New Mexico Science and Engineering Fair 2005
New Mexico Bureau of Geology and Mineral Resources
"Excellence in Geoscience" Award

On April 8 and 9 more than 500 middle and high school students from across the state participated in New Mexico's 53rd annual Science and Engineering Fair on the campus of New Mexico Tech. New Mexico Bureau of Geology and Mineral Resources is proud to be among the more than 50 organizations, companies, and individuals sponsoring special awards. The bureau's "Excellence in Geoscience" Award is supported by the employees of the bureau and is presented to a student in the junior division (grades 6 through 9) and a student in the senior division (grades 9 through 12; ninth graders may choose the division in which they wish to compete). *New Mexico Geology* is pleased to acknowledge the junior and senior winners of the bureau's Excellence in Geoscience Award, to print the abstracts of their research, and to list their other special awards and their placement within the junior and senior divisions of the 13 science fair categories.

This year's winners of the bureau's Excellence in Geoscience Award are Nicholas Q. Tritz in the junior division and Abigail J. Gray in the senior division. They will receive cash awards of $100.00 (senior division) and $75.00 (junior division) and 1-year subscriptions to *New Mexico Geology* and *Lite Geology*. The bureau's junior division award winner, Nicholas Tritz, placed first in his division in the category Earth and Space Science. He was also awarded $100.00 from the New Mexico Geological Society and the $150.00 second-place honors from the Rio Grande Chapter of the Health Physics Society. Nicholas received a pin, certificate, and invitation to enter the Discovery Channel's Young Scientist Challenge, which is awarded to junior high students for good science and the ability to communicate about science.

The bureau's senior division award winner, Abigail Gray, placed second in the senior division in the category Environmental Science. She also received a certificate and an invitation to enter the Stockholm Junior Water Prize competition, which is awarded by the Water Environment Federation to an outstanding water-related science project. Abigail received first place and a $250.00 savings bond from the Rocky Mountain Water Environment Association, a $150.00 savings bond from the New Mexico Groundwater Association, a $50.00 savings bond and certificate from the U.S. Army, and a certificate from the Association for Women Geoscientists. Abigail also was awarded the third place plaque and certificate in the senior division from the Albuquerque Chapter of the American Statistical Association for the best use of statistics.

All photographs by Maureen Wilks.

Infinitely long? Is the Rio Grande a true fractal?

by *Nicholas Q. Tritz*
Jefferson Middle School,
Albuquerque
Winner, Junior Division

The objective behind this experiment was to see whether or not the Rio Grande was a true fractal. The hypothesis was that the river was a true natural fractal. To be a fractal the river must have infinite length, infinite precision, and no derivative. There were multiple degrees of precision of measurement in order to see whether or not there was an increase in length going from less precision to more.

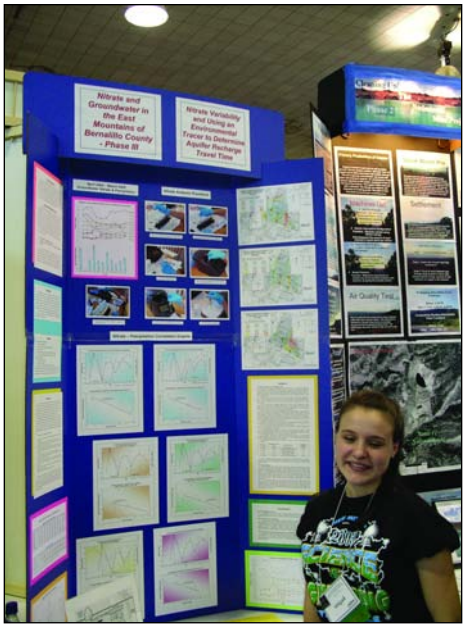
To prove the hypothesis, the map length of the Rio Grande was measured using four different units of measurement from two centimeters to one millimeter. The data show that there is an increase of length from one precision to the next while measuring the map length of the Rio Grande. Infinite length for the river was supported by showing that you can look at finer and finer resolutions of measurement and keep getting map lengths that are longer. Infinite length can not be shown in any other way than this.

The data were plotted on a graph (log/log diagram), and the compass dimension was taken from the line of the Rio Grande, which also proves the Rio Grande is a true natural fractal, by having a compass dimension between one and two like all fractals. The results supported the hypothesis by showing there is infinite length, infinite detail, and no smoothness or derivative in the Rio Grande. Therefore, the hypothesis is supported and is correct.

Nitrate and ground water in the East Mountains of Bernalillo County—Phase III, Nitrate variability and using an environmental tracer to determine aquifer recharge travel time

by *Abigail J. Gray*
Manzano High School, Tijeras
Winner, Senior Division

Septic tanks in the Tablazon neighborhood of the East Mountain area of Bernalillo County have caused nitrate contamination of the ground water. Our previous studies have demonstrated a correlation between nitrate levels and frequency of septic tank pumping. Analysis of nitrate levels in ground water during Phases I and II showed that average nitrate concentrations in the Tablazon neighborhood varied from year to year by the same percentage as the well with the highest nitrate levels. This observation led to the hypothesis that increased precipitation amounts may cause dilution of nitrate concentrations due to ground water recharge, whereas drier conditions may allow nitrate concentrations to build up to higher levels. Also, the timing of changes in precipitation and changes in nitrate levels could be used to estimate the travel time for aquifer recharge.



This study attempted to quantify how much nitrate in the ground water varies seasonally over a year's time and to evaluate the amount of time it takes for precipitation to recharge ground water in the Tablazon area by comparing changes in nitrate to local precipitation. Water samples were collected from 10 wells in the neighborhood on a monthly basis and analyzed for nitrate as nitrogen. Information on septic tank pumping and well depths was collected to account for those possible influences. Precipitation was measured with a rain gauge, and accumulated snow depths were measured and converted to water equivalent amounts assuming an average snow density of 9.5%.

Time series graphs comparing nitrate levels to precipitation showed that variations in nitrate were more significant at some locations than others. The well with the highest nitrate varied by about 8 mg/L. Nitrate variations in the wells that showed the largest changes correlated with monthly precipitation amounts measured from one to three month before sampling events, indicating a relatively rapid ground water recharge time of one to three months for these sites. Assuming an average well depth of 350 feet resulted in a computed seepage velocity of 3.9 to 11.7 feet per day for aquifer recharge.