



**CALIFORNIA STATE SCIENCE FAIR  
2017 PROJECT SUMMARY**

<b>Name(s)</b> <b>Theodore F. Pierce</b>	<b>Project Number</b> <b>J1422</b>
<b>Project Title</b> <b>Carbon Composite or Steel: Which Resists Strain Better?</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Due to their light weight and high strength attributes, carbon composite materials are being used more frequently in airplanes, cars, and sports equipment. However, I want to explore whether they are as resistant to strain (plastic deformation) as traditional metallic materials such as steel.</p> <p><b>Methods/Materials</b> 3 carbon composite golf club shafts (regular stiffness rating), 3 steel golf club shafts (regular stiffness rating), 2 19 liter buckets, 1 #S# hook, 1 hose clamp, Drill, 15.875 mm drill bit, 1 piece of straight wood, Metric ruler, Metric tape measure, Scale, Safety glasses, Framed doorway, Clamps, Paper clips, Pen, 1 metric measuring cup, Tap water for weight</p> <p><b>Results</b> Carbon composite shafts perform much better than the steel shafts. While all three steel shafts suffered plastic deformation and eventually failed, there was no plastic deformation in the carbon composite ones, and they did not fail. I was not able to permanently bend or break the carbon composite shafts even with almost 19 kg of water in the bucket.</p> <p><b>Conclusions/Discussion</b> Based on my research, data, and calculated results, I believe that carbon composite is better resistant to strain when compared to traditional metals like steel. My testing definitely supported this hypothesis. The steel shafts deformed at an average weight of 8,842 grams. The average deflection in which the steel shafts deformed was 23.9 centimeters. The average weight that the steel shafts fractured at was 13,776 grams with a deflection of 34.3 centimeters. The carbon composite shafts never actually deformed or fractured, clearly supporting my hypothesis.</p>	
<b>Summary Statement</b> I showed that carbon composites resist plastic deformation far better than steel.	
<b>Help Received</b> Dr. George Youssef, Professor of Mechanical Engineering at San Diego State University helped me develop my procedures and project. Mrs. Reed, my Science teacher helped me organize my project.	