Request for Proposal Number: 2500-SP03
Design Concept of the Balloon Satellite

Team HALO

Project Ghosts

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Overview

Our mission is to enhance our education in the engineering industry by designing, creating, testing, and flying a balloon satellite up to 32,800 meters.

This satellite will complete multiple objectives. First, the satellite will measure the intensity of the sun's energy as altitude increases and compare our results to the efficiency of solar panels on earth. In addition, we also want to measure the acceleration due to gravity throughout the satellite's elevation and determine whether it changes according to Newton's Law of Gravity. Last, our satellite will take pictures of the earth and the balloon as it travels through the atmosphere.

We plan to find that as the altitude increases there will be less gravity than on earth. Also, due to less atmosphere blocking the sun, the solar panels will receive more sunlight and produce more energy at a higher altitude.

Technical Instructions

Our balloon sat will be made of six aluminum squares 11.4cm in length, creating a volume of 1481.54 cubic centimeters. We will insulate the satellite with foam core to keep the internal temperature above 0 degrees Celsius. We will solder the edges of the cube to seal it.

Encapsulated in our cube is the HOBO data logger, the JAM camera, the voltmeter, accelerometer, two 9 Volt batteries, and the BASIC stamp.

On the outside of our cube are four solar panels, one on each side of the cube. Internally, we plan on inserting PCV pipe to run the cable through, allowing us to better seal the inside of the cube.

Gravity Experiment

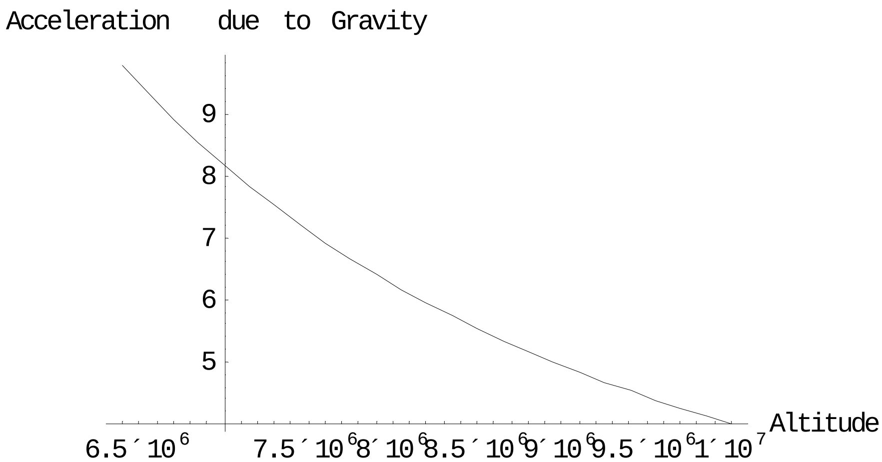
The satellite will measure the acceleration due to gravity. Using this information we can determine whether the gravity changes by using Newton's Law of Gravity. The Universal Law of Gravity states:

$$F = G\frac{m_1 m_2}{d^2}$$

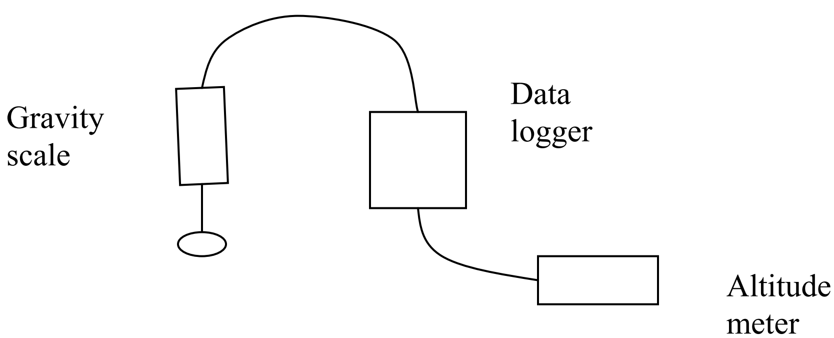
where G, the gravity constant is 6.672×10^{-11} m^3/(kg sec^2). On earth, mass 1 is the mass of earth, which is approximately 6.0×10^{24} kilograms, and the distance is the radius of earth, 6.4×10^6 meters. Since G, m_1, and d are constant on earth surface, their product is a constant as well,

$$G\frac{m_1}{d^2} = g \approx 9.8 \text{ m/sec}^2$$

Ideally, the acceleration due to gravity, *g*, should be around 9.8m/sec^2. As the satellite ascends, *g* should decrease according to the inverse square law. The acceleration due to gravity becomes a function of distance, as shown below:



To actually perform the experiment, we will need a digital scale, a data logger and an altitude meter. We'll hang a mass on the digital scale and mount the digital scale on the wall of the satellite. In our case, the mass is a wire of 10 grams. We are also going to have an altitude meter on board to measure the elevation of the satellite. Both the altitude meter and the digital scale are connected to a data logger for data collection. After we recover our satellite, we can download the data from the data logger for analysis.

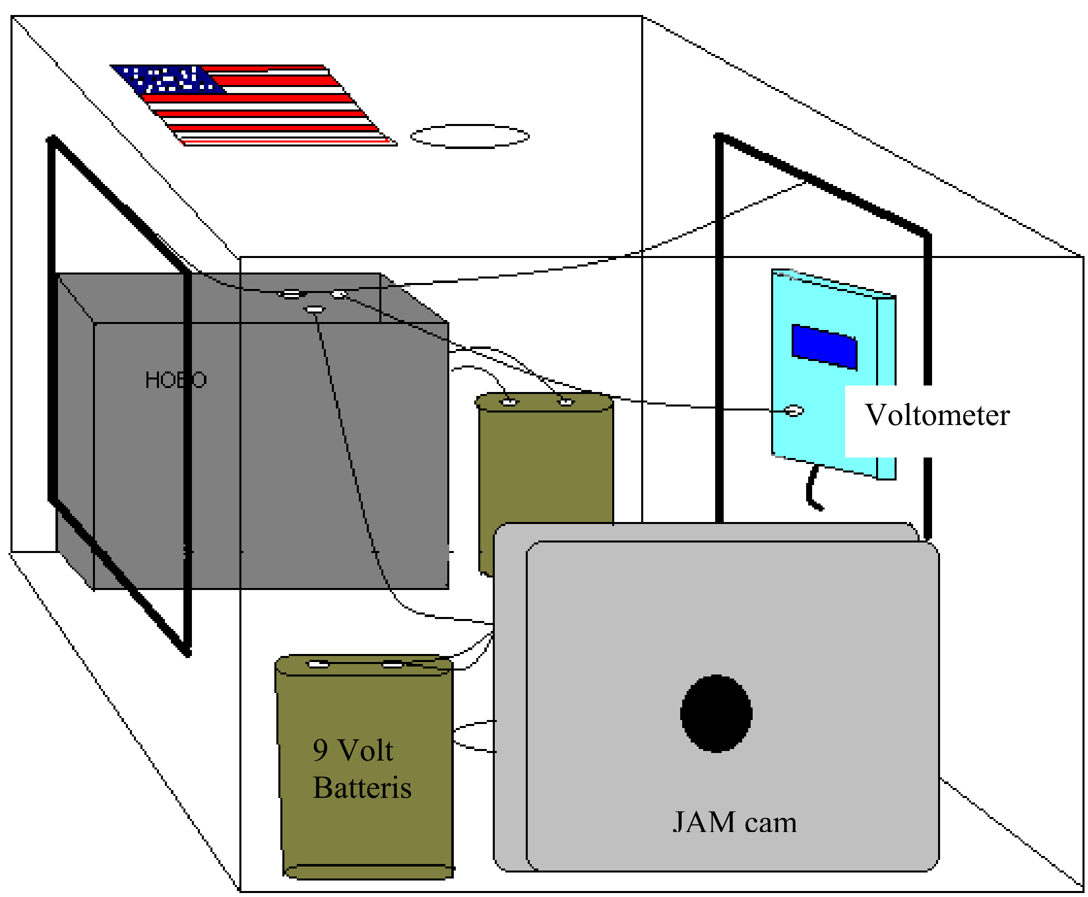


Solar Panels

The idea behind our solar panels experiment is to compare the energy received by the solar panels on Earth's surface with the energy received by the solar panels one hundred thousand feet above the surface of the Earth. It is possible that the atmosphere is so much thinner up there that much less energy from the sun is filtered out, making solar panels more efficient.

There will be four solar panels places on each side of the cube sat, except the top and bottom, to maximize the exposure to the sun. The solar panels will be hooked to the amp meter and then to the HOBO to record the amps produced during the trip.

Illustration of our design



How our team will test our design

Each system will be checked individually then combined and checked as a whole. We are going to test the cube's versatility by performing a shock test. To make sure the cube sat will stay above freezing temperatures we will surround the system with dry ice for an hour (estimated time of freezing temperatures). We want to test the gravity setup by using an elevator to see if a change is noted in our device and if possible travel to a higher location, such as the Rocky Mountains. It is also thought to draw the design in CAD so stress test analysis for impact can be performed.

Launch

On Saturday, April 26th we will travel to Windsor, Colorado, our launch site. Once we arrive at our launch site we will begin by checking the systems and attaching the cable to our balloon sat. Once we are ready to launch we will begin the timing systems. After launch we will track the balloon with the attached GPS tracking system. The satellites should be recovered by 3pm later that day.

Management and Cost Overview

Our team will be ready on launch day, as we will all make sure to set our alarms for the correct time. As we will have followed our schedule to the letter, we will have a completed BalloonSat in our possession ready to be launched 100,000 feet above the earth with both experiments ready to go.

Timeline

February: 2nd - 3rd – 4th 10:00 to 11:50pm
Work on the proposal.
Test and make the results ready for the proposal.

February: 5th 10:00 pm
Finalize the proposal, and make sure we have every thing we need.

February: 9th 6:00 to 9:00pm
Should have the hardware needed.
Start working on team presentations

February: 13th 2:00 to 3:15pm
Team presentations are due

February: 18th 2:00 to 3:15pm
Should get the Authority to Proceed
Complete design

February: 23rd 8:00 to 10:00 pm
Begin prototyping design

March: 9th 6:00 to 10:00 pm.
Start building the box.
Hook up all equipment (out side the box)

March: 23rd 6:00 to 8:00 pm.
Finish with the shell

April: 3rd 2:00 to 3:15pm
First Readiness review

April: 6th 6:00 to 9:00pm
Finalization of final design

April: 13th – 18th, when ever possible
Testing of final design

April: 17th 2:00-3:15pm
Second Readiness Review

April: 19th
LAUNCH DAY!

May: 1st 2:00-3:15pm
Final Reports Due and Team Presentations

Each Team Member's Roles

Danielle is acting as the leader because of her organization skills; she also is helping to manufacture any pieces in the workshop. Terry will work on the electrical aspect due to his computer science background and experience in the field. Matt and Danny are working on the structure and construction of the outside of the cube sat. Vipul is in charge of testing the cube. Morgan takes care of all external issues and will assist Vipul with the testing phases of the project. We all will work together on the assembly of the cube sat once the small phases are done.

Team Members

Daniel J. Butler
Major: Architectural Engineering
Facts: He graduated from Loveland High School and is a freshman here. He currently is on the club baseball team.

Vipul Lati
Major: Open Option
Facts: He graduated from Overland High School and is a freshman here. When not trying to reach his goal of being an astronaut he likes to play tennis and golf
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Mathew Strassburg
Major: Aerospace Engineering
Facts: He graduated from Manitou Springs High School in Colorado Springs, CO and is a freshman here. He loves to drive and work on vintage cars.

Morgan Anderson
Major: Psychology
Facts: He graduated from Burley High School in Idaho and is a sophomore. He loves the Rockies and enjoys playing baseball.

Terry Song
Major: Aerospace Engineering with a minor in Computer Science
Facts: He graduated from Overland High School and is a freshman. He likes driving fast cars and playing video games as an F-22 pilot.

Danielle Massey

Major: Aerospace Engineering

Facts: She graduated from ThunderRidge High School and is a freshman. She enjoys playing sports and hanging out with friends.

Itemized budget

This is a high estimate in the event we need to pay for some devices, such as the HOBO. With luck, we hope to borrow or have some equipment donated from companies.

Components	**Price**	**Source**
HOBO data logger	$59.00	http://www.microdaq.com/
Accelerometer	$0	Borrow from Chris
Digital scale	$19.99	Dick's Sporting goods
4 x Solar panels	$48.00	Plastics.com
Voltmeter	$20.00	ebay.com
JAM cam	$17.00	Hopefully scrap
BASIC Stamp	$34.00	Not sure
9V Batteries	$4.50 each	Store
Amp meter	<$50	Not sure
Foam Core	$5.00	Store
Aluminum	$10.00	Store
Wires	$5.00	Store
Miscellaneous	$20	
Total	**<$298**	**Less if HOBO is provided= $238**