CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
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Project Number
S0610

Project Title
Correlation of Soil Nutrient Release and Pollutant Absorption at Geologic Equilibrium

Abstract

Objectives/Goals
I wanted to find a measurable soil characteristic to compare the relative ability of soil types to produce nutrients and remove pollutants over eons.

Methods/Materials
I set up a test column apparatus in the shower. Each weighed soil was placed in a glass column. Deionized (DI) water was run through each soil column to leach out ionic nutrients. To assess pollutant reduction, a common liquid with a lot of compounds, diet cola, was run through fresh soil columns. I monitored leachate conductivity for both DI and diet cola eluents in a small, continuously overflowing beaker under the column until each run reached a steady conductivity plateau. It took from several hours to several days for each soil leachate to reach the equilibrium plateau. Potassium chloride standards were used to calibrate my conductivity meter.

Results
There were short term effects for both eluents. When DI elution started, conductivity rapidly increased as the more soluble salts, nutrients, and minerals found in different soil samples dissolved. It then gradually decreased before reaching a steady conductivity reading. In most diet cola runs, conductivity dropped first before rising to a conductivity plateau representing the ion production rate expected at long term geologic conditions.

Conclusions/Discussion
At equilibrium many soil types were similar. There was little difference between sand, cat litter, or costly potting soils. It appears that the added fertilizer in potting soil will wash away with less than an hour's rainstorm, leaving only inert particles behind that do little to generate or absorb ions. On the other hand, highly complex garden soil or mulch provides continuing nutrients and also continues to absorb polluting ions. I found that comparing measured conductivity, directly, was not adequate because it did not account for the amount of soil or flow rate. I tried various ways to normalize conductivity data, such as dividing by the respective mass and eluent flow rate. I finally considered the ability of the soil to allow a liquid to permeate. After taking leachate conductivity, mass, flow rate, and permeability into account, I calculated a characteristic value for each soil. I found this characteristic correlated both the observed ion production and pollutant absorption (reduction in diet cola conductivity) of the soils. I am intrigued that the same characteristic allows comparison of seemingly opposite processes.

Summary Statement
I developed a method to correlate the long term ability of different soils both to provide nutrients and to absorb pollutants.

Help Received
Metropolitan Water District donated conductivity standards and deionized water. Mom helped arrange board. Dad critically reviewed my project and checked my math.