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Dimensional analysis scaling of impact craters in unconsolidated granular materials DAVID R. DOWLING, Mechanical Engineering, University of Michigan, Ann Arbor MI 48109-2133, THOMAS R. DOWLING, Skyline High School — Dimensional analysis is a general technique for determining how the independent parameters that describe physical phenomena must be arranged to produce dimensionally self-consistent results. This presentation describes how dimensional analysis may be successfully applied to the formation of impact craters produced by dropping spherical objects into a bed of unconsolidated granular material. The experiment is simple and safe, and laboratory results for different impact energies (0.001 to 1.6 J), seven different spheres (masses from 4 to 64 grams, diameters from 1.0 to 4.3 cm), and two different dry granular materials (granulated sugar, and playground sand) may be collapsed to a single power-law using parametric scaling determined from dimensional analysis. Thus, impact crater formation may provide a useful validation test for simulations of granular material dynamics. Interestingly, the scaling law shows that the impacting sphere's diameter is not a parameter. And, the resulting power law can be extrapolated, with some success, over more than 16 orders of magnitude to produce an independent estimate of the impact energy that formed the 1.2-km-diameter Barringer Meteor Crater in northern Arizona.

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