New Mexico Science and Engineering Fair 2003
New Mexico Bureau of Geology and Mineral Resources
Excellence in Geoscience Award

New Mexico Geology congratulates the students from across the state who participated in the 51st annual New Mexico Science and Engineering Fair held April 11–12 at New Mexico Tech. Nearly 500 students traveled to Socorro to present their original research and to compete for hundreds of awards. Employees of the New Mexico Bureau of Geology and Mineral Resources sponsored their 4th annual "Excellence in Geoscience" Award. To evaluate all the geoscience-related exhibits, judges must consider junior- and senior-division entries in both the Earth and Space Science and Environmental Science categories and occasionally the Engineering and Chemistry categories as well. This year the exhibits again covered a range of geological/environmental problems:

- water quality—from nitrates to arsenic
- water chemistry—from salinity to fluoride
- radon—which houses are at risk
- soil permeability and controlling erosion
- the effects of Jemez volcanism on the ancient Rio Grande
- the growth of stalactites and stalagmites and the risk visitors pose for Carlsbad Caverns

In this large field of very talented students, the difficult task of choosing one winner in the junior and senior divisions is eased slightly by recognizing a runner up. This year's winners and runners up of the bureau's "Excellence in Geoscience" Award are Vincent T. Metzger and Erin M. Schellinger in the senior division, and Abigail J. Gray and Terrin A. Hoffmann in the junior division. *New Mexico Geology* is pleased to introduce its readers to these four students, to list their other awards, and to include the abstracts of their winning research.

Vincent Metzger was chosen as the Grand Award winner in the senior division in the field of Physical Sciences. This is the highest award given by the New Mexico Science and Engineering Fair, and Vincent receives an all-expenses paid trip to the International Science and Engineering Fair in Cleveland, Ohio, May 11–17. Vincent also won first place honors in the Environmental Science category, senior division, as well as cash awards from the American Vacuum Society and Atmospheric Physics, Inc., and the Intel Excellence in Environmental Health and Safety Award. Vincent is a sophomore whose teacher is Patricia Duda.

Erin Schellinger was awarded an honorable mention in the Environmental Science category, senior division. She won a cash award from the American Society of Civil Engineers and a certificate of merit from the Association for Women Geoscientists. Erin is a junior and her teacher is Theresa Walker.

Abigail Gray received first place honors in the Environmental Science category, junior division. She received additional cash awards, certificates of merit, and recognition from the Rocky Mountain Water Environment Association, New Mexico Museum of Natural History and Science, New Mexico Network for Women in Science and Engineering, and the Discovery Channel Young Scientist Challenge. Abigail's teacher is Analee McCoy, and she is in 8th grade.

Terrin Hoffmann was awarded an honorable mention in the Earth and Space Science category, junior division. She also received cash awards and certificates of recognition from the New Mexico State Highway and Transportation Department, New Mexico Groundwater Association, American Society of Civil Engineers, and Association for Women Geoscientists. Terrin's teacher is Cathey Manning, and she is in 8th grade.

Polymer Possibilities, Phase III—Biodegradable Cellulose for Wind Erosion Control

by *Vincent T. Metzger*, Cibola High School, Albuquerque
Winner, Senior Division

The results of previous experimentation indicated that the aqueous application of corn cellulose forms a polymer film (or "crust") that controlled wind erosion, reconstituted when rained upon, and did not interfere with plant germination during controlled tests where naturally occurring conditions were simulated.

The purpose of this project was to determine whether or not the polymer film formed by the aqueous application of biodegradable plant material to soil is an effective, practical, and economical method of controlling wind erosion.

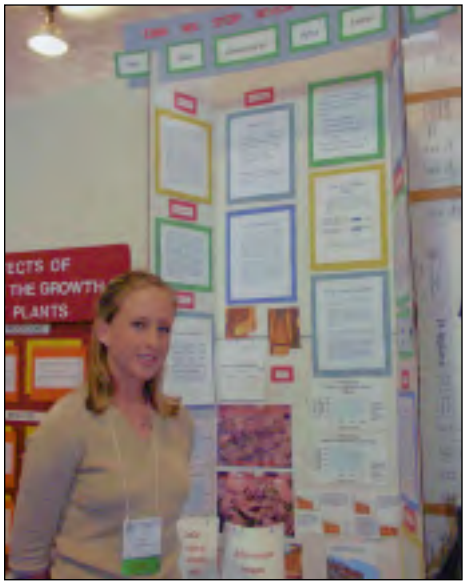
This was determined by:

- Discovering whether or not the cellulose mixture must be heated before soil application.
- Applying a polymer film to both organic and inorganic soil and comparing how effectively wind erosion was controlled.
- Comparing how effectively the polymer film controls wind erosion on a slope with gravity tension.
- Testing whether or not vegetation can be established in an area prone to wind erosion through a ydroseeding technique using cellulose, seeds, and water.
- Applying a polymer film to 81 ft^2 of soil and observing the durability and strength of the polymer film in the environment over time.
- Analyzing the soil used in both the controlled test and the "real-world" experiments in order to determine the vulnerability of the soil to wind erosion.

The results of this project indicate that the aqueous application of biodegradable cellulose to the surface of soil may provide an effective, practical, economical, and environmentally friendly solution to the extremely harmful effects of wind erosion.

Can We Stop Beach Erosion? Phase II—Particle Characteristics and Mineral Content

by *Erin M. Schellinger*, Rio Rancho High School, Rio Rancho
Runner up, Senior Division



In this experiment, the effects and causes of beach erosion will be explored (as a continuation from a previous project). However, because many factors could be to blame for beach erosion, the possibilities of experimentation have been narrowed down to examine how exactly particle characteristics (shape, size, gradation) affect the rates of erosion. This experiment has been tested on five samples of beach sand from around the United States. Their physical as well as chemical characteristics have been broken down, tested, and analyzed. A "beach" was simulated using water and a motorized "wave-maker" to move small waves over a simulated beach sand. The sand that eroded was collected, and the rates of erosion of different sands were found. The data did and did not support my hypothesis, and I have concluded that particle characteristics play a key role in how a sand erodes. Beach erosion is a monumental problem, but before any solutions are discovered for defeating this destructive process, it is important to examine how one grain of sand fits into the entire picture—perhaps that one grain of sand is the very cause of the erosion. I plan in the future to continue my research and look deeper into the causes of the urgent problem of beach erosion.

Nitrate and ground water in the East Mountains of Bernalillo County, New Mexico, Phase Two

by *Abigail J. Gray*, Roosevelt Middle School, Albuquerque
Winner, Junior Division

The use of septic tanks in the East Mountain area of Bernalillo County may present a threat to ground-water quality. A common contaminant associated with septic tank discharges is nitrate, an oxidized form of nitrogen that is easily dissolved in water.

Water samples were collected from 26 homes in the Tablazon neighborhood with private wells and septic tanks. The samples were tested for nitrate with a Hach test kit. A Hach DR/700 portable colorimeter was calibrated with nitrate standards and used to determine the nitrate concentrations for each water sample. Owners answered several questions: how long it had been since their septic tanks were pumped, well depth, distance between septic tank and well, age of the home, number of people in the home, amount of fertilizer used, and if livestock was present. This information was then correlated with the analyzed nitrate amounts.

The results showed that nitrate was present in every sample collected, ranging between 0.1 mg/L and 7.5 mg/L. Plotting nitrate concentration against the time since the septic tank was pumped gave a correlation coefficient of 0.61. All the other variables showed weak correlations with nitrate concentrations.

The study concluded that there is widespread nitrate contamination of the ground water in the Tablazon neighborhood. A moderately strong correlation with time since septic tanks were pumped indicates that septic tanks are the most likely source of this contamination, and that more frequent pumping of the septic tanks can help to lessen the nitrate content in the ground water.

Testing Soil Permeability Using Darcy's Law

by *Terrin A. Hoffmann*, Sierra Middle School, Las Cruces
Runner up, Junior Division

In 2002 when I was preparing for my science fair project *Oil in the Soil and Other Contaminants in the Vadose Zone*, I learned that different soil types have different permeability. Permeability is the capacity of rock or soil to transmit water. As I was doing a literature review for that project, I came across Darcy's Law, a method for testing soil permeability.

I decided that for 2003 I would test the validity of Darcy's Law in determining the permeability of three soil types (gravel, sand, and a gravel and sand mixture). In my experiment I also measured the flow of water through the three types of soil and the hydraulic head at three different measuring points.

To conduct this experiment, my dad and I made an apparatus using PVC pipes, clear plastic tubes, and valves. Next, we used sieves to separate gravel from sand and remove the fines. For each test we loosely packed one type of soil (gravel, sand, or the gravel and sand mixture) into a horizontal PVC pipe between valves and screening. We closed the downstream valve and slowly poured water into the reservoir. We opened the valves connecting the three clear plastic tubes to the horizontal PVC pipe and waited for the soil to saturate and the water to

begin to rise up the clear tubes. When the water reached the top of each of the clear tubes and leveled off, we stopped pouring water into the reservoir. Now the permeability test really began. As we opened the downstream valve on the horizontal PVC pipe, we also started a stopwatch. Water began to flow through the saturated soil and into a bucket. My dad then poured more water into the reservoir trying to keep the height of the water in it constant. During this time the water levels in the three clear tubes began to drop. When the levels stopped dropping I measured the height of the water in each tube. We then shut off the valve and stopped the stopwatch. Next we measured the volume of water that had flowed into the bucket. We ran five test runs with each of the three soil types.

Finally, we compiled all of our data and calculated permeability for each type of soil using Darcy's Law:

$Q = K \cdot A (h_3 - h_1)/L$

I found that gravel is much more permeable and has a lower hydraulic gradient than sand or the sand and gravel mixture. Therefore, scientists and engineers should use sand or a gravel and sand mix when their goal is to achieve a higher hydraulic gradient or a lesser flow. They should use gravel when their goal is to achieve a low hydraulic gradient or a greater flow.