

1077-O1-2696      **Aaron D Wangberg\*** (awangberg@winona.edu). *Raising Calculus to the Surface.*

Many of the beautiful ideas in multivariable calculus are simple extensions of single variable calculus concepts. Too often, these geometric ideas are lost behind a myriad of parametrizations, coordinate-dependent formulas, and the need to use computer visualization technology in the course. In this talk, I'll share how groups of students used short 15-minute hands-on activities with physical wooden surfaces, cut with a CNC Machining Center, to discover the fundamental concepts in Multivariable Calculus. In addition to sharing activities involving the geometry of gradient vectors, directional derivatives, and the method of Lagrange multipliers, I'll also report on some surprising misconceptions that prevented students from raising their single variable calculus understandings to this multivariable setting. (Received September 22, 2011)