



# CALIFORNIA STATE SCIENCE FAIR 2016 PROJECT SUMMARY

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<b>Project Title</b> Changing Angular Momentum in Midair	
<b>Abstract</b> <b>Objectives/Goals</b> The goal of this project is to determine if the rotation of a mass can change the angular momentum of a car in mid-air, causing it to land on four wheels. This involved multiple trials in which the car would drive off a platform rotating as it fell. Counter rotating masses were used to reorient the car. <b>Methods/Materials</b> The hardware I used was an RC car, metal tail with servo, tables, camera, Plexiglas, Arduino, Oscilloscope. I used these materials to build a car and attach a tail. I wrote software to control the speed of the car and the rotation of the mass (tail). <b>Results</b> I did a control and an experiment for each of two mechanical configurations. Each control and experiment was tested three times. The car drove off the platform, fell and I measured its clockwise rotation frame-by-frame in a video recording. For each control, the car drove off the platform without counter rotating the mass. The control trials of the tail-less robot hit the ground at 58 degrees +/- 10 degrees. The experiment trials of the tail-less robot used the rotation the wheels in midair to cause a change in the pitch. The car left the platform, rotated and then reoriented itself, landing at 20 degrees +/- 10 degrees. The control trial of the tailed robot had a non-active tail throughout the fall. The car left the platform and hit the ground at 86 degrees +/- 10 degrees. The tailed experiment trials rotated the tail in midair and caused a change in the pitch. The car left the platform, rotated and then reoriented itself, landing at 45 degrees +/- 10 degrees. <b>Conclusions/Discussion</b> In both experiments the pitch of the car was changed by the rotation of a mass. I was surprised by the fact that accelerating in midair changed the pitch of the car so much. I had thought that rotating the tail would cause a greater pitch change than it did. The reason that this happened was because the torque that can be applied by the spinning wheel is greater than the torque applied by the rotation of the tail. The wheel can apply more torque than the tail because it is rotating for the entire period of time that the car is in midair. The tail could only rotate for .5 seconds. There are two main factors that make the angular momentum of an object. The factors are the speed an object is going and the moment of inertia of the object.	
<b>Summary Statement</b> My project is about designing a car that will rotate in midair so it can safely land and continue driving.	
<b>Help Received</b> Thomas Libby from UC Berkeley	