Laurels and laureates at 48th science fair

Each year at the International Science and Engineering Fair (ISEF), the two high school students who accumulate the most points during the week-long science competition win a trip to Stockholm for the next Nobel prize ceremony.

Last week, the Glenn T. Seaborg Nobel Prize Visit Award went to Anne Jarvis Jefferson, 18, from Winona (Minn.) Senior High School and Logan Joseph Kleinwaks, 17, of Thomas Jefferson H.S. for Science and Technology in Alexandria, Va. Jefferson took top honors among the earth and space sciences projects for her study of sediment movement in the upper Mississippi River. Kleinwaks received the top physics honors for his X-ray analysis of a material used in nanotechnology and optics.

For the students who wouldn't be making the trip, Stockholm had a few emissaries on hand. Six Nobel laureates attended this year's Intel ISEF in Louisville, Ky., along with 1,089 students from 23 countries.

Joseph Murray of Harvard University, who won the 1990 Nobel prize in medicine, remarked on the variety and "freshness" of the projects, taking particular note of studies of simple organisms for their therapeutic value. Joining him were physics laureates Norman F. Ramsey (1989) and Sheldon L. Glashow (1979) of Harvard and chemistry laureates Mario Molina (1995) of the Massachusetts Institute of Technology, Robert F. Curl Jr. (1996) of Rice University in Houston, and Dudley R. Herschbach (1986) of Harvard.

Herschbach is chairman of the board of Science Service, which publishes SCIENCE NEWS and administers the Intel ISEF. Intel and other corporate, federal, and educational sponsors awarded $2 million in scholarships and prizes to two-thirds of the students, based on judging by 967 science professionals.

Intel judges awarded $40,000 scholarships "for outstanding research" to three students: Kleinwaks, who was also a finalist in this year's Westinghouse Science Talent Search (STS) (SN: 2/1/97, p. 69); Scott Nicholas Sanders, 17, of Ely H.S. in Pompano Beach, Fla.; and Karen Mendelson, 15, of Doherty Memorial H.S. in Worcester, Mass. Sanders wrote a mathematics paper on edge detection in image processing. Mendelson devised an optical method to measure carbon monoxide in blood.

For their design of a submersible robot probe, Renee Jeanne Filion, 16, and Stefane Robert Filion, 18, of École Secondaire Algonquin in North Bay, Ontario, won top honors among team projects and a trip to the European Union Contest for Young Scientists. Students from Saint Louis School in Honolulu—Chi-Fai Law, 18, Allen Winn Yoo, 18, and Preston Wing-Kwong Ma, 17—won a trip to the 12th International Fair of South America in Novo Hamburgo, Brazil, for their mountain bike design.

The top projects in each of 15 categories received $8,000 awards: in behavioral and social sciences, Jan Renee Linkenhoker, 17, of Lincoln H.S. in Vincennes, Ind.; in biochemistry, Adam Goon Wai Matthews, 18, of Punahou School in Honolulu; in botany, Joseph Robert Hastings, 17, of North Attleboro (Mass.) H.S.; in chemistry, Stuart Duncan Ibsen, 17, of Hanford H.S. in Richland, Wash.; in computer science, Benjamin John Schmidel, 17, of Hawaii Preparatory Academy in Kamuela; in engineering, Carl Mangus Samuelsson, 18, of Danderyds Gymnasium in Bankeryds, Sweden; in environmental sciences, Vishal Primal Grover, 18, of Miami (Fla.) Coral Park Senior H.S.; in gerontology, Deepta Shankar Atre, 17, of Nelson Snider H.S. in Fort Wayne, Ind.; in mathematics, STS winner (SN: 3/15/97, p. 159) Davesh Maulik, 17, of Roslyn H.S. in Roslyn Heights, N.Y.; in medicine and health, Jona Ashok Hattangadi, 18, of University H.S. in Orlando, Fla.; in microbiology, Merri Carole Moken, 17, of Morristown (N.J.) H.S.; and in zoology, Melissa Chak, 17, of John F. Kennedy H.S. in Bellmore, N.Y. — *C. Mlot*

How zeolites hold tight to metal ions

The petroleum industry would be on its knees without zeolites, porous solids that refineries use in the processing of oil and gas. Zeolites grab metal ions and hold them tightly in complicated networks of channels and pores. The ions can catalyze a wide variety of chemical reactions that break large oil molecules into smaller, more useful ones.

Researchers at the University of Cambridge in England have used a computer analysis to explore how zeolites grasp metal ions so tenaciously. At some locations, they find, the zeolite structure distorts to accommodate the ions. As well as helping scientists understand existing zeolites better, the computer program may also make possible the creation of structures that catalyze particular reactions. The findings appear in the May 12 PHYSICAL REVIEW LETTERS.

"To a large extent, [zeolites] are used on a trial-and-error basis," says study coauthor Kenton D. Hammonds. Although scientists have long thought that flexibility in zeolite structure was important, "there haven't been that many ways of actually calculating what's going on."

Most zeolites have a framework of small tetrahedral molecular units, triangular pyramids in which four oxygen atoms enclose a central aluminum or silicon atom. Using their computer model, Hammonds and his colleagues have discovered that when an incoming metal ion situates itself within a zeolite pore, the group of surrounding tetrahedrons twists slightly, closing in on the ion like a camera shutter. That movement optimizes the distance between the ion and the oxygen atoms, enhancing the strength of the bonds.

The tetrahedrons move as a unit, which requires much less energy than rearranging the individual atoms. "In zeolites, the framework distorts but these [tetrahedrons] remain undistorted," says Hammonds. "On a large scale, the framework can flex, but on a much smaller scale, it's not flexible."

The flexibility of the framework may underlie zeolites' ability to catalyze reactions, the researchers suggest, because the structure can adjust to wrap around incoming molecules.

The computer program calculates, from the symmetry of the zeolite structure, where distortions in a framework would occur and analyzes what would happen if low-frequency vibrations, or phonons, propagated through that framework.

Like waves in the sea, a large number of phonons can converge and either add together or cancel each other out. Where the phonons add, the greatest structural deformations occur. "Our calculations were based on coming up with the best way of predicting what this constructive interference would be," Hammonds says.

Six years ago, another group used X-ray spectroscopy to pinpoint the locations of metal ions bound to a zeolite called faujasite. The Cambridge researchers found "a close correlation" between their predictions and those previous findings, Hammonds says.

The group is now looking at how a zeolite's size affects its flexibility—larger zeolites appear to be more flexible than smaller ones. The program can also analyze how phonons distort other materials with tetrahedral structures, such as quartz and feldspar.

Although the program allows researchers to "play around" with zeolites on the computer, Hammonds says, it's no substitute for working with the actual material. "You'd still have to go to the lab and test it all out for real," he says. — *C. Wu*