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<u>Project Overview:</u>

Mission Statement:

We want to take advantage of the opportunity to send a BalloonSat to the edge of space by performing scientific experiments to enrich our lives with the knowledge of the environment in the upper atmosphere, and to gain experience in our prospective fields in a practical application of our academic knowledge.

Driving Force:

We want to perform the experiments our team is proposing mainly because they are of interest to us. We have an interest in the general requirements of the satellite so that it functions properly and our experiments and data collection succeed. We have an interest in finding out more about the upper atmosphere, and more importantly, in what we can already do as students in our intended fields. We see this opportunity as a time to apply our knowledge and skills to a task, and to learn new knowledge and skills which we will need in the remaining time we have as students, and in our future careers.

Experiment Overviews:

This is a brief summary of what we plan to discover for each experiment. Clearly there is not enough space in the proposal to appropriately discuss each experiment in depth; a more thorough analysis of most experiments should be available at: http://ucsub.colorado.edu/~hodgeskl/astr2500.html, but it may be a while before complete versions are online.

Camera:

This part of the satellite is required and will image the balloon in flight and the ground once the balloon has burst. It will probably be achieved either by mirrors.

Thin Film Photovoltaic Paper:

For this experiment we plan to discover how the emerging technology of thin film photovoltaic cells works, how it compares to standard solar cells, and whether the cell collects more solar energy on the ground or in the stratosphere (scattering, intensity, etc. are factors).

High Energy Radiation Survey:

This experiment intends to record how many gamma rays and other high energy photons and other particles trigger a Geiger counter inside the satellite. In this way, we will be able to analyze how incidence of high energy radiation increases with altitude

Radio Waves in the Stratosphere:

This proposed experiment uses a Ham Radio to determine the maximum range for two-way radio signals to travel from the ground to the satellite and back. Signals will be sent at regular intervals to the satellite and should it fail to respond for any reason at some time we will be able to determine the approximate altitude corresponding to that time. This experiment may weigh too much.

<u>Technical Overview:</u>

The theory involved with the experiments is discussed qualitatively, but not entirely quantitatively for lack of space. Equations will be used extensively in predictions and data analysis, but there is not enough room to include all the work here. Available upon request.

Design Overview:

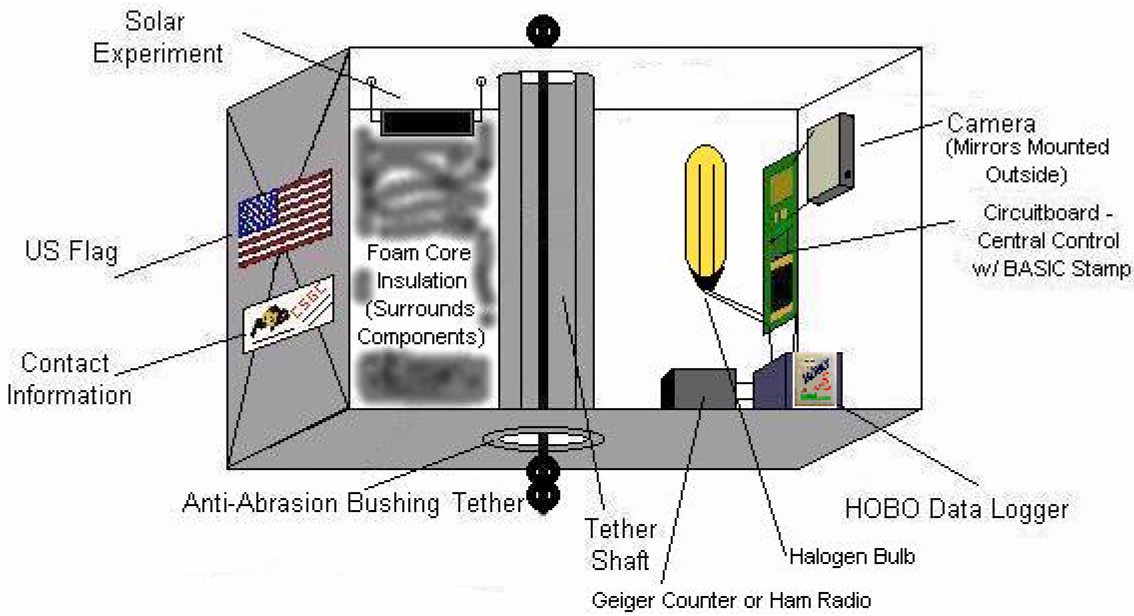
Our design will consist of a 1500 cm^3 balloon satellite box insulated with <foam core, aluminum> with a battery power source, a heat source powered by the battery (resistive material), and our experiments, along with the camera, HOBO data logger, BASIC stamp packaged in our insulation. The outside of the box will have a thin film solar panel/paper on one side, as well as a US flag on a different side. There will be a hole through the center which will be treated as an edge for insulation purposes through which the tether uniting the satellites will run. There will be an additional hole for the camera to look out at the balloon, and an opening for air sampling. The remainder of the experiment will be contained inside the insulation and heated appropriately.

The materials will remain above 273 K, will be designed to land upright (by putting the heavy materials on the bottom).

Schematic Diagram:

Figure 1: BalloonSat Structure

Figure 2: BalloonSat Cross Section



Hardware Profile:

Table 1: Hardware		
Hardware	Quantity	Cost
BASIC Stamp	1	Provided
HOBO Data Logger	1	Provided
Camera	1	Provided
Thin Film Photovoltaic Paper	1	Provided
Rechargeable Battery	1	Provided
9V Battery	2	Provided
Wires	As many as needed	Provided
Circuit board	1	~$5
Geiger Counter	1	~$125 (est.)
US Flag Sticker	1	~$2
Bushing	2	~$5
Spare Parts (batteries, wires, electronics, etc.)	As much as needed	Up to $40 (estimate)

Structure Profile:

Table 2: Structure Materials			
Part	Where	Price	Mass
Aluminum corner siding	Lowes	$10.77	70 grams (est)
Hinge	Lowes	$1.99	4 grams
Pipe (3/4”)	Lowes	$1.29	14 grams
20 watt halogen bulb + wires	Lowes	$4.98	4 grams (est)
Duct tape	(already own)	$0.00	5 grams (est)

Black foam board	Michaels	$3.69	50 grams (est)
Hot glue - glue	Michaels	$1.99	15 grams (est)
Super glue	Michaels	$2.79	2 grams (est)

The above hardware will all be needed for the experiment. The insulation, plating, and tether hardware is needed for the satellite in general, the power will come from 9V batteries, which will power the data logger, BASIC stamp, and other experiments. Other equipment is needed for circuitry, thermal insulation, thermal output (halogen bulb), and the specific experiments. The hardware needed for specific experiments will be discussed with those experiments.

Note: Our total weight is currently estimated at about 470 grams, although we have included up to 700 grams worth of material. The radio experiment goes over weight by quite a lot and will be canceled first if we run into a problem. Structural weight will be sacrificed where we can afford to do so.

Distribution of Labor:

As we all have different schedules, it is unlikely that many aspects of the satellite building will be done by all of us together outside of class. We will try and get the basic design done inside class and in several scheduled meetings for all of us, but aside from that smaller divisions of the group will be working together or individually. See the specific experiments section for information about which team members will be responsible for which parts. It is everyone’s responsibility to make sure their part gets done on time and that the satellite is done and ready for testing some time before launch. It is everyone’s responsibility to communicate to the group what they are doing, if they are having any problems, and keep everyone updated. If another group member is having difficulties, it is the team’s responsibility to help them get their part finished.

Design Tests:

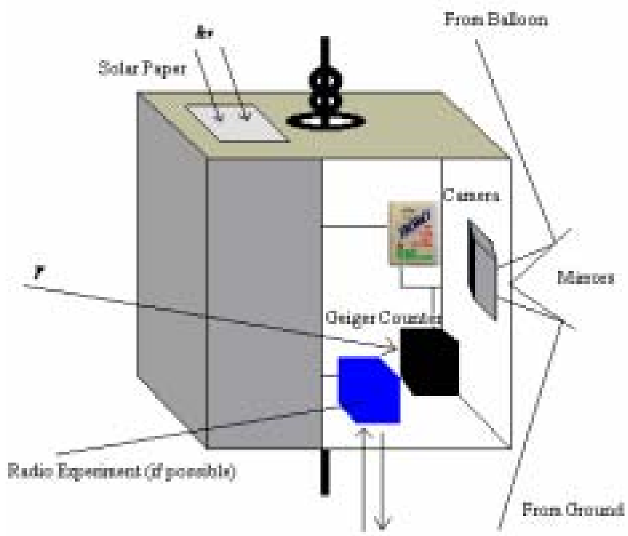
Each primary designer responsible for an experiment will test that experiment thoroughly, and if possible another knowledgeable member will double-check his or her results. When it is time to assemble the satellite we will put all the working components in, pack them with insulation, and have our satellite undergo the drop test and freeze test.

Safety:

Safety in the lab and in other places where construction of the satellite takes place is of the utmost importance. In the lab, we will wear safety goggles and take further precautions if working with dangerous materials, and all electronics work will be done in an electronics lab with a supervisor. We will make sure that the BalloonSat is securely attached to the tether connecting the balloon and the satellites so that it will not fall off and potentially injure anyone.

Diagram of Operational BalloonSat:

Figure 3: Experiments in BalloonSat Operating



Management and Cost Overview:

Launch Day Preparedness Overview:

We will arrange for travel up to the launch site in Windsor, CO. We will check all our systems at the launch site and make sure our satellite is secure and ready for launch. We will make sure we are ready a few days before launch day in case we have to correct anything that goes wrong with the satellite during any final testing. This will be done by keeping track of the schedule and finishing specific tasks on time. The team members will all report to the team as a whole on how they are doing and on their progress. Should any team member need help or be unable to complete a part of the project, another member will be assigned to help them based on skills, time availability, etc.

On launch day we will check all our systems one more time, start any timers we might have, turn the power on, secure the balloon to the wire, and release it.

Schedule of Events:

2/6/03	Proposal Due
2/11/03	Everyone must know how to hook up their specific parts, what data they'll be collecting, how they'll be storing it, and everyone must order their parts by this time.
2/13/03	Presentation will be made in class.
2/20/03	Proposals for testing each unit/experiment completed by this time.
2/27/03	Each experiment has been tested outside the satellite. Structural design is completed and ready to be constructed. A complete parts list is assembled.
3/11/03	Satellite assembled for the first time, modifications made as needed up until 1st Launch Readiness Review.
4/03/03	1st Launch Readiness Review
4/17/03	2nd Launch Readiness Review
4/19/03	Launch Day (bad weather dates 4/26-4/27)
4/26/03	ITLL Design Expo

Team Member Roles:

Heather: Team leader. Primary Designer for the Geiger counter experiment. She is responsible for watching schedule, motivating the team, organizing meetings, work efforts, keeping morale high, and smoothing out conflicts.

Adam: Status Reporter. Primary Designer for the Satellite Box. Auxiliary Designer for the Photovoltaic experiment. He is responsible for keeping the team on track, reminding everyone of due dates, and making sure each team member is kept informed of what each other team member is doing.

Eddie: Central Organizer. Primary Designer for the Photovoltaic experiment. He is responsible for maintaining the web page, receiving and transmitting project data, making sure the team knows all about the experiments everyone is doing, and keeping track of size and weight to make sure it does not go over the limit.

Leah: Primary Designer for the Radio experiment. Auxiliary Designer for all experiments. She will be responsible for keeping up to date on all the separate projects and helping as needed; finding out the principles and the plans for each individual experiment. She will help people whose experiments overlap coordinate.

Eric: Financial Manager. Primary Designer for the Camera. He is responsible for making sure the team stays within budget, for keeping track of receipts, and for calling attention to any financial matter in need of discussion.

Riley: Primary Designer for the circuitry, HOBO data logger, BASIC stamp, etc. He is responsible for figuring out how the data storage will be wired together, how other experiments will connect to a centralized power source if we choose to have one, etc. The entire team will work with him on this.

Team Profile:

Heather Passe:
University of Colorado at Boulder: College of Engineering and Applied Sciences
Major: Mechanical Engineering
Special Skills: Delivering presentations, group leadership skills, communication skills in general, and design skills.

Adam Davidson:
University of Colorado at Boulder: College of Engineering and Applied Sciences
Major: Aerospace Engineering
Special Skills: designing, building, and testing projects. Can do programming if necessary.

Edmund Hodges-Kluck:
University of Colorado at Boulder: College of Arts and Sciences
Major: Astronomy: Astrophysics, Aerospace Engineering
Special Skills: Electronics, programming, design, theoretical work, atmospheric/astronomical knowledge, physics knowledge in general

Eric Johnson:
University of Colorado at Boulder: College of Arts and Sciences
Major: Physics
Special Skills: Design, adept at atmospheric and astronomical science.

Riley Whiteman:
University of Colorado at Boulder: College of Engineering and Applied Sciences
Major: Aerospace Engineering
Special Skills: Designing, building, and engineering in general.

Leah Ruch:
University of Colorado at Boulder: College of Arts and Sciences
Major: Open-Option
Special Skills: Designing, communicating, and general engineering knowledge.

Fiscal Management:

We will keep our budget by limiting ourselves to the parts we listed as necessary (including spares). We will set aside a certain amount of money to be used in case something unexpected happens, and keep all receipts for our purchases. If it looks like we may go over budget we will reassess what we are doing and if necessary make extra purchases and note these occurrences. When possible, we will get parts used in good condition or for a discount/free when we are able. Eric will be responsible for keeping receipts and making sure the team isn't going over budget. If it looks like one team member needs more money for a certain experiment we will have a discussion about whether we want to increase our spending at the risk of going over the reimbursed spending limit provided by the class.

Tentative Budget:

Casing -	$35
Camera Accessories -	$20
PV Experiment -	$20
Radiation Experiment OR Ham Radio Experiment -	$150
Other Parts -	$20
Total -	$245

To remain within budget and within weight limit we will probably only do one of the two expensive experiments, although a Geiger counter may be found that is relatively cheap, in which case we will re-evaluate. We are also setting aside some extra money such that the total could surge to ~$300 and we'd be fine, but we are hoping to avoid this.