



**CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY**

Name(s) Zachary C. McGaugh	Project Number J2116
Project Title What Material Is Best for Lining the Inside of a Surf Bootie to Prevent Foot Penetration from a Stingray Barb?	
Objectives/Goals The goal of the project was to analyze 10 puncture resistant fabrics to determine which material would best resist penetration from a Round Stingray barb strike when lined in a neoprene surf bootie.	
Abstract Methods/Materials The goal of the project was to analyze 10 puncture resistant fabrics to determine which material would best resist penetration from a Round Stingray barb strike when lined in a neoprene surf bootie. Three control tests were conducted in the process of the experiment. A stingray barb was attached to a pendulum that swung into a force probe at different angles for test #1. Data obtained showed an increasing max force and impulse generated by the striking barb at various angles of release. The second test involved measuring the max force and impulse generated from a real Round Stingray [Urobatis halleri] by provoking the ray to strike a force probe. These stingray data obtained correlated to a pendulum release angle of 25 degrees. The third test involved releasing a stingray barb via pendulum into simply 2mm neoprene to simulate a strike into a typical surf bootie. Depth of penetration was measured in millimeters at various angles of release. The final and most important test was to release the stingray barb into the 10 puncture resistant fabrics. Each fabric was glued to a piece of neoprene then clamped onto a plastic box filled with ballistics gel and screwed onto the pendulum base. The barb, attached to the pendulum arm, was then released at 20, 25, and 30 degrees- angles corresponding to the upper range of maximum impulse data from the stingray strikes.	
Results The data collected revealed that all fabrics were found to reduce penetration at all angles, compared to neoprene. However, the most resistant fabric, Rhinoguard, showed no penetration at both 20° and 25°, and at only 0.5mm penetration at 30°.	
Conclusions/Discussion It was concluded that the registered material "RhinoGuard" made by Tilsatec# would be best for lining a surf bootie. The information received potentially benefits surfers and beach goers.	
Summary Statement Various materials were tested against a swinging stingray barb attached to a pendulum that released at angles corresponding to a stingray's impulse.	
Help Received Handled Round Stingrays with Grad Students at Cal State Long Beach, Dr. Chris Lowe at CSULB provided information for the project, Teachers Dan Lavine and Mena Abdo at SRHS provided physics help, Metalshop teacher at KHS helped with welding the pendulum, Father helped collect data and	