Title:
The Effect of Altitude on Oxygen Concentrations, January 10, 2005, Shannon Grimes.

Objective:
The purpose of this experiment is to find the amount of oxygen at different altitudes in the atmosphere to see if it is possible to burn flammable objects at high altitudes.

Theory:
Oxygen is part of the fire triangle. In the fire triangle, you have to have fuel, an oxidizing agent, and an ignition source. Everything needs to be in proper proportion in order for combustion to take place. Oxygen is the oxidizing agent, sometimes called an electron acceptor. Something else can be used for an oxidizing agent, but it is usually oxygen. If not, it will be fuels mixed with chemical oxidizers, or something like liquid oxygen. Fuel is any substance that can undergo combustion, and normally these substances contain oxygen. An ignition source could be a spark or extreme heat.

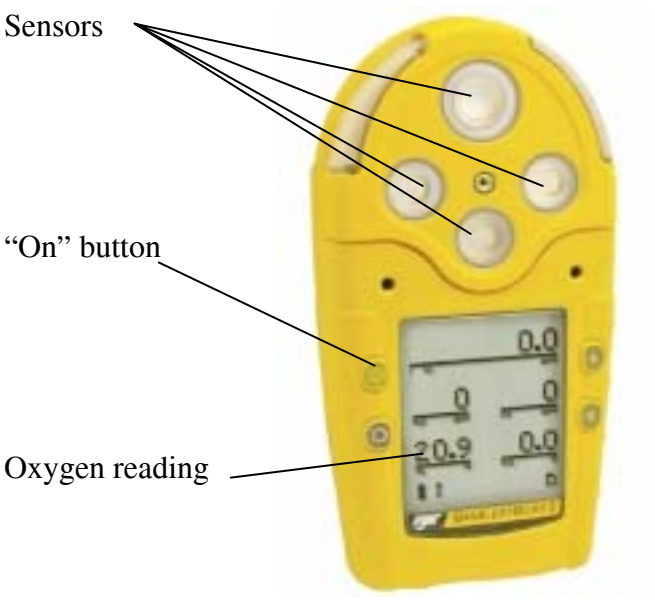
Normal air contains about 21% oxygen, 78% nitrogen, and the other 1% minor gases including ozone. If there is more oxygen percentage, then combustion is more likely to occur. Combustion can occur at normal temperature with 14%-16% oxygen, depending on the fuel.

Temperature also has an affect on combustion. If the temperature is higher, there is less need for oxygen. If the temperature is lower, combustion is less likely to occur. The transfer of heat is also very important to combustion, because without heat and thermal energy, combustion is impossible.

Oxygen molecules stick together in pairs. This is why oxygen is usually written as O_2. Occasionally, oxygen molecules will stick in threes, O_3, and that is ozone. Oxygen is a colorless, odorless, and tasteless gas. During burning, oxygen will combine with a fuel in a chemical reaction. When saying percent O_2, it is really a partial pressure (partial pressure is the amount of pressure a gas would exert if it were alone in a container).

The apparatus measures oxygen percentages, by taking in a volume of air and measuring how much O_2 there is compared to the other elements in the air, such as nitrogen.
By comparing time (also known by the device) and altitude with the oxygen data, the highest altitude possible for burning can be found.

Apparatus:



Procedure:
First, the detector was tested on a few different days. It was carried around in greenhouses and other places to make sure it would function.

Next, the detector and the transmitting part of the tracking system were put in a light Styrofoam box. A hole had been cut into the side of the box so that the sensors of the detector would be outside the box. To prevent the detector from becoming too cold, hand warmers were put into the box and activated, as the detector does not work under extremely cold conditions. The detector was turned on.

The box and a parachute were then attached to a large latex balloon, which was then filled with helium. The wind was a huge problem moving the balloon around, and so it was filled extremely early in the morning. The entire load was then released to travel to heights of at least 100,000 feet. The balloon would then burst and the box would float down slowly, held up by the parachute and carried by the wind.

The balloon and cargo were then tracked to its landing site in vehicles using the receiving part of the tracking system. The box sometimes landed in a field or on private land, so permission to get it was needed. Once found, the box that the detector was in was opened, and the detector was turned off.

The memory card was then taken out of the detector and read using a memory card reader and a computer. The oxygen data was extracted from the memory card, examined, and made into graphs, as well as evaluated according to the hypothesis. The complete process was repeated twice.

Data and Computations: Separate pages

Results:

According to the hypothesis, the oxygen percentage was to go down at a curve with the altitude. The data does go down on a curve, and so the hypothesis was correct. Wind may change some things about the graphs, especially while launching, because the air would be rushing into the sensors of the detector. This problem was basically eliminated while attached to the balloon because it was set sideways, and any air going into it would not be forced.

References:

Alberts, Johnson, Lewis, Raff, Roberts, and Walter. Molecular Biology of the Cell. Fourth ed. 824-825.

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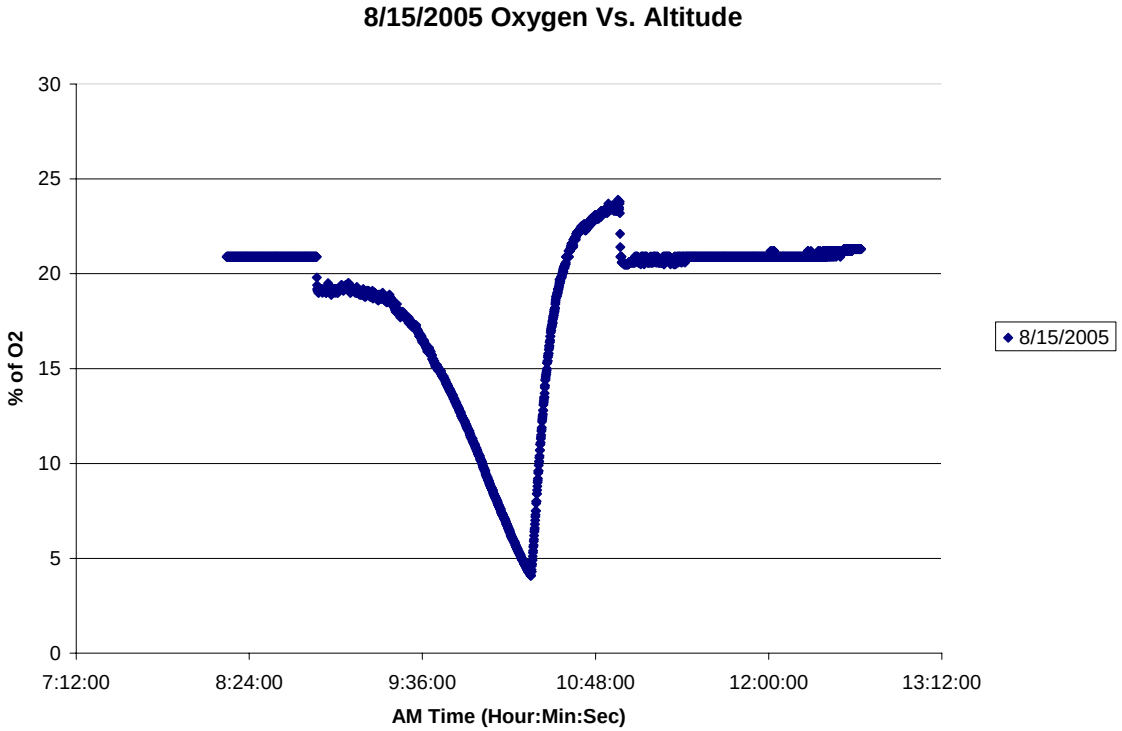
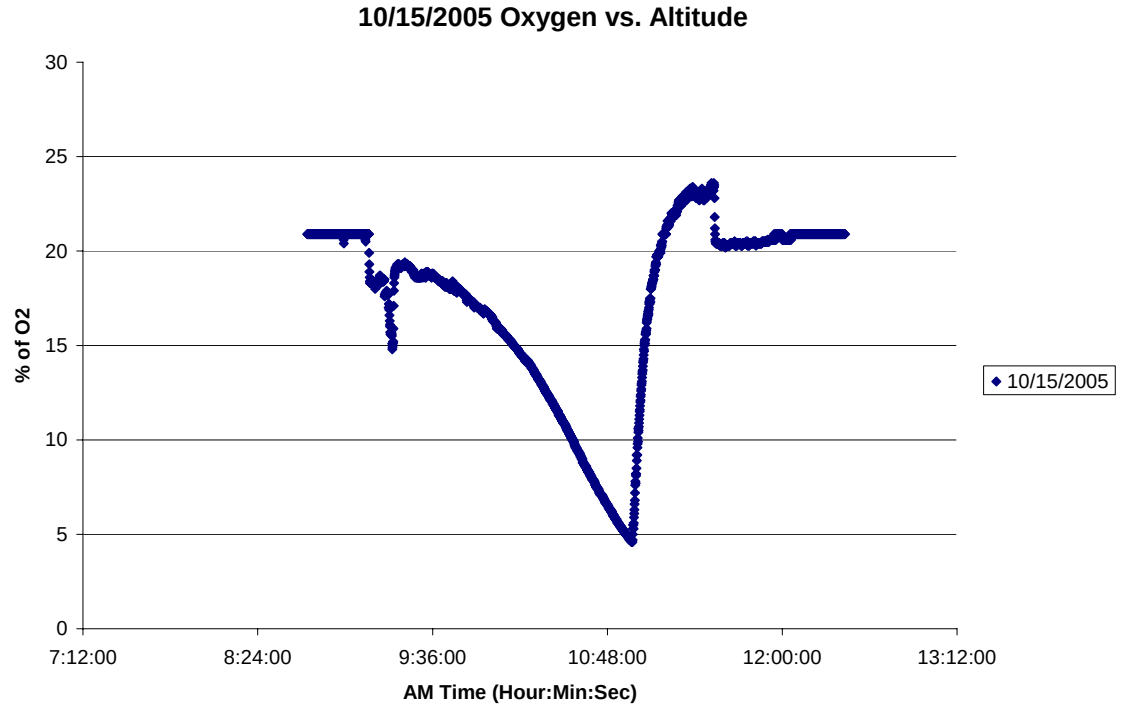

8/15/2005 Oxygen Vs. Altitude
30
25
20
15
10
5
0
% of O2
7:12:00
8:24:00
9:36:00
10:48:00
12:00:00
13:12:00
AM Time (Hour:Min:Sec)
8/15/2005


10/15/2005 Oxygen vs. Altitude
30
25
20
15
10
5
0
% of O2
7:12:00
8:24:00
9:36:00
10:48:00
12:00:00
13:12:00
AM Time (Hour:Min:Sec)
10/15/2005