



**CALIFORNIA STATE SCIENCE FAIR  
2008 PROJECT SUMMARY**

<b>Name(s)</b> <b>Bradley E. Perek</b>	<b>Project Number</b> <b>S0225</b>
<b>Project Title</b> <b>Ballistics of Materials for Armor Applications</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> This project, Ballistics of Materials for Armor Applications, was initiated to test and improve the ballistic performance of certain specialty and everyday materials.</p> <p><b>Methods/Materials</b> The materials include: Polyetheretherkeytone (PEEK), Carbon Fiber Pre-preg, Vitem 7201, Kevlar, Lexan, and fiberglass cloth. These materials, with the exception of Kevlar and fiberglass cloth, were cut into 4-by-6 inch sections, mounted on a cardboard sheet, and tested using a Ruger 10/22 .22-caliber (5.6) rifle. Of the aforementioned materials, the fiberglass cloth and Kevlar were previously known to fail in ballistic testing when used independently. After the initial series of tests on the materials, the samples were examined and certain measurements and characteristics were recorded, including entry hole diameter, exit hole diameter, spall, and key hole effects. With the exception of entry/exit hole diameters, the effects were determined by examining the witness plate, a piece of cardboard mounted behind the sample during testing to show the presence of penetration, spalling, or key-holing. Using available reference material, prior knowledge, and outside opinions--namely the opinions of a police sergeant and a materials engineer--, two final samples of armor were created to test the concepts determined from the initial test results. The foci of the final test included the use of a hard frontal plate to dissipate energy, the use of carbon fiber and other materials to provide stiffness and rigidity, and the use of layers to capture any fragments or shrapnel. The first sample used PEEK, Lexan, fiberglass, carbon fiber, Vitem 7201, and Kevlar in that specific order. The second sample used the same order of materials with the exception of Vitem 7201 as the frontal material instead of PEEK. The second sample also differed in its composition of 4-ply carbon fiber pre-preg versus the 2-ply carbon fiber of the first sample. The two samples were then tested and examined in the same manner as the previous test samples.</p> <p><b>Results</b> Both samples were successful in preventing complete penetration of the projectile. The partial penetration that occurred was expected based on the prior information gained from references and tests.</p> <p><b>Conclusions/Discussion</b> The hypothesis was correct in that the PEEK plate stopped the projectile, but was incorrect because the second sample also stopped the projectile.</p>	
<b>Summary Statement</b> This project was designed to test the ballistic ability of different materials when shot with a firearm.	
<b>Help Received</b> Folsom Police Department Sgt. John Landahl conducted the ballistic testing. John Perek provided material samples.	