



**CALIFORNIA STATE SCIENCE FAIR  
2010 PROJECT SUMMARY**

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<b>Project Title</b> <b>How Is Friction Affected by Properties of the Inclined Surface and the Contact Object?</b>	
<b>Objectives/Goals</b> The objective of this project is to determine the effects on friction by the independent variables: incline material, incline angle, contact area, and contact object mass. I analyzed how each independent variable affected the following dependent variables: force applied to the contact object to produce motion, maximum static friction force, and static friction coefficient. I hypothesized that friction would be reduced by a smoother incline material, a flatter incline, a smaller contact area, and a lesser contact object mass.	
<b>Abstract</b> <b>Methods/Materials</b> With various incline materials, incline angles, contact areas, and contact object masses, I constructed inclines and contact objects. For each configuration of incline material, incline angle, contact area, and contact object mass, I gradually applied force to the contact object until the object started to move. Immediately, I measured the force at this instant using a spring scale. I then calculated the maximum static friction force and static friction coefficient.	
<b>Results</b> After I collected data, I analyzed the effects of incline material, incline angle, contact area, and contact object mass on friction. Furthermore, I statistically analyzed the relationships between the independent variables (incline material, incline angle, contact area, and contact object mass) and the dependent variables (force applied to the contact object, maximum static friction force, and static friction coefficient).	
<b>Conclusions/Discussion</b> The results suggest that friction is affected by incline material, incline angle, and contact object mass, but not by contact area. The validity of my hypotheses was checked by the findings below: (1) smoother incline materials reduce force applied to the contact object, maximum static friction force, and static friction coefficient; (2) a flatter incline results in less force applied to the contact object, greater maximum static friction force, and greater static friction coefficient; (3) no relationship exists between contact area and each of the dependent variables; (4) less contact object mass reduces force applied to the contact object and maximum static friction force; and (5) static friction coefficient is independent of contact object mass.	
<b>Summary Statement</b> My project analyzes how incline material, incline angle, contact area, and contact object mass affect applied force, maximum static friction force, and static friction coefficient.	
<b>Help Received</b> My thanks go to Ms. Agapoff for her scales to measure mass and force, and my parents for assisting in building the setup, and checking data and formulae.	