



**CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY**

Name(s) Dominique Bhatti	Project Number J1702
Project Title Studying the Dynamics of Granular Materials	
<p style="text-align: center;">Abstract</p> <p>Objectives The objective of this project is to study the dynamic properties of granular solids by measuring angle of repose, packing density, and size separation.</p> <p>Methods 3 different granular materials, flat board, tall cylindrical container, silicone mat, marbles, ruler, measuring cup, timer, erasable marker. Angle of Repose: place a pile of granular material on the mat on a board. Elevate until it starts to avalanche. Record height and calculate the angle of repose. Vibrating Size Separation: Combine 2 materials together in 1:1, 2:1 and 1:2 ratios and pour into the cylindrical container. Vibrate the container until the 2 materials separate and record elapsed time. Packing Density: Pour 1 cup of material into tall cylinder. Use erasable marker to mark its height. Vibrate at consistent pace. At 30 second intervals, examine how much the material compresses below the mark.</p> <p>Results For the angle of repose test, 5 trials were run for each material. Salt had the lowest angle at 15 degrees while the others measured about 25 degrees. For the Vibration Size Separation Part A, equal parts of materials were tested. All combinations had similar separation times of about 20 sec. For Part B, ratios of 2:1 and 1:2 were tested. 1:2(small:large) was 10-12 sec faster than 2:1. For Part C, all materials were tested with marbles. The marbles always surfaced, even in lighter materials. For the packing density test, the settling process was measured. The rice compressed the most, increasing density 20 percent.</p> <p>Conclusions 5 different experiments were used to explore the dynamic properties of granular materials: vibrating size separation(3 parts), angle of repose and packing density. In the angle of repose test, salt had the finest grains that slid off themselves easier, thus having a lowest angle of repose. Vibration test Part A showed that no matter what 2 materials were tested, they separated in the same amount of time. Vibration Part B found that when there is less of the smaller material, the other material rises faster. Vibration Part C surprisingly revealed that size separation is independent of weight and buoyancy. The packing density test showed that rice increased in density the most because of its large, initial air pockets. These properties are applicable to mining, agriculture, and astrophysics.</p>	
Summary Statement After conducting 5 different experiments, I found that granular solids have many surprising and dynamic properties.	
Help Received None. I designed and performed the experiments myself.	