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Sweet Shots, Sharp Concepts: Teaching Piecewise Derivatives with a Marshmallow Gun

In first-semester single-variable calculus, students often find computing the derivative to be quite challenging. This is especially true when working with piecewise functions. In this workshop, we will explore how one could use a marshmallow gun as a manipulative to leverage students intuition to gain a better understanding for: why we use a piece-wise function in real world situations; the relationship between average velocity and average rate of change; why the velocity function is a derivative; and how to compute the velocity/determine if it is defined, when the function changes definition with the piece-wise function. In the worksheet we will explore, students are challenged to reanalyse the function, thinking about the acceleration of the marshmallow, when it is defined and why determine if the defined accelerations make sense physically. Finally, we discuss how this manipulative could be used again, later within the same course. As students are learning about initial value problems, students could derive the piece-wise function that defines the position of the marshmallow for themselves by proving force is equal to mass times acceleration and assuming: the marshmallow had no initial velocity; a constant force is being applied while within the marshmallow gun; no force is being applied (horizontally) while the marshmallow travels through the air; and the marshmallow sticks to the wall it hits. We provide the .tex file for both worksheets as well as a parts list for the marshmallow gun.