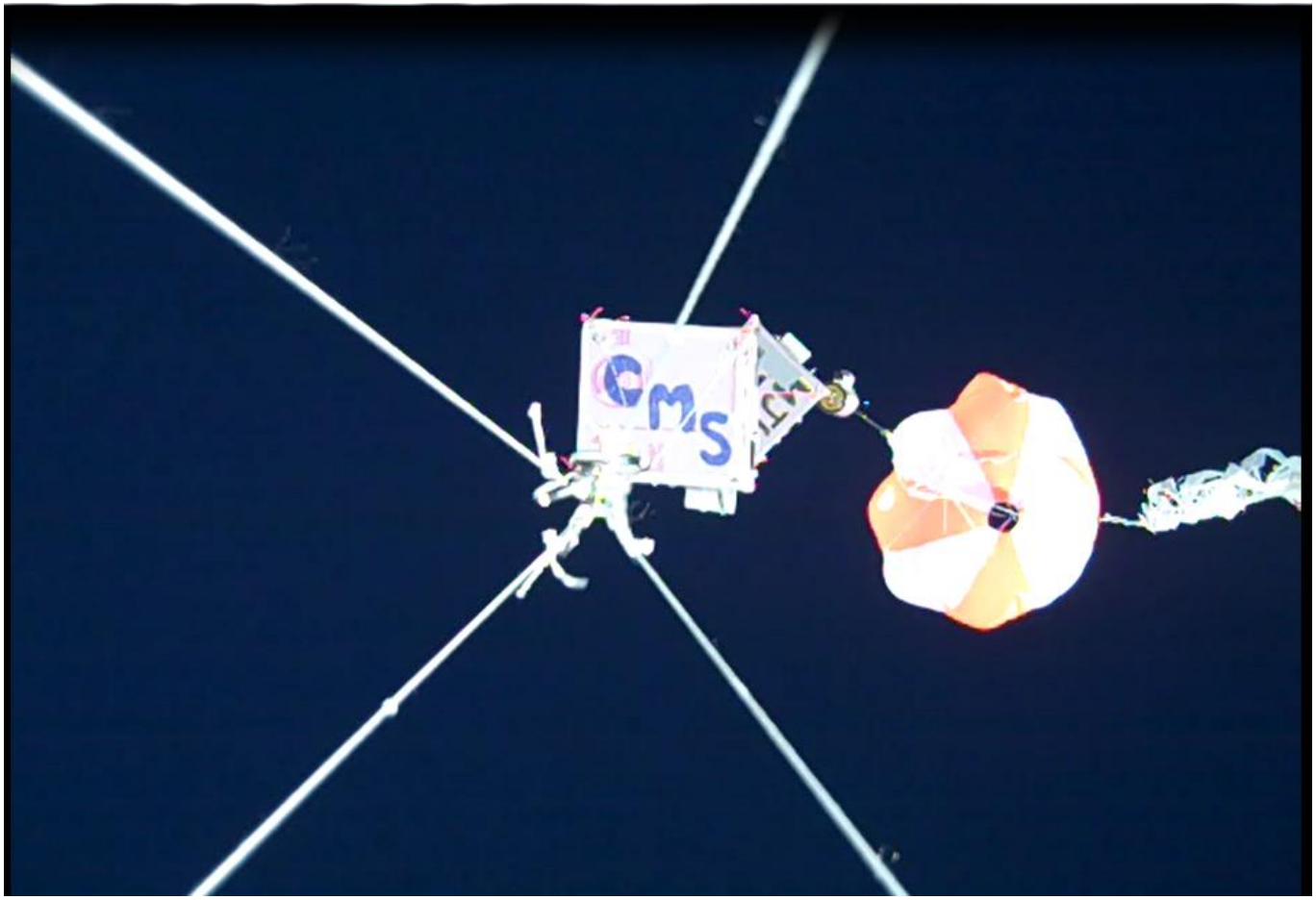
The x-axis acceleration (in G's) versus time (in minutes) graph during all stages of flight from the Columbia Height's payload.

Tracking the Balloon's Flight Path



Source: http://aprs.fi

Descent under parachute



Future Outcomes

Each school would like to make some changes for the second round of flights examples include:

- Changing the timeline of the project (especially with having more time for data analysis)
- Involving more students in each aspect of high-altitude ballooning (i.e. tracking)
- Be able to have additional student-built experiments (i.e. testing radiation levels)
- Bridging the communication gap among different schools for insights into their curriculum and activities for their students

Acknowledgments

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