Intel ISEF—Profiles of Success

Changing the World

Why Student Researchers Appreciate Being Taken Seriously

"Most of my science research students wind up knowing more about their topic than I do, and that's OK. I'm only here to guide them."

—Sheila Porter
Loreto College, St. Stephens Green
Dublin, Ireland

Today's young scientists and inventors deserve to be taken seriously. Whether they are working on cures for diseases, solving environmental challenges in their own communities, or inventing the next breakthrough in technology, they are determined to make a difference. Their passion, perseverance, and creativity may help to improve the world of the 21st century.

A Better Treatment
Khairul Talib, Ahmad bin Ahmad Hazmi, and Nurull bte Zulkifli

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Solving Two Problems at Once
Nathan Kebede and Berhanemeskel Nida

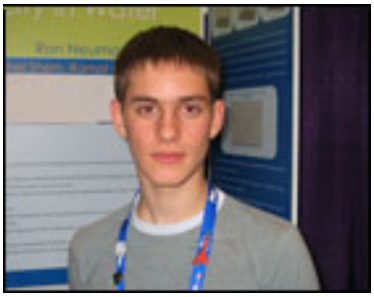
Turning lagoons of animal waste into a clean energy source is an idea that could solve two problems at once. Two international students from Piney Woods, Mississippi, have designed an apparatus and system for converting pig effluent to methane, creating an environmentally sound alternative to fossil fuel. Read more.

Searching for a Medical Breakthrough
Eigen Israel Rara

For decades, people in the Philippines have brewed a medicinal tea from the leaves of the Sibukau tree. Eigen Israel Rara, 17, became curious about the scientific properties of this traditional medicine. After a year of studying plant extracts in a laboratory setting, he is now convinced he has discovered a wonder drug. Read more.

Improving Water Safety

Ron Neuman



Ron Neuman, 16, from Ohel Shem High School in Ramat-Gan, Israel, remembers the day two years ago when he and two million fellow Israeli citizens had to avoid drinking water because the central water system had been poisoned with ammonia. Concerned about the threat of bioterrorism as well as "ordinary pollution," he has fused biology, genetics, and electronic technology to create a water safety detection system that is as small as a cell phone. Read more.

Wood From Paper

Shiram Jayaaraman and Srividya Swaminathan

A concern about deforestration in India and around the world prompted two students to design an ecologically sound alternative for wood to be used in construction. Shiram Jayaaraman and Srividya Swaminathan, both 15, attend the Modern English School in Mumbai. They call their environmental science project "Paperood-Paper From Wood? No! Wood From Paper." Read more.

A Better Treatment

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Malaysia, home to a growing petrochemical industry, may soon have an economical way to deal with the sludge that is a byproduct of production. Three students from Mara Junior Science College Taiping in Perak, Malaysia, developed a process for converting hazardous sludge waste to a material that could be used to produce integrated circuits.

Khairul Talib, 18, Ahmad bin Ahmad Hazmi, 18, and Nurull bte Zulkifli, 18, have applied for a patent and plan to continue working on their idea.

Khairul Talib, Ahmad bin Ahmad Hazmi, and Nurull bte Zulkifli

Although developing their successful project took considerable time and problem solving, coming up with the idea was straightforward. “We can see the sludge waste with our own eyes,” explained the students.

They started their project at school, where science research is a requirement. Eventually, they worked in a university laboratory where a postgraduate student helped them learn to use sophisticated equipment, such as a scanning electron microscope.

The students learned that current processes for dealing with petrochemical waste are expensive. Some waste is currently turned into artificial stones used for construction, for example, but this accounts for only a limited amount of hazardous waste. The students wanted to make a higher-value product out of sludge. Their process produces a semi-crystalline composite, which they describe as “soda lime glass-sludge.” The composite has a high dialectic constant property. It has the potential to be used as a capacitor in the next generation of high-capacity integrated circuits. Producing the composite is also less costly than currently available treatment methods.

Solving Two Problems at Once

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Turning lagoons of animal waste into a clean energy source is an idea that could solve two problems at once. Two international students from Piney Woods, Mississippi, have designed an apparatus and system for converting pig effluent to methane, creating an environmentally sound alternative to fossil fuel.

Nathan Kebede, 17, and Berhanemeskel Nida, 17, attend Piney Woods School. Both students are originally from Ethiopia.

Nathan Kebede and Berhanemeskel Nida

“We know that energy is scarce around the world,” explained Nida, “and we wanted to find the best source, using resources already available.” Added Kebede, “We also wanted it to be cheap, so that this could be affordable in a local community, even in rural areas or villages.”

They settled on pig waste as a readily available raw material for producing methane, and concluded that the waste produced by one pig could produce 2.8 cubic feet of methane gas. Their process is a closed system. As they explained, “That means you don’t have to add energy to make it work.” The more biomass that is added to their system, the more energy results.

Their first round of experiments focused on determining the right temperature to extract methane. Next, they began working on the design of their apparatus. It consists of a series of tanks, acid-forming bacteria and methanogens, compressor, generator, heater, and other electronic equipment.

The students plan to continue their project for a second year, and are applying for funding to continue building and testing their apparatus. Attending Intel ISEF provided them a chance to learn from other student researchers, “and see how our ideas compare to theirs,” Nida said. “It’s given us better ideas, ways we can improve our project.” Both students said they enjoyed the chance to meet students from around the globe. Said Nida, “The future scientists of the world are all here together.”

Searching for a Medical Breakthrough

Eigen Israel Rara

For decades, people in the Philippines have brewed a medicinal tea from the leaves of the Sibukau tree. Eigen Israel Rara, 17, became curious about the scientific properties of this traditional medicine. After a year of studying plant extracts in a laboratory setting, he is now convinced he has discovered a wonder drug.

"Wonder Drug: A Broad-Spectrum Antibiotic Substance Obtained From Sibukau Tree" is the botany project that earned Rara top honors at the national Intel Philippines Science Fair and a trip to compete at Intel ISEF in Cleveland, Ohio, in 2003.

He has become a passionate spokesman for what he sees as a medical breakthrough. Because some strains of bacteria have become resistant to antibiotics, health experts forsee the need for new sources of antibiotics. "So I am very proud that I have discovered a new antibiotic," Rara says. "It provides a broad-spectrum antimicrobial agent which is inexpensive, effective, and doesn't bring about harsh side effects."

Indeed, Rara hopes to see the drug become commercially available. But that's still a distant goal, requiring further studies in molecular biology—the field he now plans to study in college.

Getting Started

Rara launched his research project while a student at MSU-ITT Integrated Development School, a high school with a strong science focus that is located on a university campus in Iligan City. With a mentor from the university biology department serving as adviser, Rara used methanol to extract components from different parts of the tree, including trunk, leaves, and fruits. He found that dried leaves contain the highest concentration of the active substance.

Rara conducted further analysis using gravity column chromatography and spectrophotometry, and concluded that the active compound he isolated likely has a peptide-like structure. In his lab tests, it proved effective against a broad spectrum of bacteria, both Gram-positive and Gram-negative. "The results led me to conclude that this is really a broad-spectrum antimicrobial agent, because all of these were inhibited. And not just inhibited, but they were totally killed," he says.

Ready for Questions

Presenting his project to judges required Rara to be ready to explain his research process, as well as answer questions about the potential value of his discovery. Although judging in the Philippines was rigorous, the questions got even harder once he got to Intel ISEF.

"They asked a lot of questions. It was little frightening," Rara admits, "but I answered all of them. The questions are very technical and the judges go deep through your study. It made me think, but I have done my very best."

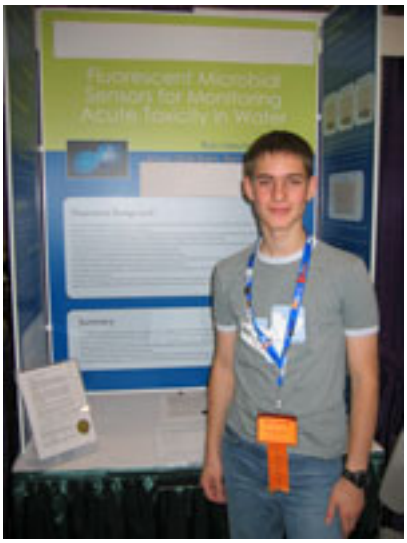
Attending Intel ISEF was a dream-come-true for Rara, whose older brother competed in the international event the previous year. "He gave me some overviews of what this contest is all about. And, in fact, he is my inspiration with this work. When he came back from Intel ISEF, he was moved to continue his research at the university, where he is studying biology. He feels he has a great task to continue. He is the first scientist in my family," Rara says. But not, apparently, the last.

Improving Water Safety

Ron Neuman

Ron Neuman, 16, from Ohel Shem High School in Ramat-Gan, Israel, remembers the day two years ago when he and two million fellow Israeli citizens had to avoid drinking water because the central water system had been poisoned with ammonia. Concerned about the threat of bioterrorism as well as "ordinary pollution," he has fused biology, genetics, and electronic technology to create a water safety detector system that is as small as a cell phone.

Neuman was a finalist at Intel ISEF 2003 for his project, "Fluorescent Microbial Sensors for Monitoring Acute Toxicity in Water."



Improving Existing Systems

Neuman's environmental project, developed in a university laboratory, involves genetically altering E. coli bacteria to emit a fluorescent light wave that can be measured. He explains, "A biosensor using a small number of carefully selected engineered cell strains can adequately address a broad range of toxic chemicals in water." When incorporated into a biochip that is currently under development, these cells offer the promise of a rapid, accurate assessment of water safety.

Neuman sees his work as a complement to existing water safety systems. Chemical analysis, for example, is effective but requires taking water samples to a lab and waiting for test results. The new device allows for mobile testing. "It's small, cheap, mobile, easy to operate, but most important, reliable," he says.

Always Curious

What qualities have helped Neuman develop his ideas? "I have always been curious," he says. As a young boy, he was fascinated by math and recalls contemplating the ratio between angles before he learned there was a discipline called trigonometry. "The wheels are always spinning in the back of my head," he says.

At his high school, which enrolls about 1,400 students, students with a passion for research are encouraged to work on an independent project under a faculty adviser's direction.

Neuman plans to shift gears with his research and focus next on robotics. It's an area certain to appeal to his sense of curiosity. "You need sensors, mechanics, electronics. And of course, you have to program it."

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As Swaminathan explains, "Paper recycling that exists today just creates more paper. We wanted to use paper to create a new material that is a substitute for wood."

The students attend a school of about 1,500 where scientific inquiry is part of the curriculum. "Most students do a research project," Swaminathan said. When these two students decided to work as a team because they share a concern about deforestration, their teacher, Sitalakshmi Parameshwaran, helped them refine their research. The students learned, for example, that only about 30 percent of the 1,000 million tons of paper produced each year is recycled. As the students began to envision a way to use waste paper and a resin solution to make a wood substitute, their teacher connected them with a nearby laboratory where they could conduct chemical and laboratory testing.

In the lab, the students conducted experiments, used a trial-and-error process to make improvements, and did testing to devise a process that would result in the product they wanted. Testing confirmed that Paperood—the end product of their manufacturing process—offers excellent properties for construction. "It is better than wood in almost all structural properties," Swaminathan said. Stronger than wood in tests of flexural strength and compression strength, Paperood is also fire retardant and resistant to termites. It has minimal water absorption, another benefit when compared to wood. Students envision their product being used in place of wood for roofing, cabinets, and insulation.

Developing a sophisticated project such as this one "is hard work, day and night, for many months," said the teacher, "and not just for the students." When the students learned that they had won a spot at Intel ISEF as finalists, "you cannot imagine the joy that we had," added Kalyani Venkatraman, the school's headmistress. "This will encourage everyone in our school to work harder and develop more projects."