CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
Kathleen V. Abadie

Project Number
J0601

Project Title
Ready, Set, Flow! Calculated Permeability of Coarse Sand, Fine Sand, and Soil

Abstract

Objectives/Goals
My project has two objectives. The first is to calculate the permeabilities of coarse sand, fine sand, and soil. The second is to find out how the calculated permeability of each sand or soil differs with each different liquid run through it: water, soybean oil, and isopropyl alcohol.

Methods/Materials
Cut nine, 20 cm lengths of plastic tubing and attach a piece of cloth to one end of each tube. Fill three tubes with coarse sand, three tubes with fine sand, and three tubes with soil. Run water through one coarse-sand tube, soybean oil through another coarse-sand tube, and isopropyl alcohol through the last coarse-sand tube. Do the same for fine sand and for soil. Measure the time it takes for a known volume of each liquid to run through each sample, calculate the flow rates for each liquid flowing through each sample, and calculate the sample permeabilities.

Results
The coarse sand had the greatest calculated permeability for all liquids, the fine sand calculated permeability was intermediate for all liquids, and the soil had the lowest calculated permeability. For both sand samples, water gave the highest calculated permeability, soybean oil gave the next highest, and isopropyl alcohol gave the lowest. For soil, I calculated the highest permeability with soybean oil, the next highest with isopropyl alcohol, and the lowest with water.

Conclusions/Discussion
My hypothesis that coarse sand would have the greatest calculated permeability, fine sand would have the next greatest, and soil would be the least permeable was correct. This is because the spaces between the grains in the coarse sand are larger than in the fine sand and the soil. My hypothesis that I would calculate the highest permeabilities for each material with soybean oil, the next highest with isopropyl alcohol, and the lowest permeabilies with water was correct for soil but wrong for both sands. Water gave the highest permeability for both sands, not the lowest. A possible reason why I calculated the lowest soil permeability with water could be because the clay in the soil absorbed the water, expanded, and plugged up the pore spaces, thus, decreasing the soil permeability with water.

Summary Statement
I calculated the permeabilities of coarse sand, fine sand, and soil based on measuring the flow rates of water, soybean oil, and isopropyl alcohol through each of the three materials.

Help Received
Father helped think of experiment and helped with Microsoft Excel; various family members assisted in parts of my experiment that required two people (i.e. worked stopwatch); mother helped paste papers onto backboard.