# CALIFORNIA STATE SCIENCE FAIR
# 2014 PROJECT SUMMARY

**Name(s)**

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**Project Number**

**J1823**

**Project Title**

## Gravity and the Torsion Balance

**Abstract**

**Objectives/Goals**

The objective was to recreate an age-old experiment (Cavendish's gravitational torsion balance) in an original way to show gravitational interaction between two small masses. I asked: How does mass affect gravitational attraction between objects? I hypothesized: If the masses of two objects are increased, then the gravitational attraction between them will increase, and the torsion bar will move a greater distance toward the affecting mass.

**Methods/Materials**

An original gravitational torsion balance was constructed using nylon fiber to suspend a titanium rod with a steel sphere at each end. The system was constructed in a covered trundle bed frame and the windows in the testing room were covered with aluminum foil for maximum stability. Two receptacles were constructed to allow placement of affecting test masses adjacent to the each of the bar's masses but on opposite sides. A laser was reflected off a mirror centered on the torsion bar and onto a ruler to measure bar movement. A programmed webcam recorded the laser's position on the ruler every minute. A control setting with no affecting masses, and four different mass settings (14.52 kg, 7.29 kg, 0.40 kg, and 0.20 kg), were tested.

**Results**

The laser's position on the ruler for two of the four mass settings (14.52 kg, 7.29 kg) averaged 9.4 cm and 3.4 cm away from the control's average in the direction my hypothesis predicted. A third mass setting (0.20 kg) returned data averaging -37.7 cm away from the control, opposite the hypothesized direction. The error margin was +/- 1 mm. A fourth mass setting returned inaccessible data (the laser beam rarely appeared in the webcam's view).

**Conclusions/Discussion**

My hypothesis was supported with data from the greatest two of the four mass settings (14.52 kg and 7.29 kg), but not with data from the lowest mass setting (0.20 kg). A possible explanation for the unpredicted data is that this smallest mass tested was so small, external factors overwhelmed the slight gravitational force. Though I can support my hypothesis with the majority of the data, I cannot conclusively prove or disprove it due to conflicting data. To improve this experiment, a more isolated environment than my house would be used. In the future, using its subtle sensitivity, the torsion balance could measure the Casmir Effect, an attraction between two plates in a vacuum due to decreasing energy between them compared to the surrounding vacuum.

**Summary Statement**

A gravitational torsion balance was constructed to experimentally measure the gravitational attraction between very small masses.

**Help Received**

Mentor (Dr. Philip Lubin) helped with theoretical and mathematical concepts behind the project, Mother helped with gluing and pasting on the display board, Father helped me with some of the drilling and lifting during construction.