# REQUEST FOR PROPOSAL

Attention: Chris Koehler
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## Balloon Satellite Project: Bacterium and Pressure Testing

**TEAM EASY**

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# Overview:

*Mission Statement*:

We intend to observe the atmosphere at about 30,400 meters while recording the pressure in this environment and observing the harsh effects of pressure, temperature and sudden change in altitude on bacteria.

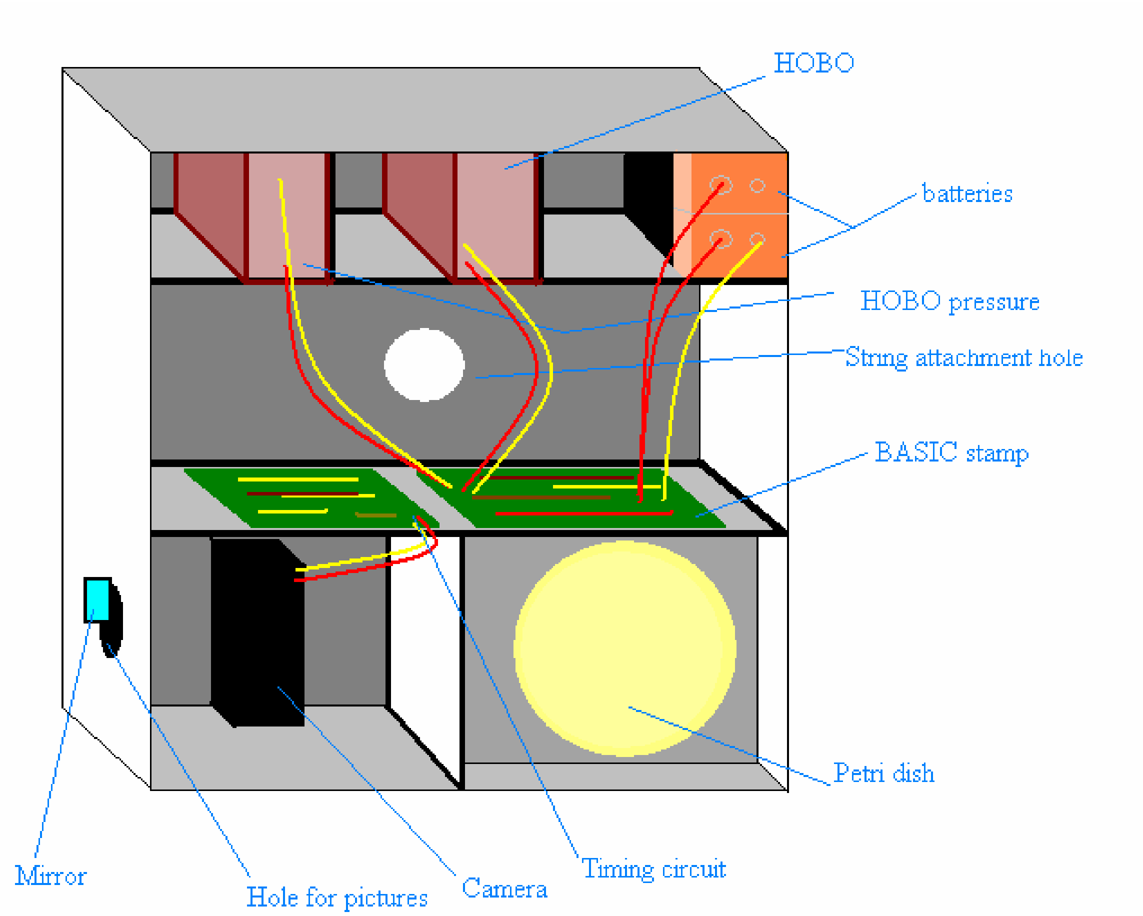
*Why*:

- We want to grow bacteria in this environment to see if life can exist in harsh environments, such as a low level oxygen environment or in a space-like situation.
- We also want to measure the changes in pressure in our atmosphere to see exactly what the bacterium is experiencing and to verify physical laws in our atmosphere.

*What we plan to discover*:

- We plan to see if bacteria can survive in such a harsh environment.
- We will measure atmospheric pressure and verify that it adheres to atmospheric pressure laws.
- We will measure the temperature changes in altitude externally.
- We will see if our insulation and heating techniques work efficiently to keep our internal temperature above zero degrees Celsius.
- We plan to image the Earth and the sky and weather balloon to get a visual scene of what is happening during the flight.
- We also will measure ascent and decent rates to see how fast a weather balloon can climb in the atmosphere and to see if the parachute effectively slows the decent of our satellites.

# Technical Overview:




*Design*:

Our balloon satellite exterior will be composed of foam with aluminum tape and foil to reinforce the interior and help with heat loss. There will be a Petri dish in a separate internal compartment with a hole to the outside in order to allow the exterior environment to interact with the interior Petri dish compartment for the bacterial experiment. We will place chemical hand warmers in the bottom of the satellite as our heat source, with the premise that the heat will rise up to the top of the interior of the satellite, so that we will use the heat efficiently and lose as little of it as possible. There will be a PVC piping conduit set vertically through the center of our satellite in order to connect the weather balloon flight string to our satellite. Washers will be attached to the top and bottom of the PVC piping for use as anti-abrasion bushings. Also at the top and bottom of the piping we will tie the weather balloon flight string into figure eight knots, to keep our satellite attached to one point on the string. Also internally we will have our digital camera, with an exterior hole to the outside so the lens can see through the walls of our satellite.

We will utilize a mirror attached to the exterior of the satellite in order for the camera to render the earth below the satellite and the balloon above the satellite. The camera will be attached to a time circuit to take pictures intermittently throughout the flight. The HOBO data logger will be set up on the inside of the satellite with its external temperature cable on the exterior of the satellite, connected to the HOBO through a hole in the satellite's exterior. Internally we will also have a Barometer and Altimeter that will record data on the flight for analysis afterward. Also internally we will have an accelerometer to measure the ascent and descent rates of the satellite.

*Hardware*:

Our design requires a few major components, and many smaller ones. The major components consist of our digital camera, HOBO, and bacteria experiment. Besides just the camera itself, we will need a mirror to place in front of the lens so we can photo the earth and balloon at the same time. The camera will also likely need time circuits to control when the pictures are taken. The HOBO will work in conjunction with the HOBO Pressure to measure the pressure. Also, a temperature gauge will be attached to the HOBO. The bacteria experiment consists of a Petri dish filled with agar. Run of the mill hand warmers will be used to control the heating. Some sort of accelerometer will be on board measuring the ascent and descent rates. However small, this could prove to require some major circuits. Some sort of insulation, epoxy, aluminum tape, and our foam core siding make up the rest of our hardware.

*Method of construction*:

Our team will start the building with the individual internal pieces. We will combine each component and make sure it works before we put it into the satellite. Once we have all the working interior pieces we will build the exterior foam core and line it with aluminum foil to prevent heat loss. Then we will install each piece into the satellite interior and make sure it works once it has been installed. Each piece will be divided up into its own "system" which includes the camera system, the HOBO system, the Barometer and Altimeter system, the accelerometer system, and the bacteria containment area. Each piece will be installed and tested as separate parts to make up the whole satellite.

Each one of our team members will specialize in certain parts of our satellite. Kristen and Dana will work specifically on the exterior foam casing of the satellite and the bacteria containment area. Gerry and Chris will work on the camera and accelerometer system. Shane and Sally will focus on the Barometer and Altimeter system and the HOBO system. All work will be split up into in order to make the whole project be completed faster. While anyone on the team will be able to move through the system groups and help each other, this is where each team members' focus lies.

*Testing*:

To examine the functionality of the satellite and its components, we will perform certain tests throughout the design process. It will be easiest to begin on a small scale and work our way out. Electronics and power systems will be the first thing tested, followed by the testing of the larger components (i.e. camera, HOBO, thermometer, etc) for basic operations. After assembly, the entire satellite must be tested to make sure it will withstand the strains that will be placed on it during its flight. A temperature test will be conducted to make sure the interior stays above the required 0 degrees Celsius. This will be accomplished by simply placing the satellite into a freezer that is close to the temperature it will be faced with, and then observing how it reacts. The drop test is another critical step to the process. We will basically drop the satellite from a predetermined height that will simulate the speed at which it will impact the earth to see if the components can withstand such force. Finally, a faulty balloon string attachment could result in complete loss of the satellite, so testing the strain put on the attachment is very important. Swing tests and other types of tests will be made to assure that this will not be an issue on launch day.

*Launch program overview*:

On launch day, we will go through a series of events that will prepare our satellite to work properly. First, we will prepare the Petri dishes before we leave for the launch site. To prepare the Petri dishes, we must put them in the microwave and zap them to make sure that they are sterile. If any bacteria is in the Petri dishes before we put the agar into them, the entire experiment may be destroyed. To prepare the agar, we will boil water, and mix agar powder into the water until the powder is dissolved. After the agar is dissolved, we will pour the solution into the Petri dishes and let it cool. Once the agar is cooled, it will make a jelly like substance. The cover will be taped on so to ensure that the agar isn't contaminated before we launch it. We will have three Petri dishes, two on the surface and one in the satellite. Second, we will have to make sure that all of the components work with their respective power sources. To ensure that all our systems should work, we will test the batteries with a battery tester to make sure that they have enough power to fuel the units. Third, we will make sure that our digital camera is in working condition. The camera can take many pictures on one memory card, so we can do one test to make sure that it is in working condition on launch day. Next, all the systems will be tested to make sure that they work at ground level. Finally, before we launch the satellite, we will take the tape off of the Petri dish, and remove the cover at the last moments so the agar can collect the bacteria as the satellite ascends.

*Safety Precautions*:

The safety of our team members is vital and in order to ensure the safety of everyone there must be certain precautions to follow.  We will all remain very alert during the building, testing and launch of our satellite.  Extra safety measures will be taken especially during the circuitry and soldering points of the construction. The tether testing phase will be done in a large area will all team members out of the range of the swinging satellite.  If dry ice is used for the temperature test, we will be cautious as to not burn ourselves.  Safety is important to our team, thus these precautions and common sense will be used throughout the entire project (i.e. we will not put legos in our mouth).

*Special features*:

We are going to have some special features on our satellite.  One of our features is going to be a mirror that will reflect half of our camera image up towards the balloon.  This is special because we are supposed to have a picture of the Earth, and the balloon.  Because of the mirror, we will be able to take pictures of the Earth and balloon at the same time.  Another special feature is our Petri dish compartment.  This compartment will be isolated from the rest of the satellite.  The reason that it will be isolated is because we need a hole in the satellite so the Petri dish can receive air from the outside.  The Petri dish compartment will be able to have the top come off easily so we can remove the Petri dish cover minutes before we launch.

## Management and Cost

*Schedule of Production Events*:

| | |
|---|---|
| February 6, 2003 | Turn in proposal by 1:00 PM |
| February 10, 2003 | Organize our ideas for presentation |
| February 13, 2003 | Presentation Day |
| February 15, 2003 | Begin Building  Satellite |
| March 1, 2003 | Complete Satellite and Begin Testing |
| April 3, 2003 | Begin Launch Readiness Review |
| April 17, 2003 | Finish Launch Readiness Review |
| April 19, 2003 | Launch Day |

*Readiness for Launch Day and Launch day Events*:

We plan to meet and drive to Windsor, CO on launch day, April 19, 2003. We hope to arrive well before the 7:00 AM launch time so we will have ample time to set up our balloon satellite as well as make certain everything is working correctly. We will activate the heat packs and place them in the design then seal it properly. After connecting the sealed satellite to the balloon, we will launch the balloon satellite. We plan to track it from a vehicle and collect the satellite and our data once it touches back down.

*Team Member Descriptions and Roles*:

Gerry Emmerich: College of Engineering and Applied Science
Aerospace Engineering
Knowledge and experience of the manufacturing center
Role in production:  Price comparisons for parts, budgeting

Chris Hart: College of Engineering and Applied Science
Aerospace Engineering
Knowledge of circuits and circuitry
Role in production:  circuitry and aid in price comparisons for parts

Sallie Hill: College of Arts and Sciences
Open Option/English
Excels in creativity
Role in production:  researching equipment and requesting donations from technology companies

Dana Jewett: College of Arts and Sciences
Studio Arts
Extensive typing and drawing ability
Role in production:  rendering drawings of design for presentation

Shane Quigley: College of Engineering and Applied Science
Computer Science
Skilled in leadership and computer programming
Role in production:  organize ideas and aid in any programming needed

Kristen Zuidema: College of Engineering and Applied Science
Aerospace Engineering/Engineering Physics
Enjoys problem solving and physics
Role in production: comparison in parts (size, weight, price) and producing presentations

*Itemized Budget*:

| Part | Estimated Price |
|---|---|
| Foam Core | $30 |
| Digital Camera | $30 |
| Barometer/Altimeter | $122 |
| Batteries | $10 |
| Aluminum Foil | $5 |
| Petri Dishes | Donated |
| Small Mirror | $5 |
| Epoxy | $5 |
| Hand Warmers | $5 |
| HOBO | Provided |
| External Temperature Cable | Provided |
| BASIC Stamp | Provided |
| Anti-abrasion Brushings | $3 |
| Time Circuit | $30 |
| Plastic Tubing | $5 |
| Paint | $5 |
| Accelerometer | Donated |
| Agar (for the Petri dish) | Donated |
| TOTAL | $250 |

This mission has a very specific and limited budget.  In order to be successful in completing and launching our satellite, our proposed budget must be strictly followed.  In an effort to keep costs down, we plan on using parts that are less expensive, but at the same time will be able to withstand the harsh environment they will be exposed to.  The above budget also contains some overestimation that may prove helpful in providing for unexpected expenses (including spare parts).  Team Easy will be utilizing each member's unique engineering skills to minimize mistakes or errors, which will also ease the cost of extra parts.  By abiding by the budget and exploiting each member's skills, we will stay on schedule and be prepared for launch.