Highlights From Intel ISEF 2006

A Week of International Competition

Fair Honors Young Scientists From Around the World

Nearly 1,500 young scientists from 47 countries, regions, and territories came together in Indianapolis, Indiana, for Intel ISEF 2006. The world's largest pre-college science competition awards US$4 million in scholarships, cash prizes, and awards.

Meet the Intel Foundation Young Scientist Winners ›

Three high school students who earned the Intel Foundation Young Scientist Award at Intel ISEF 2006 share a passion for science. Each received a US$50,000 scholarship.

Projects Reflect Range of Interests ›

Student researchers investigate everything from cleaning up waste water to artificial limbs. Take a look at some projects that just may improve the world of tomorrow.

Insights on Innovation ›

Distinguished scientists, including five Nobel Laureates, a Herschel Medal Winner, and two Intel Fellows shared insights with finalists on the challenges and rewards of scientific careers.

2006 Photo Album ›

View memorable moments captured during Intel ISEF 2006 in the photo album.

On the Road to Intel ISEF ›

Learn how Costa Rica developed a winning science fair program.

No Boundaries, No Limits

This year's keynote speaker was primatologist Mireya Mayor who inspired finalists to dream big.

Learn more ›

Press Information

Read the press releases.

Access the Intel ISEF Virtual Press Kit.

Looking Back

Intel ISEF 2005 (PDF; 19 pages)

Intel ISEF 2004 (PDF; 23 pages)

Intel ISEF 2003 (PDF; 7 pages)

Intel ISEF 2002 (PDF; 3 pages)

Intel ISEF

Meet the Intel Foundation Young Scientist Winners

Intel Foundation Young Scientist Award
Three high school students received the highest award of the Intel International Science and Engineering Fair on Friday, May 12, 2006. Each of the Intel Foundation Young Scientist Award winners received a US$50,000 scholarship.

Madhavi Gavini


Madhavi Gavini

Pseudomonas aeruginosa is an opportunistic pathogen that causes secondary infections that often lead to death in patients with compromised immune systems, such as cancer, AIDS and burn victims. Madhavi Gavini, a 16-year-old junior at the Mississippi School for Mathematics and Science in Columbus, MS, discovered a novel method to destroy this common and deadly infectious bacterium. It is difficult to fight because it protects itself with a biofilm that antibodies can't penetrate. Madhavi studied several commonly available herbal compounds and extracts known for their antiseptic qualities in both traditional and alternative medicine. She believed at least one might penetrate the biofilm. She ultimately identified a molecule in an extract that could penetrate the biofilm and kill the bacterium. Terminalia chebula (Tc) extract proved the most potent inhibitor of the pseudomonas, even after a 100-fold dilution. The anti-microbial compound in Tc is very stable, making it suitable for use in an inhaler or antiseptic spray.

Meredith MacGregor

Meredith MacGregor

The phenomenon known as the Brazil Nut Effect and its implications for other industries captured the attention of Meredith MacGregor, 17, from Fairview High School in Boulder, CO. One of the most significant implications of understanding this effect is in the mixing of compound pharmaceuticals to insure particles of different densities are evenly combined as they are packaged for human consumption. When a container of granular material is shaken, particles separate by size, with the largest rising to the top, like the Brazil nuts that rise to the top of a can of mixed nuts. Meredith sought to better understand these characteristics by constructing a device that would allow her to accurately control the frequency, amplitude and duration of the shaking process. She placed various "intruder" particles in a granular sample and collected data to create computer models of the flow. The heaviest intruders rose fastest. Intruders that rose most slowly under normal atmospheric conditions sped up when pressure was reduced, indicating that air pressure is also involved in the size separation process. The effect also becomes relevant in natural phenomena such as rock slides. Meredith plans to continue her research, examining reverse effects and other variations.

Hannah Wolf

Imagine learning the impact of the next California earthquake in a 70 million-year-old rock face in Utah. Hannah Wolf, a sophomore at Parkland High School in Allentown, PA, studied formations in the Grand Staircase-

Escalante National Monument caused by ancient earthquakes to try to determine the epicenters of the quakes and assess the impact. Specifically she studied sandstone deformations called seismites in the Upper Cretaceous Wahweap Formation. This area isn't seismically active now but can be used as an analog for current active areas. The seismites were caused by liquefaction of sand and water. Hannah first became interested in geology after a freshman earth science class. She began looking for a research opportunity and joined a Kutztown University program that sends students to be part of a large scale project in Utah. There she gained considerable field experience and was able to develop her own project. Hannah mapped, photographed and measured the formations within the study area, then analyzed characteristics of the formations to determine the intensity of the quake and the direction and distance it moved. The patterns she observed indicate epicenters north and west of the study area. Understanding where the most damage has occurred can lead scientists to more accurate assessment and prediction of seismic hazards.

Hannah Wolf

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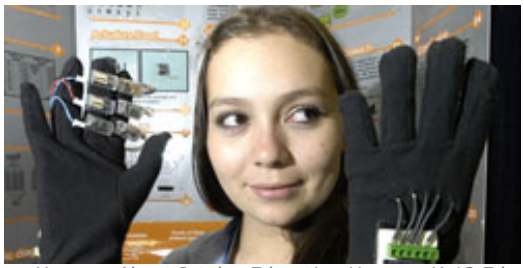

Intel ISEF

Projects Reflect Range of Interests

Lined up across the floor of the Indianapolis Convention Center are projects that could ultimately solve some of science's most vexing problems—finding treatments for autism and other learning disabilities, reducing contaminants in the water supply, and reducing electronic waste. Some simply make getting through the day easier.

In all, some 1,200 different projects were on display at the 2006 Intel ISEF where students met with senior scientists, exchanged ideas, and presented their findings. Among the nearly 1,500 finalists, 13.5 percent hold or have applied for a U.S. patent and another ten percent intend to apply. The Engineering category had the most entries at the fair, followed by Environmental Sciences, then Medicine and Health. Together these comprise 40 percent of the total number of projects entered at the fair.

These students share a passion for problem-solving and an enthusiasm for discovery. The challenges they're tackling are leading to innovative solutions, eco-friendly products, and improvements in everyday life.

Intel ISEF
Insights on Innovation

One of the great opportunities Intel ISEF provides is the chance for students to meet face-to-face with working scientists and engineers at the top of their fields, ask them questions and gain some insight on the future that lies before them.

In a morning ShopTalk with Intel Fellows Gene Meieran and Kevin Kahn, students quizzed them on the future direction of silicon technology, computer programming, and processor architecture, and learned about the possibility of re-inventing themselves a number of times, as these men have throughout their careers. After discussing the challenges looming in advancing computer and semiconductor technology Meieran reminded them that "no one imagined we would be where we are today. People pass through those artificial barriers. The cleverness of people cannot be overestimated."


Gene Meieran (left) and Kevin Kahn, both Intel Fellows, shared insights with students. Tim Saponas (right), Intel Worldwide Higher Education Manager, moderated the session.

Later that afternoon, finalists lined up 30 deep to ask questions of a distinguished panel of scientists including five Nobel Laureates and a Herschel Medal winner. Students sought advice on rising to challenges, facing failure, breaking down barriers and securing research funding. They asked about role models and inspiration, about perseverance and just plain luck.

While some knew early on they were destined for scientific careers, others found their calling later. Harold Varmas, Nobel prize winner in Physiology or Medicine in 1989, holds a graduate degree in English Literature. Kurt Wuthrich, winner of the Chemistry prize in 2002, spent his youth training for the Olympics.

A high school biology teacher from Colorado asked their opinions of the adage, "Great discoveries are not followed by Eureka, but by huh, that's funny." Most agreed that initial discoveries do come from unexpected results and that being able to interpret those results correctly is what's important. Robert Curl, Nobel Laureate in Chemistry in 1986, spoke of fortunate accidents in the lab. "We thought, this isn't supposed to happen. What does it mean?" Harold Varmus quickly added, "*What does it mean?* is the key phrase." Astrophysicist Jocelyn Bell Burnell went one step further. "In my case it wasn't huh, that's funny, but that's *very* funny." They were certain they'd made a mistake; instead they'd discovered a new type of star.


From Left to Right. Robert Curl, Jr., Dudley Herschbach, Jocelyn Bell Burnell, Horst Störmer, Harold Varmus, and Kurt Wüthrich

Most admitted their greatest discoveries were unexpected. "Very few of us are good prognosticators," said Varmas. "The initial findings are less important than how you interpret them."

"It's not easy to be sure, when you're a scientist," added Wuthrich. "But at some point you have to publish and present your work. If it's vigorously attacked, then you know you're on to something."

When asked if they credit inspiration, hard work, or good luck for their discoveries, Nobel Laureate in Physics Horst Stormer quickly answered, "All three." Burnell was more pragmatic. "I don't subscribe to luck. A well prepared person can encounter an opportunity, recognize it, and seize it. That will give you luck."

Independence of thought was another common theme. Dudley Herschbach, winner of the Chemistry prize in 1986, advised, "You have to be so obsessed that you keep plugging away when other people think it's foolish. If you're in love with a question, that's a sign that helps you not be concerned about others—that this is your destiny."

"When I was a teenager, I didn't follow the fashion; I thought for myself," said Burnell. "It was a bit lonely at the time, but it prepared me for what came next as one of very few women doing physics."

Students were interested in how the scientists overcame various barriers. "You need a natural resistance to cope with failure," said Herschbach. "Like a musician you may have talent but it requires effort to master your instrument. But unlike musicians, you can play 99 percent of the notes wrong and get just one percent right to be applauded."

"Failure is bound to happen; what's important is that you learn from it," said Burnell. As for social and cultural barriers, she added, "Being a woman in science is a disadvantage, but not a disqualification. You have to be tough, and also generous."

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Intel ISEF 2006 Photo Album

The Indianapolis Convention Center in Indianapolis, Indiana, was the gathering place for nearly 1,500 high school students who assembled for the weeklong celebration of science known as the Intel International Science and Engineering Fair (Intel ISEF). At the 57th annual fair, finalists had a chance to talk with distinguished scientists, get acquainted with fellow students from around the globe, and experience the sights of Indiana. Take a look at the week in pictures.

Finalists gathered in Indianapolis, Indiana, for Intel ISEF 2006.

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Pin-trading gives students a chance to get acquainted.

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Opening ceremonies began with a Brazilian Blues Band featuring an electric violin.

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Sharing African culture, Julius Adeniyi and the Drums of West Africa performed authentic traditional music with costumes and instruments of Nigeria's Yoruba tribe.

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After opening ceremonies, Intel Chairman Craig Barrett, signs autographs.

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Student finalists treated Craig Barrett like a celebrity.

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Students representing 47 countries, regions, and territories gathered on stage for an international shout-out during opening ceremonies.

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The exhibition floor included individual and team projects in 14 scientific categories.

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Intel Chairman Craig Barrett met students and learned about their research.

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Craig Barrett visits the exhibition hall.

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Craig Barrett enjoys meeting Larry Nyanti from Malaysia.

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Student finalists rehearse their projects for judging with Craig Barrett.

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Finalists found time in their busy schedule to tour the Indiana State Museum.

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Not always serious, finalists let off steam while playing a friendly game of soccer.

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Soccer game saw finalists getting to know each other.

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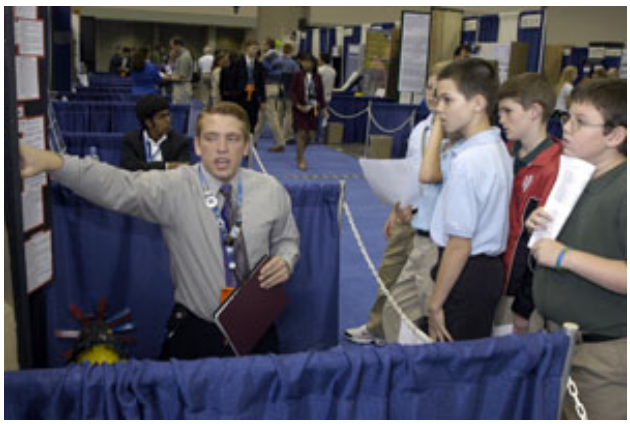

Finalists help spark younger students' interest in science.

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Intel ISEF finalists uphold the scientific tradition of sharing their research results.

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During public viewing, finalists explain their projects to visitors.

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The three top-prize winners enjoy their moment in the spotlight.

Intel ISEF

On the Road to Intel ISEF

Intel opened an assembly/test facility in Costa Rica in 1998 and quickly put programs in place to build interest in science, math and technology and encourage students to consider those fields as careers. Costa Rica has a population of about 4.5 million and is about the size of West Virginia.

"What we wanted to do was get the opportunity for kids to participate in science fairs," said education manager Mary Helen Bialas. "Costa Rica has had a national science fair for 16 years but it was drawing students from just 30 to 40 schools in the central valley."

For winners of the national fair to participate in Intel ISEF the procedures, regulations and processes for the fair needed to meet the requirements for affiliation. Intel worked with them to meet affiliation requirements in 1999—in time for students to attend Intel ISEF 2000.

The Ministry of Science and Technology and the National Research Council sought to increase participation by creating regional fairs in 20 different districts. Intel sponsored a major four-day workshop for teachers and curriculum advisors on how to develop fairs. Three regional fairs sent students to the national fair in 1999, more than doubling the number of participants.

The Minister of Education issued a mandate that every region had to have a fair. In 2001, the Ministry of Science and Technology contributed additional money to support that mandate. Meanwhile, Intel continued to provide teacher training. A presidential decree in 2003 that became law in 2004 established a national science fair program supported and administered by the Ministry of Science and Technology in collaboration with the Ministry of Education, adding more funding and a framework wherein every school has an opportunity to participate.

In five years the participation rate grew from 1% of the student population to 45%. About 3000 of Costa Rica's 5000 schools are now participating. Even students from remote one and two-room schoolhouses are participating at a competitive level. "We've seen a lot of change in the attitude of the kids and in the quality of their projects," said Bialas.

As participation in science fairs throughout the K-12 system increased, the University of Costa Rica found they needed to strengthen their teacher training program. Therefore, the Students as Scientists program, developed by educators in the U.S. and funded by Intel, was offered as a continuing education credit program. 1500 teachers were trained in 2004, and the program is in high demand. Local universities have become involved in their regional fairs as sponsors, judges, and by providing scholarships.

Two individuals and one team presented their projects at Intel ISEF 2006.

Josue Roberto Murillo Fernandez, 17, created a new environmentally-friendly construction material from recycled milk and juice containers (Tetra brics) called Bricklam. The material is an inexpensive, sturdy substitute for other construction materials. Jorge Andres Morales Delgado, 18, designed a software program interface for common user tasks that runs on multiple operating systems.

The team project from Costa Rica focused on a method to biodegrade compact discs. Olga Yuts, 18, Jose Trigueros, 17, and Diego Segura, 17, determined the fungus *Geotrichum*

candidumoen, which already lives in the natural environment, could adapt to the difficult substrate and use it as a food source.

They easily gathered more than 300 compact discs in five days for their experiment, a subtle indication of the amount of waste they cause. The team inoculated soil and rice with the fungus and added those to Petri dishes containing pieces of CDs. Within two weeks there were noticeable results; the fungus was growing and the CDs were disintegrating. The team went on to design a device to degrade the CDs in larger volumes. What's more, they found the residue from the CDs could be recycled into other plastics.

The team won the third place Grand Award in Environmental Sciences and scholarships of $1000 each.

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Intel ISEF

No Boundaries, No Limits

Primatologist and National Geographic correspondent Mireya Mayor found her destiny in the palm of her hand. Speaking before a crowd of 4,000 at the opening ceremonies, Mayor showed Intel ISEF attendees what it means to live with no boundaries, no limits—the theme of the evening's event. Embracing every opportunity as a learning adventure she's traversed the jungles of Madagascar, swam among great white sharks, and camped on the narrow ledge of a sheer rock wall 14,000 feet above the ground.

"I didn't take the typical scientist route...As a child any interest in science was quickly dispelled by my teachers." While in college she became an NFL cheerleader for the Miami Dolphins. Then in 1996 she took her first anthropology class and was hooked. "I started asking questions. I found the more I asked, the fewer answers there were. There was still a lot of mystery out in the world."

About a year later, having never been on so much as a family camping trip, she set off on her first expedition to a remote part of Madagascar, the only place on earth where lemurs are found. More than 60 species of lemurs are found on the island, but at least 15 more have become extinct. On one of her frequent field expeditions there, in 2000, Mayor discovered a new lemur species—microcebus, or mouse lemur. Nestled between her thumb and forefinger, this rare, small creature inspired her to tackle another great challenge. Presenting her field work to the Prime Minister of Madagascar, Mayor was able to convince him to declare the region a national park to protect and conserve the remaining ten percent of the island's original vast forests. "That's what the inability to see boundaries can accomplish."

At the close of her speech, Mayor reminded everyone to "dream big. Don't let anyone discourage you. And save the lemurs."

Primatologist Mireya Mayor urged finalists to dream big.

In 2000, Mayor discovered the world's smallest primate.

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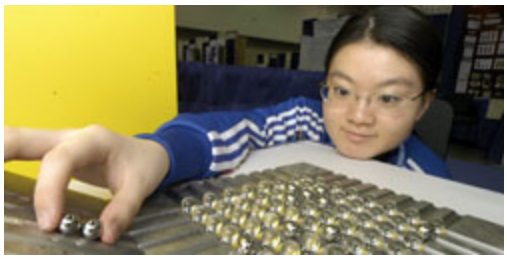
intel innovation in education



Intel ISEF
Discovering Innovative Solutions

Learning with Music


Kayla Cornale

Canadian Kayla Cornale, 16, developed a computer-based teaching system for children with autism that helps them learn to read, write and recognize emotions. Children with autism have difficulty interacting socially and experience developmental delays in all aspects of language comprehension and acquisition. Sounds into Syllables* is based on the premise that musical tones can assist these children with linguistic and social development.

Inspired by a young cousin with autism, Kayla began her research two years ago. She learned that autistic children often have an affinity to music and better tone recognition. She assigned musical values to each letter of the alphabet to aid letter recognition and started with simple common words—essentially spelling by sound. She identified word groups (noun, verb, adjective) by color to increase visual recognition.

After working successfully with her niece on reading and writing with this method she further developed the program to help develop social recognition by associating three-part harmonies with icons representing the six universal emotions (happy, sad, afraid, angry, surprised, disgusted). Then she combined these elements in an electronic story book, *The Story of Little Bear*, to provide the necessary context. The computer-based program includes a modified keyboard incorporating the icons and color coding.

Results are impressive. Kayla found the cartoon images of Little Bear and his changing expressions made her nine-year-old cousin more conscious of the human face and the linking of three-part harmonies to the six emotions has reinforced the feeling each emotion conveys. Kayla's cousin now tries to reproduce the expressions herself in a mirror. In addition, her attention span has increased considerably.

Kayla has applied for a patent in the United Sates and Canada and plans to continue testing the program across a wider spectrum of learning disabilities.

Designing an All-Terrain Wheelchair


Christopher Olsen

Many people throughout the world have physical handicaps that confine them to wheelchairs. Although they allow a basic level of mobility, there are considerable limits to maneuverability. Even the most advanced wheelchairs can be stopped by a curb.

Christopher Olsen's mother is a nurse and cares for a patient with multiple sclerosis who'd played wheelchair tennis until she lost additional functionality. Chris started to work on a machine to help her when he began to recognize the numerous everyday obstacles people in wheelchairs face. He spent some time trying to navigate one himself and nearly fell out more than once. As a result he decided to design a wheelchair that could function on all terrain.

His design criteria included: omni directional movement; the ability to climb curbs and other obstacles up to eight inches high; the ability to travel along natural paths and rough terrain; 4-wheel drive; and the ability to adjust the center of gravity, seat height and width. He began with preliminary sketches of wheel designs and found a hubless wheel would allow off-set pivot points for added extension of the arms. Each wheel has a small drive motor like those used in robots. Linear activators allow sufficient extension to climb steps. Chris built a ¾-scale model made of PVC and ABS plastic. A survey of dozens of wheelchair designs show none combine all the maneuverability, terrain and climbing attributes of Chris's design.

Improving Water Meter Technology

The projects at Intel ISEF frequently demonstrate how the precise application of the right technology can solve a vexing problem. During the past few years there has been a steady increase in the cost of water for the people who are served by the Water and Sewers Authority of Puerto Rico. Water theft and other sabotage is increasing consumer costs and

has become a growing problem. Patricia Torres's goal was to try to prevent theft by designing a new electronic water meter to replace older, unreliable analog designs. She sought out the expertise of an electronic technician, and civil, electrical and mechanical engineers in designing and constructing the new wireless digital device for which she has received a patent.

CONRESCA (wireless remote meter) generates its own electricity and communicates to a central wireless system. The San Juan senior housed sensors in a PVC cylinder that activates every 12 hours to monitor water usage and flow. The meter sends data to the nearest data compiling center. Patricia found the meter gives much more accurate readings than previously available and can be used to find broken parts and leaks in the water system. Having proved the concept, Patricia's hope is to convince the government and Water and Sewers Authority to fund a pilot program in the metro area with full scale models of the device.


Patricia Torres

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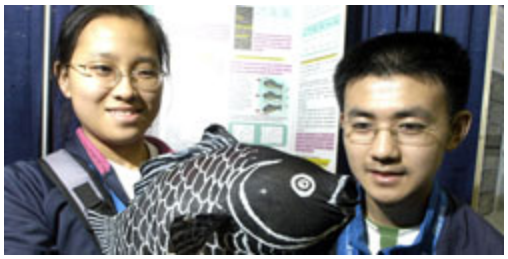

Intel ISEF

Creating Eco-Friendly Products

Oil-Eating Bacteria Clean Waste Water

Jordan Singer

Off-shore oil wells pump water to force oil up into the rig. The water is continually recirculated, which concentrates the water with organic waste and salt. Refining oil creates even more waste water. Methods of treatment are limited by the high salinity and the toxic nature of the crude oil - the food source bacteria would use to efficiently degrade the Total Petroleum Hydrocarbons (TPHs). Alternatives such as disposal in landfills and desalinization can be costly, time consuming, and ineffective in terms of the extent to which the waste is degraded.

Pennsylvania senior Jordan Singer focused his approach on a new degradation method—natural selection. In previous years he'd looked at different types of bacteria to degrade oil. He knew he would need halophilic (Greek for salt-loving) bacteria that thrive in saline conditions. He bred them on pure crude oil. Many transfers from one culture to another naturally selected for bacteria best suited toward growth on crude oil and yielded a community of bacteria especially suited to degrade TPHs.

Jordan's data shows this bacteria may represent the most cost-effective and efficient means whereby large volumes of salty, oil-contaminated water can be purified. He plans to continue his research in college and look at isolating individual hydrocarbons and breeding bacteria for certain compounds.

Solar Powered Desalinator Purifies Water


Denilson Freitas

In the small town of Umbuzeiro dos Santos in the southwestern state of Bahia, Brazil Denilson Freitas's grandfather and his neighbors walk for miles for potable water, carrying it back to town on their heads. The poor community has aquifers nearby, but the concentration of salt in the water is so high they are unable to use it for domestic consumption.

With limited resources available, Denilson created an inexpensive, effective solar converter to desalinate the water. He constructed a solar simulation system with an artificial source of radiation (a halogen lamp) to test his device. The desalination device consists of a glass tube with a thinner metal tube running through it. He'd determined copper to be the best material to use relative to aluminum or copper-coated tubes. As water flows through the tube it is heated by thermal energy collected and concentrated by a parabolic mirror surrounding the tube. The mirrored surface effectively converts solar energy to thermal energy to heat the water to boiling temperatures. The salt collects along the copper tube, and cleaner water flows out of the device. The total cost of the system is about $12 per structural meter. Denilson's grandfather and friends are already putting the device to use.

Native Wildflower Cleans Up After Hurricanes


Alicia Ranney

After Hurricanes Katrina and Rita flooded the coastal regions along the Gulf of Mexico and the water retreated, the amount of salt left behind was more than six times higher than the concentrations that can cause crop damage. Salt concentrations in Louisiana's fields rose to 13.1 ppt; a concentration of only 2.0 ppt will cause substantial yield reduction. Plants that don't immediately die have trouble staying hydrated and have to divert energy from other processes. Left to desalinate naturally, it could take about ten years for the soil to return to normal.

When Alicia Ranney's father mentioned an article he'd read about deer eating a particular type of iris that absorbed salt in its leaves it gave her the idea to look at the native *Iris Giganticaerulea* as a means of desalinization. The giant blue flag iris is native to Louisiana, Mississippi and Texas.

Alicia grew the plants in salt solutions with concentrations of 5.0 ppt and 10.0 ppt and collected weekly samples for six weeks

to analyze the concentration of sodium in each. The sodium chloride concentrations from the leaves were all significantly increased, demonstrating that the plants are tolerant of the high salt concentrations. In practical application the leaves would be harvested to remove the salt they absorbed, while the rhizomes remain to re-grow and absorb more salt. Further research would determine the maximum a plant could absorb and whether the predictions hold true for different salt combinations. A few of the family's friends are planning to try it in their own fields.

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Aid for the Elderly

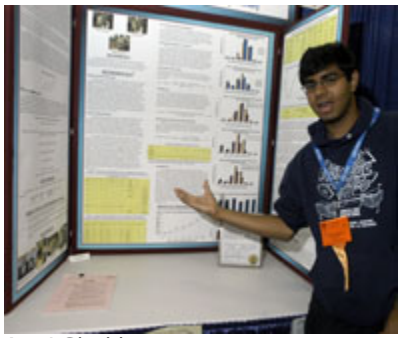
Gitte Jonsson

When Gitte Jonsson's grandmother in Denmark broke her hip, one of the most difficult tasks she faced was trying to get her socks on and off. The daily tasks that many of us take for granted can be arduous for the physically handicapped and elderly. At one point Gitte's grandmother even fell trying to remove a sock and had to be hospitalized. According to Gitte, the existing aids have left both patients and physiotherapists dissatisfied. "It's a quality of life issue; it's humiliating to ask for help all the time."

Convinced there had to be a better solution, the 19-year-old senior set about designing a device that would fix the shortcomings of existing products, especially the ability to both put on and take off socks. She studied existing aids, sketched several designs and tried out several models using steel wire until she found a design she felt would work, then she found a machine shop to create the prototype.

She took the aid to a therapeutic ward at the local hospital where patients and staff had experience with existing solutions. The first tests found Gitte's Sock-Aid much easier to handle but it needed additional refinements to accommodate different-sized people and different thicknesses of socks. The current product, available in three sizes, uses recycled steel and should be inexpensive to produce in quantity. Gitte has received a patent for the design in Denmark and has applied for one in the U. S. She plans to continue to improve the design, increasing its strength and making it easier to hold.

Stomach-Friendly Pain Relievers



Anuj Shukla

Many prescription drugs have adverse reactions, leading pharmaceutical scientists to search for new ways to deliver combination drugs that can mitigate negative effects and thus increase patient compliance. Anuj Shukla, 16, of Memphis, Tennessee, looked at how to solve the problem of popular pain relievers causing stomach distress.

Non-steroidal anti-inflammatory drugs (NSAIDs) are widely used for muscle aches, headaches and fever. But because of their acidic nature, NSAIDs irritate the lining of the stomach, which can lead to the development of gastric ulcers. Doctors often prescribe antacids to combat this. Anuj's goal was to design and formulate a single-dose combination capsule consisting of an NSAID (ibuprofen) and an antacid (sodium bicarbonate).

Combining two or more drugs into a single dosage form such as a capsule requires a thorough understanding of the properties of the drugs and the equipment and processes used to manufacture the dosage form. Anuj used a process called extrusion spheronization to create spherical pellets that can be put in capsules. Through the course of his project he used various process and formulation parameters to optimize the process, including different types of extruders and different spheronization times, conducting a series of tests on drug release times, dissolution and acidity.

Anuj found an effective combination dosage form that can prevent gastrointestinal irritation and possible bleeding from the side effects of NSAIDs. He plans to continue optimizing the formula, and look at additional antacids, such as calcium carbonate.

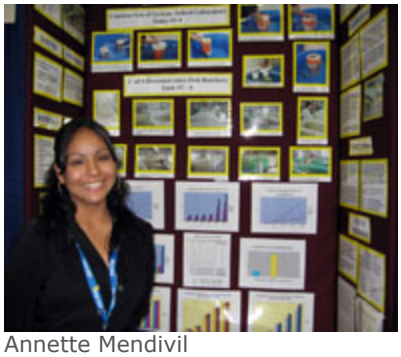
Do Feed the Fish

Annette Mendivil, 17, had one goal when she started her aquaculture project three years ago—determine the optimal conditions for growth in producing tilapia fish for commercial use by the Gila River Indian Community. The Tribal Farm's commercial aquaculture production had once thrived, but was abandoned as it became unprofitable.

Her earlier studies determined optimal lighting conditions for raising the fish. She found continuous lighting using fluorescent light so that no extra heat was generated, was ideal. Now she would tackle optimal feeding. Tilapia are fed a Total Daily Protein (TDP) ration, typically once a day, to stimulate growth. With access to the Tribal Farms tanks, and the

support of a mentor who used to work at the hatchery, she experimented over a four-month period with different feeding schedules. Fish fed once a day gained 15% in overall weight over the four months. Those fed their TDP in two portions a day gained 20%. But those with a feeding schedule of five times a day gained 65% in overall weight in the same period. It typically takes up to eight months for tilapia to reach a sellable weight; Annette had cut the time to market in half.

"The information gained in this three-year study will help our Tribal Farm raise tilapia in a more economically viable way to sell to Arizona groceries and restaurants." Annette said. She will be presenting her findings to the Tribal Council and has developed a business plan. "My research in aquaculture production means a return to the community's cultural roots and a way of having economic diversity."


Annette Mendivil

New Hope for the Disabled

Yin Fan Denis Huen, a senior from Hong Kong, presented his fourth-generation design for a cheaper, more effective prosthetic leg. He was aware that people living in poverty cannot afford sophisticated prosthetics, and had read about the number of people injured from old World War II land mines. His own volunteer work brought him into contact with people with physical disabilities. As a result he began his effort to produce a practical, inexpensive yet effective artificial leg.


Yin Fan Denis Huen

He has always liked to draw and was sketching a robot one day when he realized he could adapt the leg design into something far more useful. Taking further inspiration from his environment he noticed a backhoe and loader and got the idea to incorporate a pneumatic system to help the leg expand and contract. He researched the structure of the human body, the contraction of muscles, and the force needed to raise the body while climbing stairs. He created several prototypes for testing, improving the design along the way, making it slimmer, lighter and improving the movement.

Denis plans to study biomedical engineering and would ultimately like to design an artificial heart that relies on the body's own electrical properties for power.

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