EFFECT OF ATMOSPHERIC CONDITIONS, SPACE WEATHER, 
AND TIME OF DAY ON COSMIC Ray MUON RATES.

1. ABSTRACT
The Regents Physics-Honors classes at Mendon High School operate an on-site detector that monitors cosmic ray muons. Muon rates are recorded and analyzed to establish connections with other measurable variables. For this experiment, the muon detector was run from September 18, 2003 until February 4, 2004. Muon rates were recorded hourly. During this time, nearly fifty million muon hits were recorded, at an average frequency of approximately 4 Hz. A drum-style barometer was used in recording the atmospheric pressure along with muon rate. The resulting data was analyzed by the three Regents Physics-Honors classes. Mendon data was compared to data from both the National Oceanic and Atmospheric Administration (NOAA) and from the University of Adelaide Cosmic Ray Muon Monitor.

2. BAROMETRIC PRESSURE AND MUON RATE
It was determined that a negative correlation exists between muon rate and barometric pressure.

3. THE HALLOWEEN SOLAR FLARE FORBUSCH DECREASE
A very large and complex region of the sun produced a series of major solar flares between October 23 and November 4, 2003. The X17 magnitude solar flare that occurred on the 28th of October was one of the largest ever recorded and was aimed almost directly at the Earth. This resulted in a dramatic decrease in muon rate on the following day as the ejecta shock wave reached the earth. This reduction was observed at detectors around the world. This decrease is evident at hour 975. Forbush first noted the decrease in the cosmic-ray intensity after a solar flare in 1954.

4. SPACE WEATHER AND COSMIC MUON RATE
Further analysis of Mendon data revealed anticorrelations between surface muon rate and geomagnetic activity (as measured by NOAA’s planetary Kp index) and between muon rate and bulk solar wind speed (also from NOAA).

5. DAILY MUON CYCLE
An approximate 1% daily cyclical variation was observed in both Mendon and Adelaide data. This may be the result of muons of solar origin. Although solar wind particles are generally low in energy, a small percentage may be energetic enough to reach the surface intact.

6. CONCLUSION
The accepted value for the average muon lifetime is 2.2 µsec. Since muons are formed in the upper atmosphere, it is only the highest energy relativistic muons that reach the surface before decaying. It seems clear that increased interaction with atmospheric molecules, solar wind particles, and time-varying magnetic fields can reduce muon energy sufficiently to significantly affect muon rates at the surface. It also seems likely that high energy particles striking earth directly from the sun can add to the surface muon rate.