A harvest of scientific talent

Chung

Zhu

Saito

Among the cream of the scientific crop chosen this week in the 45th annual Westinghouse Science Talent Search were Wendy Kay Chung and Wei-Jing Zhu, who tied for first place. Chung, a student at Miami (Fla.) Killian Senior H.S., found that Caribbean fruit flies are most likely to lay their eggs in guava fruit when the fruit has reached a specific degree of ripeness. She suspects that the flies may be attracted to or repelled by a chemical in the fruit. Chung says such a repellent chemical may offer a safe alternative to the currently used insecticide, which will be banned in five years.

Zhu, a student at Brooklyn (N.Y.) Technical H.S., was chosen for extending a famous mathematical problem to include complex numbers. He determined the number of ways and the conditions under which a number can be expressed as the sum of the squares of other numbers. Chung and Zhu each won $20,000 scholarships. This is only the second time there has been a tie for first place since the Talent Search began in 1942.

The fruits of Yoriko Saito's labors were third place and a $15,000 scholarship. Saito, a student at Homewood (Ala.) H.S., used soil-dwelling bacteria that normally cause tumors in tomato plants to change the plants' genetic structure, with the goal of making them more resistant to disease, drought and herbicide.

The winners of fourth through sixth places received $10,000 each. A study of how a solution of suspended particles could be used with long-wavelength laser light in an optical switch won fourth place for George Jer-Chi Juang, a student at Benjamin N. Cardozo H.S. in Bayside, N.Y. In fifth place, Anh Tuan Nguyen-Huynh of Cleveland, a student at University H.S. in Chagrin Falls, Ohio, discovered that vitamin C and magnesium inhibit the binding of an antischizophrenic drug to receptors in the brain. This means that the common laboratory practice of using vitamin C as an antioxidant in tests of such drugs could be distorting the results, he says. Sixth place went to Jessica Louise Boklan of East Hills, N.Y., a student at Roslyn H.S. in Roslyn Heights. In just two weeks, she found a way to generate all reversal products for two to four digits. A reversal product occurs when the product of two numbers equals the product of the numbers' mirror images; for example: $13 \times 93 = 31 \times 39$.

William Edward Bies, a student at Mount Lebanon H.S. in Pittsburgh, modeled on a computer the formation of galaxies for seventh place. Glastonbury (Conn.) H.S. student Mary Elizabeth Meyerand built a machine, for which she has a patent pending, that generates electricity from the difference in water pressure under crests and peaks of ocean waves. In ninth place, Andrew Lawrence Feig, who studies at University H.S. in Los Angeles, produced antibodies that bind to portions of a protein thought to play a key role in a childhood cancer. For tenth place, Allen Wallis Ingling, at Buckeye Valley H.S. in Delaware, Ohio, engineered a computer-controlled device for testing color blindness. Each of these students received $7,500.

The remaining 30 national finalists each were given $1,000 awards. Jung-Pu Lin of Elmhurst, N.Y., and Todd Harrison Rider of North Little Rock, Ark., were named as alternates to the top 10.

This is the first time that high school students born in Asia or of Asian parentage have won all of the top five scholarships of the Talent Search. According to Dorothy Schriver, assistant director of Science Service, Inc., which administers the Talent Search, this year's entries were oriented much more toward molecular biology and applied sciences than in the past. The projects have also been getting more sophisticated, she says. "In the early days we had some beautiful collections of butterflies, fossils and things," notes Schriver, who will step down as program director of the Talent Search after 45 years with it. "Now the students tend to do much more pure research." □

How to give teeth a fluoride 'apatite'

For 30 years, dentists have been treating teeth topically with fluoride to make them more resistant to cavities. This treatment typically incorporates fluoride into the tooth as calcium fluoride. However, notes American Dental Association (ADA) chemist Laurence Chow, research has shown that because calcium fluoride is soluble in saliva, topically applied fluoride can leach out of treated teeth completely within a week or two and even result in a "net loss of tooth mineral and fluoride." Together with Walter E. Brown, Chow has developed a new treatment that not only makes teeth incorporate more fluoride but also bonds the chemical in a form, known as fluorapatite, that is not soluble in saliva – features they have demonstrated in humans.

Their chemical treatment is nontoxic, Chow says, and can be delivered much as fluoride is today, as an ingredient in toothpaste, mouth rinses, gels – even in chewing gum. Chow and Brown, who work at the ADA's Paffenbarger Research Center at the National Bureau of Standards in Gaithersburg, Md., have just received a patent for their treatment. They are awaiting Food and Drug Administration approval of a three-year human study to confirm what they have already shown in animals: that the fluoride they can bind into teeth will translate into fewer cavities.

Their technique involves treating teeth with aqueous solutions or gels that will cause some of the apatite – a structural mineral in tooth enamel – to convert into dicalcium phosphate dihydrate, or DCPD. Because it is very unstable, DCPD will react with any fluoride in the mouth – from toothpaste, water or food. Fluoride picked up by tooth enamel in this reaction is converted back to an apatite. But instead of the previous hydroxy apatite, it's an even more stable mineral, fluorapatite.

The treatment's DCPD-forming compounds do not contain fluoride, Chow points out; they simply make the tooth enamel more reactive so that it will incorporate any fluoride more readily and securely. Moreover, Chow says, "The process is essentially self-limiting. As the tooth becomes richer in fluoride, it no longer responds to the treatment as much," so even daily use should not overfluoridate teeth. But because teeth are constantly demineralizing and remineralizing – dissolving and laying down new mineral – the treatment is not permanent, but instead should be part of a regular dental-care program.

Right now, the challenge is to deliver the treatment to the cavity-prone areas – between teeth, along the gum line and in crevices on the grinding surfaces. In addition, Chow says, several researchers are trying to harness the technique's ability to remineralize teeth as a means of repairing teeth in the early stages of decay. *– J. Raloff*