Intel International Science and Engineering Fair

What it Takes to Make it to the World's Largest Science Fair
It starts with a good idea. Motivated by curiosity and an enthusiasm for research. Driven by the resolve to keep going even when obstacles arise. This is what it takes to make it to the world's largest science competition, the Intel International Science and Engineering Fair (Intel ISEF).

Eventually, each of these young scientists achieved degrees of success, resulting in recognition at local, regional and/or state science fairs affiliated with Intel ISEF. Their projects are impressive: potential treatments for medical diseases, valuable research on environmental issues, and a whole range of gizmos and gadgets that may just improve life for us all.

Here are a few of the stories of the young men and women - and projects - that made it to Intel ISEF.

Siti Sarah Zainal Alimuddin, Kuah Kedah, Malaysia	Concerned about her neighbor's health and the environment, Siti Sarah Zainal Alimuddin, developed a simple, inexpensive, environmentally-friendly portable stove.
Jie Jin Beijing, China	Jie Jin developed a sophisticated anti-drowning system by attaching sensors to swim goggles.
Holly Reid Batchelor Edinburgh, Scotland	In her research on cosmic rain, Holly Reid Batchelor designed and constructed cosmic ray particle detectors.
Cameron Kruse Colorado Springs, Colorado, USA	To ensure that new baseballs are uniformly prepared for professional play, Cameron Kruse designed an electronic baseball mudding machine.
Cristian Miguel Orozco Vega Upala, Alajuela, Costa Rica	After observing a plant that appeared to be naturally repellant to insects, Cristian Miguel Orozco Vega used the plant to develop an organic insecticide for agricultural use.

Siti Sarah Zainal Alimuddin, Malaysia
When Siti Sarah Zainal Alimuddin looked around her rural Malaysian community, she grew concerned about the health of her neighbors and the wellbeing of the entire planet. "Many people in my country are still burning wood," the 18-year-old explains. "They don't have a proper stove and so they burn wood in the open air. This is not good for them or the environment."

To help her neighbors find a better alternative, Alimuddin set out to design a simple, environmentally-friendly stove.

Because the stove had to be constructed of something easily accessible in this remote region and, above all, something affordable to the people who reside there, Alimuddin settled on using recycled tin cans of different sizes as the key components of her design. She constructed the stove to work via a gasification process which converts solid fuel into gas burned to produce heat.

For fuel, Alimuddin turned to rubber-wood sawdust obtained at no cost from a local furniture company. This sawdust biomass, she realized, could be converted into a useful form of energy instead of ending up in a landfill or burned as waste.

Based on several parameters of data, Alimuddin's portable sawdust biomass stove proved to be an efficient source of heat and a healthier option for all. "Fossil fuels will face depletion in the near future and it is incumbent upon us to find alternative forms of energy for the future generation," Alimudden says. "Among the various kinds of alternative fuel available, biomass is one of the most potential sources of energy." Alimuddin earned recognition for this research at the Malaysia Technology Expo and MRSM Young Scientist fair before coming to Intel ISEF.

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Jie Jin, China

At first glance, they look like your average pair of swim goggles. But if you look more closely, you'll see the intricate wiring and attached sensor, a clue that there's nothing ordinary about them. They are part of a sophisticated anti-drowning system designed by Jie Jin, an 18-year-old student from Beijing, China, who came up with the idea after learning that drowning is a leading cause of unnatural death for children.

Looking for a solution, Jin came up with the idea of incorporating an alarm system in swim goggles. Utilizing photoelectric sensors, along with wireless network communications and computer technologies, Jin developed goggle detectors, alarm handsets, and a computer data processor that work together to provide an anti-drowning system for use at home, on the beach, and at large public swimming pools.

When the goggles are immersed in water, a clock starts running. Users set the clock for a specified number of seconds, based on the experience level of the swimmer. When the goggles have been immersed for longer than the set period of time, an alarm is sounded on the networked handset or computer. Additionally, the goggle detector emits a radio-frequency signal to aid in locating a swimmer in trouble.

Jin says he faced "many, many challenges" in his research, including an initial problem with signal transmission under water. But he kept working. His efforts on this project garnered him awards at the Children Science Fair of Beijing and the national China Adolescents and Technology Invention Contest.

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Holly Reid Batchelor, Scotland
Some scientists believe that cosmic rays may influence the Earth's climate and have an impact on global warming. Intrigued by this theory, Holly Reid Batchelor decided to focus her research on cosmic rain. For her Intel ISEF project, the 17-year-old from Edinburgh, Scotland, investigated various aspects of cosmic ray particles as she set out to test and confirm current theories about the physical and energy distribution of the particles.

Her work involved detecting the angular distribution of cosmic rays and the energy spectrum of muons at sea level, as well designing and constructing equipment for collecting cosmic ray particle data. The latter included a cosmic ray hodoscope constructed with scintillator paddles, photomultiplier tubes, and a circuit board, as well as a diffusion cloud chamber simple and inexpensive enough for schools to use for educational purposes.

Batchelor says there were a few bumps along the way. One design she attempted was so "hugely fragile" she had to add a protective case. She says she also struggled with photomultiplier tubes: "They don't behave at all. They break. They shatter. They turn themselves on. They turn themselves off. They take a lot of fiddling about just to get them working."

Before coming to ISEF, Batchelor earned an award for her research at The British Association for the Advancement of Science Service CREST Science Fair.

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Cameron Kruse, USA
In professional baseball, one of the requirements is that new balls must lose their shiny finish before they can be used for play. As a veteran batboy for the Colorado Springs Sky Sox, Cameron Kruse, 17, had already logged in a few summers rubbing balls with commercial "baseball mud" to dull the finish. Because the balls were rubbed by hand, Kruse noticed that there were inconsistencies from ball to ball, and sometimes even on the same ball. These variances could make a big difference in how a game might play out. For instance, a bright, white ball could give the edge to a batter hoping for a homerun; a duller ball might be nearly invisible as it flies across the plate and an umpire yells, "Strike!"

To address this problem, Kruse started tinkering. Using some Lego* bricks, including small motors that come with some mechanized kits, Kruse invented a device capable of rubbing baseballs to a uniform color and weight. Lasers and sensors incorporated in the device help ensure that the same, precise results are achieved every time.

There were some hitches along the way, notes Kruse, who built two prototypes before the current model. As testament to the new-and-improved function of prototype number three, the device is now used consistently by the Colorado Springs Sky Sox, and has been tested in the Major Leagues by the Colorado Rockies.

Kruse won the Grand Prize and an electrical engineering award at the Pike's Peak Regional Science Fair and placed second at the Colorado State Fair before coming to Intel ISEF.

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Cristian Miguel Orozco Vega, Costa Rica
On the Costa Rican farm where he was raised, Cristian Miguel Orozco Vega, 19, witnessed firsthand the damage insects can do to crops. He was also well aware of the potential health hazards of various chemical insecticides. So when he noticed a common, decorative house plant that seemed immune to insects, he came up with a novel idea. Why not create a natural, environmentally-friendly insecticide using this insect-repellant plant as the key ingredient, and see if it could be used to protect farm crops from insects? Thus, his research project was born.

Using a randomized bio-statistical block design and different concentrations of extracts from the plant Zamioculcas zamiifolia, Vega treated vegetable crops—in this case, Raphanus sativus, a variety of radish—on his family farm. Each plot in each block received a different treatment, and evaluations of plague attack events were routinely conducted.

"The data determined an attack to the plantation inversely proportional to the concentration of plant insecticide applied," Vega reports. "In other words, the higher the concentration, the lesser the attack of insects."

Vega's research is important to the small farming community in which he lives as it offers effective, organic insect control for agricultural use. Additionally, it may open the door for further research and broader geographical application.

Before bringing his work to Intel ISEF, Vega won prizes in local and regional competitions, as well as Costa Rica's national Feria de Tecnologia e Ingenieria.

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Intel Chairman Craig Barrett kicking off the 2007 Intel International Science and Engineering Fair.

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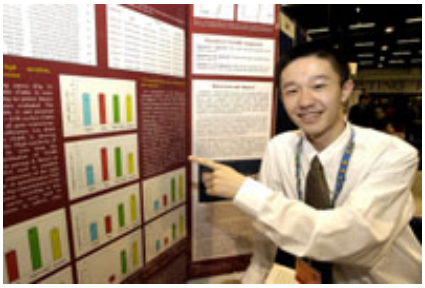
Meet the Intel Foundation Young Scientist Award Winners
Three high school students earned top honors at the Intel International Science and Engineering Fair when they each received an Intel Foundation Young Scientist Award and a USD 50,000 college scholarship.

Dayan Li



Dayan Li has been interested in "the mysteries of human anatomy" since he was a young child. So when the 17-year-old Eleanor Roosevelt High School senior from Greenbelt, Maryland, interned at the National Institutes of Health last year, he dove right into an area that's been puzzling scientists for years: how to prevent cancer.

"Specifically, I looked at tumor markers in endothelial cells," Li explains. Working with cells from the inside of human umbilical veins, Li examined the effects of Thrombospondin-1 (TSP1) and nitric oxide (NO) on angiogenesis. The objective: to determine how to inhibit this process—essential to tumor growth and metastasis—and thus, inhibit cancer.

Past studies have shown TSP1 to be an angiogenesis inhibitor and NO to have the opposite effect. But in Li's research, he found that NO can actually inhibit angiogenesis in low concentrations. And when TSP1 was combined with NO, the reaction switched from inhibitory to stimulatory.

"This is the first report of a TSP-1-induced NO functional switch in human endothelial cells," notes Li. "Such finding clarifies NO's friend-foe reputation and the contradictory tumor responses to TSP-1-releasing drugs, thus prompting a re-evaluation of the drugs to make them safer and more efficient."

Philip Streich

"What's amazing about carbon nanotubes is that they have unrivaled mechanical, electrical, and thermal properties," explains Philip Vidal Streich, a 16-year-old home-schooler from Platteville, Wisconsin. "They are stronger than diamonds, 10,000 times more conductive than silver. And they have the highest strength-to-weight ratio of anything known to man."

The problem is that carbon nanotubes tend to clump together in rope-like bundles and lose their superpowers. Despite efforts to prove the contrary, many scientists have assumed that nanotubes are insoluble and therefore impractical for most real-world applications.

In his research, conducted at the University of Wisconsin, Streich came up with the idea of using static light scattering to observe the effects of a chemical solvent on carbon nanotubes. Because commercially available spectrometers were not sensitive enough for his testing, Streich designed and custom-built his own "using spare parts from the lab."

The result: the first quantifiable evidence that nanotubes are indeed thermodynamically soluble. "This could be the key to finally applying nanotubes as a super-material," observes Striech.

Dmitry Vaintrob

When Dmitry Vaintrob was eight years old, he asked his dad if there were an infinite number of Pythagorean triplets. His father, a mathematician, suggested Dmitri try to figure out the answer for himself. Solving the problem was so much fun, the youngster got hooked.

Today, Vaintrob, now 18 and a senior at South Eugene High School in Eugene, Oregon, is following in his father's footsteps, pursuing a career in mathematics. This past summer, Vaintrob attended "summer camp at MIT" through his participation in Research Science Institute, and began work on his current research project: a mathematical investigation of string topology.

Vaintrob's research involves applying algebraic expressions to certain dimensional spaces. His work shows that loop homology and Hochschild cohomology coincide for an important class of manifolds. "For the first time," Vaintrob explains, "there is an algebraic computation for the string topology Batalin-Vilkovisky algebra of a higher dimensional surface other than a sphere or a projective space."

This research, related to string theory, may have important implications in the field of theoretical physics.

Looking Back at Past Intel ISEFs

Intel ISEF 2006 (PDF; 34 pages)
Intel ISEF 2005 (PDF; 19 pages)
Intel ISEF 2004 (PDF; 23 pages)
Intel ISEF 2003 (PDF; 7 pages)
Intel ISEF 2002 (PDF; 3 pages)

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International students representing their countries at the opening ceremony.
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Students trading pins representing their country at the pin exchange.
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Students taking time off to dance at the New Mexico Welcome Event and Dinner.
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The Albuquerque Civic Plaza was the site for the host city welcome event. Students enjoyed the live local band.
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Attending the panel discussion and talking with six Nobel laureates is a main highlight for the students. Nobel laureates include: Jocelyn Bell Burnell, Hörst L. Stormer, Robert F. Curl, Leon M. Lederman, Dudley Herschbach, and Kurt Wüthrich.

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Alexandria Ocasio-Cortez from New York, USA, explaining her science project to Intel Chairman Craig Barrett.

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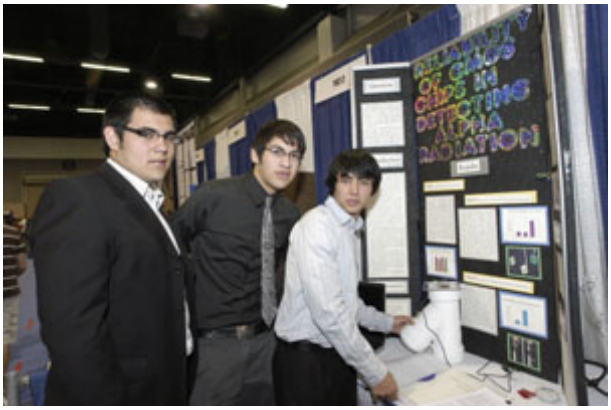

A team from Malaysia showing their science project.
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Elizabeth Flores and Christina Izatt from Provo, Utah, USA, teamed up to compete in the Intel ISEF 2007.
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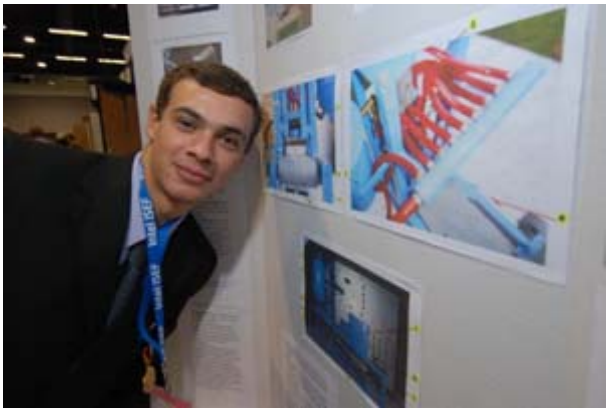

Pedro Vignolo from Paysandu, Uruguay proudly shows his project.
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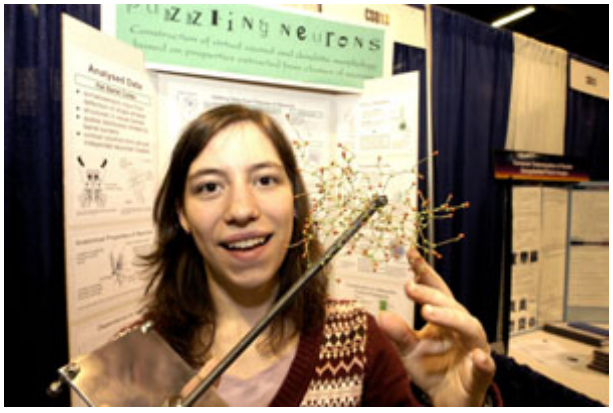

Katja Miller from Hermannsburg, Germany explains her science project on nuerons.
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Explaining their project on *Controlling Metal/Polymer Adhesion*, Jacob Lowenstein & Brienne Kugler from Jericho, New York, USA display their project.
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Intel International Science and Engineering Fair

When more than 1,500 of the world's brightest young scientists and mathematicians gathered in Albuquerque, New Mexico, to compete in the 2007 Intel International Science and Engineering Fair (ISEF), their research projects ran the gamut.

Promising projects at this year's competition tackled such themes as: global warming, including research on alternative bio-fuels; cancer treatments, including a way to target specific cell proteins that may contribute to tumor growth and metastasis; engineering solutions, including the invention of a cybernetic arm that increases user strength; and space studies, such as exploring the possibility of moon colonization.

Though subject matter varied greatly, all of the work presented demonstrated a sense of curiosity, a passion for research, and a drive to chart new territory in the world of science. Among this year's participants, more than 20 percent either already have a patent or have applied for one.

2007 Intel ISEF Podcasts
Hear from this year's Students scientists about their projects.
Start listening* ›

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Intel Foundation Young Scientist winners take the stage.
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