see the wire spring back to its original shape. With another volunteer, I repeated the experiment—this time with a cup of hot water. I finished by mentioning a potential application of memory metals, i.e., car bumpers made of memory metal could be easily repaired with a hair dryer. The teacher commented that one of her fellow teachers was accident-prone and could benefit from such an innovation. I pointed out that the cost would probably prohibit this sort of application.

For the third experiment, I demonstrated that metals melt into liquids, just like ice melts into water. This seemed to peak the students' interest since they apparently never considered that an object as solid as steel could actually melt. Using a propane torch, I melted some pieces of tin rod from the first experiment in a ceramic crucible. I explained that I had to use a crucible or container with a higher melting temperature than the metal (232°C for tin). After a few minutes, the tin melted and I poured it into a glass beaker filled with water. This demonstrated that the metal could refreeze into a solid.

The Education Exchange highlights the experiences of scientists and engineers with local schools, along with helpful hints and resources. If you would like to share your own involvement in science education, contact: Finley Shapiro, Department of Electrical and Computer Engineering, Drexel University, Philadelphia, PA 19104, U.S.A. Phone (215) 895-6749; fax (215) 895-1695; e-mail: shapiro@ece.drexel.edu

For the fourth experiment I created nylon (a polymer) with assistance from the teacher since I did not want the students to work with the type of chemicals involved. Before starting I explained that nylon is a polymer which is used in many types of clothing, such as their jackets. The chemicals had been premixed so that I only had to add solution A (hexamethylenediamine) to solution B (tetrachloroethylene and sebacoyl chloride). I then pulled out a strand of nylon about 20 ft long from a 35 ml solution. As I pulled out the strand I wound it onto a glass rod. After I thoroughly rinsed the nylon, the teacher helped me stretch it out to its full length.

Our final experiment involved a look at high-temperature superconductors (ceramic). I explained that wire used for electricity and electrical appliances was made from metals, such as copper, which are very good conductors. I also explained that polymers and ceramics are usually poor conductors of electricity and are often used as insulators to prevent electrical shocks. One exception, I said, is a new type of ceramic which is a very good conductor or a super conductor. I showed a pellet of $YBa_2Cu_3O_{7-x}$ and pointed out that it only becomes superconducting when cooled to low temperatures with liquid nitrogen. I then, with the help of volunteers, showed the simple test for superconductivity, the Meissner Effect. While a magnet was levitating on the superconductor, I had each assistant pass items (such as an elastic band) between the magnet and superconductor to show that no wires or strings were involved. While the children did not understand what was happening, they were awestruck by the floating magnet.

To close the demonstrations and experiments, I asked the students to name the three types of materials again and to give examples. They did extremely well. Their teacher pointed out that although the experiments may have appeared to be magic tricks, they were indeed scientific experiments.

Overall, the materials science experiments were a success. The students understood reasonably well what we had done, with the exception of the superconductor experiment (this was not surprising as the physics of superconductivity is not easily explained in simple terms). They were encouraged to ask questions throughout, which they did, and I questioned them as well. The entire process lasted about an hour and a half, about twice as long as I originally figured. I did not anticipate the degree of enthusiasm on the part of the students. I would not recommend more than an hour and a half, as the children started to get restless near the end. I think they learned a little about materials and particularly liked being involved. As much as the students enjoyed themselves, I think I enjoyed myself even more.

The teacher invited me to return the following year to demonstrate the experiments with her new class. The experiments were equally successful and the children just as inquisitive and enthusiastic. When I finished, several of them asked more questions and chatted with me. Some of the children said that they wanted to be scientists, and one girl even asked for my autograph. She was followed by several other autograph hounds. Who would have thought—materials science groupies?

My son is now in second grade and I demonstrated experiments with his new class. My theme was related to chemistry of gases. His classmates wanted to repeat some of the experiments from the previous year. I first quizzed them to see what they had remembered. They were able to name the three types of materials and give examples. Virtually everyone remembered the memory metal and one child even remembered the bumper example I had given before. Needless to say, I was extremely gratified.

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