**ESCI 1454 High Altitude Balloon (HAB) Experimental Design**

You are now participating in the HAB flight. The first step is to design an experiment based on one (or more) of the following parameters that will be measured as the balloon ascends through the atmosphere. There will be sensors on board that continually measure and record the following data:

* Temperature (discussed on p316 of the class textbook)
* Pressure (discussed on p315 of the class textbook)
* Relative Humidity
* Ozone
* Time
* Altitude
* Latitude and Longitude

Your first task with your team (teams described below) will be to design an experiment in which you will test the way something responds to changing atmospheric conditions as the balloon rises through the atmosphere. You will design an experiment and hypothesize on its outcome.

An example might be:

“As *Temperature and pressure falls in the troposphere* we expect that a hot dog will freeze at a temperature of -20 degrees Celsius and explode at a temperature of -30 degrees Celsius when the pressure drops to 1/100 of the pressure on the ground.”

The above example is based on no known understanding of the behavior of hot dogs. But a real example is easier than it looks. It is a matter of recognizing how something might physically change as it passes through the changing conditions in the atmosphere. To help with recognizing those relationships and to help generate ideas, there are two major required Parts to this activity to help you refine ideas.

**Part 1:** Discuss this challenge with a CLC Prof.

**Part 2.** Review past HAB research reports.

The processes are described below.

**Part 1 Discussing ideas with a CLC prof**

Take your challenge to a CLC prof. Explain to her or him what you are doing, and what you need to come up with (an experimental design and a hypothesis). Ask the prof (in your way) if they can help you by suggesting any ideas for a simple, but effective experiment. In doing so, follow the guidelines below:

* Before visiting the professor, prepare in advance:
  + Your explanation of what you are supposed to do and why
  + Your request for advice

Please bear in mind the following:

* Plan on visiting them in person during their office hours. Do not attempt this through email correspondence or by telephone.
* Plan on taking no more than 5 minutes of their time for the visit. This assures efficiency on your part. Everybody’s time is valuable-theirs and yours.
* Remember you are seeking only advice. While they may give you a germ of an idea, it is your job to research the idea, and give it some thought as to how you might make it work.
* Keep notes. After the meeting review your notes to fill in any gaps. You will share these notes with your team.

Who should you visit?

Every person in your team will visit someone different. Each member is required to visit one CLC prof. Below is the list of profs that you can approach about this. All of them have been contacted in advance and have indicated that they are willing to talk to you about the project. In your first team meeting, decide who each of you will talk to so to make sure every person on your team talks to someone different.

***Editor’s note:*** *The following table was left blank. If you are using this document fill in the table with faculty names from your own college.*

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**Part 2.** Reading through past HAB research reports. After the HAB flight you will write a full report of your work. Past reports are available for you to consult. In the experimental design phase of this project, consulting past reports may help you develop ideas. They also reveal mistakes that were made on past experiments that should not happen again. You can find those reports in the HAB Library in the course D2L under HAB.

Other sources

It is also important to consult other sources as well. They are;

* Your class textbook. The chapters on Earth’s atmosphere are key to understanding what is going on here.
* Power-point presentations that were shared with you in class.
* Atmospheric data analyses that we did in lab.

**Part 2 Sharing ideas with your team and settling on an experimental design**

1. After interviewing the professors, in a team meeting, share with the others what you learned by talking with the CLC prof. Discuss any ideas that might have come to mind through your interview.
2. After the period of sharing of ideas, with your team, settle on a single idea, and design an experiment and hypothesis around it.
3. In designing your experiment, pay attention to the distinction between a natural and a controlled experiement. Also with your experiment, do your best to control variables.
4. In writing your hypothesis, bear in mind the following requirements. You hypothesis must be,
   1. Testable
   2. Falsifiable
   3. Measureable.
5. Create a sketch of your experimental design and prepare it such that you can present it to the rest of the class.
6. Your experimental design must also include a list of needed materials, and prices. See web links below for feasibility ideas.

Limitations to your experimental design

In thinking about what you can do for an experiment please bear in mind the following constraints:

* It cannot be any kind of animal. Insects are exceptions, however if you do choose to involve an insect in your experiment, the goal must be to *keep it alive*!
* It cannot be heavy.
* It cannot be so explosive that it could harm the rest of the balloon payload.
* It should be small and light.
* If it free fell to Earth, it cannot harm anyone or anything.

**Part 3. Sharing experimental designs and voting on the one we will use for our HAB flight.**

After your team has an experimental design, each team will present their design to the class. The entire class will vote on a single experimental design for the HAB flight.

Your presentation should:

* Explain your experiment and hypothesis.
* Show your sketch of how the design will go together
* Show costs.

**Here is the timeline for completion of this process:**

Team formation and initial team meeting-**Friday, 21 February**

Week of information gathering and idea generation-**Friday, 21 February** to **Friday, 28 February**.

Sharing of ideas and settling on an experimental design with your team-class time, **Friday, 28 February**

Sharing of experimental designs with the class and voting on one design for our HAB-class time, **Monday, 3 March**

Preparing HAB payload-Lab time **Monday, 3 March** and class time, **Wednesday, 5 March**

Tentative week of HAB flight: Week of **Monday, 17 March**.

**Additional Resources.** Click on these web links for ideas of the kinds of things that you could send up in a balloon. Bear in mind the above limitations.

Your experiment can be video recorded. The on-board cameras are called Contour helmet cams. Check the link here to get an idea of what they are like: <http://contour.com/>

Steve Spangler science supply: <http://www.stevespanglerscience.com/>

An example payload box and harness are sitting in lab. You can go in and look at those any time the lab is open.

**Why all this?**

It is common for scientists to take on a project about which, at first, they know very little. In science, as in life, a useful approach is to ask around for advice about how to get it right. Scientists do it all the time. That is what you are doing here. While you may know little about how to go about this, collectively, in this college, there is great understanding. It is your job to synthesize that collective understanding into something that will work for this HAB project.

Outcomes for this assignment

In this activity you will,

* demonstrate written communication skills.
* correctly operate modern laboratory and field equipment or correctly follow other directions as explicitly laid out in laboratory activities.
* demonstrate understanding of scientific theories as pertaining to geology, meteorology, and oceanography. ***MnTC Goal 3***
* submit a summary of your experimental results in laboratory. ***MnTC Goal 3***
* perform field based investigations using standard geoscience techniques.
* write a formal field report and defend your findings.
* apply an Earth systems approach to understanding Earth's concentric spheres.

**Proof of visit Due: Friday, 28 February, 10:00 a.m.**

Bring this form to the prof you visited. After your visit with them, please ask for their signature verification of your visit. You will hand this in on **Friday, 28 February** at the beginning of class.

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