



CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s) Michael H. Cassel	Project Number J1201
Project Title Can Rocket Simulations Accurately Predict the Flight Characteristics of Model Rockets?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals My objective was to find out if rocket simulations are accurate. My hypothesis was that rocket simulations would be accurate to 20% of the actual measured values.</p> <p>Methods/Materials Material List: 6 Drafts of Rockets; 1 Calculator; 1 Triple Beam Balance Scale; 6 rockets; 2 Estes Altitude Finders; 1 Estes Porta-Pad# II; 1 Electronic Beam Launch controller; 2 Stopwatches; 6 Estes A8-3 Engines.</p> <p>Procedure: 1. Obtain Materials on Material list; 2. Determine The Mass of rocket by weighing it on scale; 3. Determine diameter of rocket using draft; 4. Determine the Area of rocket in Square Meters using the following equation: $A=d*(0.5*(diameter\ in\ inches/12)*.3048)^2= dr^2$; 5. Determine engine thrust and impulse from engine specifications; 6. Compute Burn Time for the engine: impulse/thrust; 7. Determine k: $k= (0.5*1.2\ kg/cubic\ meter*.75*area)$; 8. Compute Gravitational force: $Mass*9.8\ m/sec=M*g$; 9. Calculate velocity at burn out : $velocity=q[1-exp(-x*(impulse/thrust)) / [1+ exp (-x*(impulse/thrust))]$, where $x =2*k*q/Mass$; 10. Calculate altitude at end of boost = $[-Mass/2*k) * ln[Thrust-mass*9.8\ m/sec*velocity^2]/mass*9.8\ meters/sec$; 11. Calculate altitude at end of coast phase: $[Mass/2*k]*ln(Mass*9.8\ meters/sec+k*velocity^2)]/Mass*9.8\ meters\ /sec$; 12. Sum steps 9 and 10 to come up with final altitude; 13. Calculate using the following equations: $qa = sqrt(M*g / k)$, $qb = sqrt(g*k / M)$, $ta = arctan(v / qa) / qb$; 14. Add burn time to ta to come up with time to apogee; 15. Divide altitude by time to apogee to come up with speed in feet per second; 16. Convert feet per second into MPH by multiplying speed in feet per second by .6818; 17. Launch Rocket and measure altitude and speed with altitude finder and stopwatch; 18. Repeat for every rocket used.</p> <p>Results The expected values came within 20% of the actual values.</p> <p>Conclusions/Discussion Rocket Simulations CAN Predict the flight characteristics of model rockets.</p>	
Summary Statement This project is about determining the accuracy of mathematical simulations using model rockets.	
Help Received Mom and Dad helped build board, Teacher helped correct papers.	