



Balloon Fest Design

Canadian Bacon

This document contains a detailed description of our Balloon Fest Design as well as possible alternatives that meet our design criteria and will test our hypothesis.

Ashley Levanduski
Morgan Murphy
Zach Kenyon
Zach Mondo
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Design Brief:

Our experiment will measure the change in atmospheric pressure vs. the altitude the equipment is held at. The purpose of this project is to measure and analyze the change in pressure as the helium filled balloon is raised higher and higher into the atmosphere. By using a one-way valve, barometer, and LabPro and analyzing the data from them, we should be able to determine the balloon's altitude.

As simple as this method sounds, there are still many problems we could encounter during this project. First, there are lift issues. We must be able to calculate the approximate amount of helium needed to lift our gondola without putting in too much, as this would lead to difficulties lowering the balloon. Then there are weight issues. The equipment, gondola, and rope all need to be less than 6lbs total to insure the balloon can lift them. Also, we need to insure all connections and seals in our equipment are solid to prevent leaks that will compromise the data.

PDS:

The materials needed for this project are minimal and are available either lying around group member's houses or in class. We will need a glass jar and one matching lids. A one-way valve will be constructed on the lid. It will be connected to a barometer that is connected to a LabPro which will in turn be connected to a calculator which will give us a pressure reading we can understand.

This project needs to be made to fit certain needs. Safety is a major issue for this. Our gondola needs to be made with much care so it connects tightly with the balloon and will not fall off. A glass jar falling anywhere from 100ft to 1000ft is not something we want anyone to get hit with. Also, we need ever seal within the one-way valve and jar to be extremely tight to prevent leaks. The time it takes to pull the balloon down also needs to be short to prevent any unexpected changes in pressure that will change our data out of necessary measures. One more major concern is storage. The gondola and jar won't take up too much room, but we need to put the lid with the one-way valve somewhere where it will not be damaged. We don't want to have to rebuild the valve every time we use it.

Research:

Amonton's Law-

- $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
- Altitude = $-84.50\text{m/kPa}(P) + 8560\text{m}$
- $1000\text{ft} \left(\frac{1\text{m}}{3.28\text{ft}} \right) \left(\frac{1\text{kPa}}{84.50\text{m}} \right) = 3.6\text{kPa}$
- $P_1 = 100.0\text{ kPa}$ $P_2 = 96.4\text{kPa}$ (←this is $100.0 - 3.6$)
 $V_1 = 946\text{mL}$ $V_2 = 981.3\text{mL}$
 *35.3ml difference

Alternative Design #1:

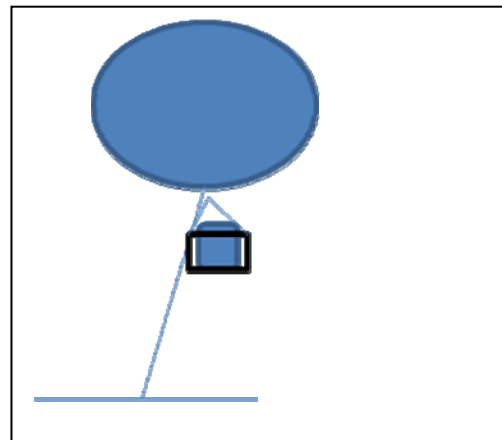
Expectations-

This design will most likely be our chosen design. It uses the least amount of cords and wires so mixing up the data would be nearly impossible. Also, the one-way valve method is a well proven up method for finding altitude so our findings should be fairly accurate. The gondola will be small enough to hang securely from the balloon and light enough to be lifted. Therefore, this design is well fit to our criteria.

Specifications-

The first possibility for this project consists of these materials:

- 1 glass jar
- 1 matching lid
- 1 setup on the lid for the one-way valve
- 1 barometer
- 1 calculator
- 1 LabPro
- 1 gondola
- 1 helium filled balloon
- 1 1000ft roll of line



Procedure:

1. The jar will be raised into the atmosphere at 100ft increments of line (eventually up to 1000ft) and will be held at each position for 3mins to insure an accurate reading.
2. It will be brought down after each 100 ft increment to have the pressure in the jar read and recorded.
3. This will need to be done at least twice, three times weather and time permitting.

Alternative Design #2:

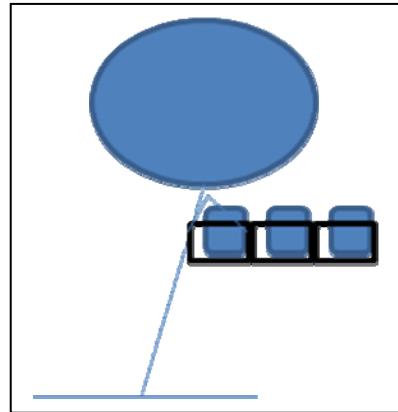
Expectations-

This design has been labeled as a back-up for our team because of the size and amount of material necessary to make it work. While using 3 jars at a time would make comparing data more accurate, we would need 3x as many gauges to measure as well as making the gondola weigh 3x as much.

Specifications-

The second possibility for this project consists of these materials:

- 3 glass jars
- 3 matching lids
- 1 setup on the each lid for the one-way valve
- 3 barometer
- 1 calculator
- 1 LabPro to be moved around between the jars
- 1 gondola (with 3 spaces for a jar rather than one)
- 1 helium filled balloon
- 1 1000ft roll of line



Procedure:

1. The jars will be raised into the atmosphere at 100ft increments of line (eventually up to 1000ft) and will be held at each position for 3mins to insure an accurate reading.
2. It will be brought down after each 100 ft increment to have the pressure in the jar read and recorded.
3. This will need to be done at least once; twice weather and time permitting.

Hypothesis:

Hypothesis A-

As the jar goes up and altitude increases, air pressure decreases.

- ❖ Test #1 (Validation Test): Air will be added to the jar in 5mL increments using a syringe to test if it is leaking. If so, the leak will be fixed and the test repeated.
- ❖ Test #2 (Flight Test): Air pressure will be equalized on the ground and the jar will be sent up to 100ft, held for 3mins, and lowered. If the valve worked properly,

the pressure reading on the ground should be lower than that of the 100ft and beyond readings.

Hypothesis B-

There is an inversion layer and air pressure will increase as altitude increases.

- ❖ Test #1 (Validation Test): Air will be added to the jar in 5mL increments using a syringe to test if it is leaking. If so, the leak will be fixed and the test repeated.
- ❖ Test #2 (Flight Test): Air pressure will be equalized on the ground and the jar will be sent up to 100ft, held for 3mins, and lowered. If the valve worked properly,