



**CALIFORNIA STATE SCIENCE FAIR  
2005 PROJECT SUMMARY**

<b>Name(s)</b> <b>Christine Dempster; Heather Kroll; Elizabeth Leire</b>	<b>Project Number</b> <b>S0104</b>
<b>Project Title</b> <b>It's a Drag</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> By exploring the characteristics of the different materials that may compose a ship's hull, this experiment seeks to find that material which creates the least amount of friction with water. By decreasing this friction or drag, it is possible in the long run to increase boat speed and reduce energy cost. The more efficient the material of the hull is, the more cost effective the vessel.</p> <p><b>Methods/Materials</b> The first step in the process was to build the frame of the stand, which would hold the test pipes of each material. This stand included a socket to place each test strip, legs that could angle the ramp to exactly 30 degrees, and a reservoir overhead to accurately and uniformly drop the water on each bar of material for every test. Water would then be let out of the reservoir, ignite the start clock, travel down the ramp, and set off the stop clock to reveal a length of time unique to each material and test. This process was repeated 12 times for each of the 8 material (polyurethane-coated aluminum, naval bronze, aluminum, copper, plastic, steel, scratched plastic and welded steel). The result was a collection of data that, when averaged for each pipe material, would provide a comparison chart of times identifying which materials created the least amounts of friction with the water and which were the most consistent</p> <p><b>Results</b> Averages of times for all materials seconds: Aluminum-Polyurethane- 4. 598; Naval Bronze-2.266; Aluminum-3.225; Copper-2.239; PVC-2.467; Steel-2.536; PVC-keyed-3.594; Welded steel-3.655.</p> <p>Standard Deviation of all Materials: Aluminum-Polyurethane-.991; Naval Bronze-.369; Aluminum-.590; Copper-.358; PVC-.287; Steel-.430; PVC-Keyed-1.461; Welded Steel-.709.</p> <p><b>Conclusions/Discussion</b> Copper proved to create the least amount of skin friction with the water because of its smooth and uniform surface. In addition, we observed that the test results of some materials were less consistent than others. The range of results for scratched PVC was the greatest while that of normal PVC was the smallest (most consistent). This revealed the great importance of not only the selection of material, but also each material's composition.</p>	
<b>Summary Statement</b> Our project is about friction and its relationship with the surface material and the material's composition on the hull of a ship	
<b>Help Received</b> Friend helped cut the materials and orded the pipes, another friend helped wire the clocks	