# Biomimicry of Woodpecker Anatomy to Improve Helmet Design in Prevention of Chronic Traumatic Encephalopathy

Oei, John (School: East Catholic High School)

Chronic traumatic encephalopathy (CTE) is an incurable neurodegenerative disease affecting people who have had repetitive concussive events. In a 2017 study, 99% of former NFL players observed had CTE. Over 3.8 million concussions are recorded per year in the United States, with 2.5 million of them being student athletes. A woodpecker has the ability to withstand the force of approximately 1,000 gs when pecking wood without substantial brain damage. A woodpecker does so 20 times per second, 12000 times per day. In comparison, a football player experiences a typical concussion at 95 g's. The tri-layer padding system designed was inspired by the woodpecker's unique anatomy. This included a combination of sorbothane, a shock absorbing material that converts energy to heat, to mimic the ability of a woodpecker's brain to convert energy to heat; Neoprene to mimic the spongy layer of the woodpecker's skull; and viscoelastic memory foam, which will keep the helmet close to the skull, to mimic the small space between the woodpecker's brain and the spongy . The average percent energy dissipated by the tri-layer protective system is 70%, compared to an average of 16% by the padding currently used. Thereby, a hit of 95 g's (3,040 lbf-ft) will be reduced to 28 g's (900 lbf-ft). This is below the average hit by a football player of 49 g's (1600 lbf-ft). The tri-layer protective system significantly absorbs the amount of energy from a collision as compared to the current protective system used by standard football helmet