



**CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY**

Name(s) Alec D. Simpson	Project Number J0620
Project Title Avalanches in a Sandpile: How Does Granularity Affect the Angle of Repose?	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals This project aims to find how granularity affects the angle of repose based on the size and shape (regularity or irregularity) of the grains in the granular material.</p> <p>Methods/Materials Sandpiles were constructed using custom built mechanisms and surfaces that allowed the angle of repose to be measured. Several types of granular materials were used in the experiments: play sand, reptile sand, iodized table salt, and coarse sea salt. An eight step process was used. Step 1 -- Construct and assemble mechanisms and surfaces. Step 2 -- Insert granular materials to be tested into the testing chambers. Step 3 -- Using release mechanism, release granular materials into testing chambers under the influence of gravity. Step 4 -- Using a protractor, measure the slope angles for each granular material. Step 5 -- Using a protractor, measure the angle that the granular material can be "tilted" before significant avalanches occur. Step 6 -- Using the protractor, measure the angle of the granular material after material collapse. Step 7 -- Invert testing chambers to return granular materials in the testing chambers to initial state. Step 8 -- Iterate Steps 3-7 an additional nine times for a total of ten trial runs (N-10) to demonstrate consistent and repeatable results.</p> <p>Results The experimental trials revealed that there is a systematic relationship between the size and irregularity of the granular materials with regard to the angle of repose. The larger (in terms of volume) and more irregular (in terms of non-uniform surface area) the granular material grains the higher the angle of repose. The arithmetic means (simple averages) for the angle of repose of the granular materials were: play sand (coarse sand) 32 degrees, reptile sand (fine sand) 29 degrees, iodized table salt 32 degrees, coarse sea salt 38 degrees.</p> <p>Conclusions/Discussion The experimental results of this study support the hypothesis that the larger and more irregular the granular material grains, the higher the angle of repose. This study was limited to small grain structures. A future study could examine larger grain structures. For example, various types of construction "sands" and "aggregates" used in the extractive and construction industries could be examined on a "large sandpile" scale.</p>	
Summary Statement Granular materials form "sandpiles" having well-defined angles of repose that are systematically related to grain size (volume) and irregularity (non-uniform surface area).	
Help Received My sisters helped me understand the scientific method. My parents helped me construct the test chambers. Dr. John C. Howe helped me understand the principles and methods of material science.	