CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
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Project Number
S0606

Project Title
Effects of Porosity and Permeability on Diffusion

Abstract

Objectives/Goals
The goal of my project is to determine the relationship between porosity, permeability and diffusion in a model aquifer.

Methods/Materials
Five different soils (clay, gravel, potting soil, sand, and silt) were tested to find their porosity, permeability, and diffusion. I repeated the experiments five times to establish validity. Before performing any tests I baked all the moisture out of the soils. To determine the porosity, I filled each beaker to the 350 ml mark with soil and then poured water into the beaker until the water just reached the top of the soil. I then recorded the amount of water used and divided it by 350 to calculate the pore space. To determine the permeability, I filled a five-gallon bucket with soil and poured 2 liters of water into the bucket and recorded the amount of time it took to permeate through the soil. To determine diffusion, I filled a beaker to the 350 ml mark with soil and then poured one teaspoon (5 ml) of food coloring and water mixture into the soil and measured the spread of food coloring in milliliters.

Results
Soils arranged from most porous to least porous are potting soil, gravel, sand, silt, and clay. Dry soils arranged from fastest to slowest permeabilities are gravel, potting soil, sand, silt, and clay. Wet soils arranged from fastest to slowest permeabilities are gravel, potting soil, sand, silt, and clay. Diffusion arranged from greatest to least is gravel, potting soil, silt, sand, and clay.

Conclusions/Discussion
My hypothesis is partly correct in that gravel did have one of the highest permeabilities, porosities, and greatest rates of diffusion. I was also correct when I hypothesized that clay would not be very permeable and I was correct in that it would have a low porosity. When I hypothesized that sand would have very little pore space and one of the greatest permeabilities, I was absolutely incorrect. Sand has approximately the third greatest porosity and the third lowest permeability. When I hypothesized that silt would have little pore space and a low permeability I was correct. I was also correct in that potting soil would be porous and have a high permeability. Based on my results, I conclude that the porosity and the permeability directly affect the rate of diffusion in a soil. For the most part, the soils tested that had large amounts of pore spore and those that permeated quickly, such as gravel, also had some of the greatest diffusion rates.

Summary Statement
My project demonstrates the effect of porosity and permeability on diffusion in a model aquifer.

Help Received
Mr. Rob Kirkpatrick and Mr. Tim Hanna advised me on project; Mother helped edit my work; Father helped out with testing and took pictures while I was conducting my experiment.