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HOBO Experimental Design
BF-D

Purpose of this experiment:
The purpose of our experiment is to measure relative humidity and how it changes with altitude.
Research:
The atmospheric research website describes how humidity condenses to form large clouds that produce thunderstorms. Because clouds form at about 8,000 ft. we will measure relative humidity. Relative humidity is the ratio of water vapor contained in a specific volume of air compared with how much water vapor that amount of air actually can hold. Relative Humidity, therefore, is not actually a measure of the amount of water vapor in the air, but a ratio of the air's water vapor content to its capacity. We got this definition out of the *(refer to #1)*.The amount of water vapor in the air exponentially decreases with altitude. This means the water vapor in any amount of air cannot reach zero, and this shows that air can hold more water vapor as temperature decreases. It is important to realize that relative humidity changes with temperature, pressure and water vapor content. For example, a parcel of air with a capacity for 10g of water vapor which contains 4g of water vapor, would have a relative humidity of 40%. Adding 2g more water vapor (for a total of 6g) would change the humidity to 60%. If that same parcel of air is warmed so that it has a capacity for 20g of water vapor, the relative humidity drops to 30% even though the water vapor content does not change. I got this example from the *(refer to #2)*
As a result of the reduced air pressure at higher altitudes, rising air expands and cools. Dry air cools at a fixed rate of approximately 2-3°C per 300m. Moist air behaves differently as once it starts rising, the water vapor starts to condense. This change of water state releases some heat and reduces the rate of cooling. This came from the *(refer to #3)*
1. Glencoe Earth Science textbook
2. http://www.gorgecreekorchards.com.au/
3. http://www.bbc.co.uk/weather/
Hypothesis A:
The relative humidity increases with altitude.

This would be the most sensible hypothesis because the relative humidity of a parcel of air will increase as the air rises, because the temperature effect outweighs the vapor pressure effect. This happens because as the amount of water vapor that parcel of air can hold decreases while the amount of water vapor in the air stays the same, so therefore the relative humidity increases with altitude.

Test 1: The altitude vs. relative humidity graph will be an increasing graph.

Test 2: The relative humidity monitor at the ground station is the same at the end of the launch as it was at the beginning of the launch.

Test 3: The relative humidity monitor at the ground station has a proportional percent increase as the relative humidity monitor in the air (if test 2 fails, due to an exponential increase of temperature) because the maximum value of humidity depends only on the air temperature and not on pressure or altitude.

Hypothesis B:

Relative humidity is not affected by altitude.

Test 1: Graph spikes (more than the resolution) due to errors in the launch or other unknown factors.

Test 2: Only one launch takes place, and has multiple errors during the launch.

Test 3: Something affected the test and was recorded and noticed in the launch log.

*Any of these results would require more launches/tests.

Proposed Experimental Method:

We plan to measure the relative humidity in the air from 0-1000 ft. We plan on using the following equipment: A vernier RH sensor, DAQ, LabPro, possible GPS, and possible Video Camcorder. It will be important to get a clear, understandable graph of the data, with multiple data sets.

1. We will set up the equipment on the ground

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2. We will start stopwatches, ground station, and gondola equipment at synchronized times
3. Every 200 feet, we will stop for 3 minutes.(the RH sensor takes 60 seconds to detect RH change)
4. Once we reach 1000 ft., we will stop for 6 minutes instead of 3.
5. repeat step 3 on the way down
6. Once we reach the ground, we will stop all stopwatches, ground

station RH sensor, and Gondola equipment at synchronized times.
7. During the launch, we may possibly use the camcorder to record the GPS data, or to just record the view of the ground as the balloon gets higher, just for viewing purposes.
8. We will take notes of all events of the launch in our launch log.
9. We will also take note of any clouds in the sky to see if it affects the data.

Instrument Characteristics:

1. Relative humidity sensor: Small black box. We will remove the box from the actual probe in order to get the best measurements possible. We will attach the sensor to the gondola and have the probe sticking out of the gondola into the open air.
2. LabPro: A rectangular device. This is attached to the relative humidity sensor and this takes in all the data and stores it.

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2. http://www.gorgecreekorchards.com.au/
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