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Intel ISEF

# Highlights From Intel ISEF 2003

A Week of International Competition

## Fair Honors Young Scientists From Around the World

Some 1,300 young scientists from nearly 40 countries came together in Cleveland, Ohio, for Intel ISEF 2003. The world's largest pre-college science competition awards more than \$3 million in scholarships.

## Meet the Intel Foundation Young Scientist Winners

Three high school students who earned the Intel Foundation Young Scientist Award at Intel ISEF 2003 share a passion for science. Each received a US\$50,000 scholarship and a high-performance computer.

## Student Research Projects Reveal Wide Range of Interests

Students tackle innovative research projects that cover the map.

## Honoring Teachers of Excellence From Around the World

Meet the teachers honored for their successful classroom strategies.

## Esteemed Scientists Share Their Wisdom

Finalists came face-to-face with seven of the world's top scientists, including five Nobel Laureates.

### 100 Years of Flight

Astronauts share stories from space.

### 'The Best Week'

Students enjoy a whirlwind week.

### View the Photos

See memorable photos of Intel ISEF 2003. A Week in Review.



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# Meet the Intel Foundation Young Scientist Winners

## Intel Foundation Young Scientist Award

Three finalists received the highest award of the Intel International Science and Engineering Fair on Friday, May 16, 2003. Each of the winners received a \$50,000 scholarship and a high-performance computer.

### **Lisa Doreen Glukhovsky: Locating Asteroids**

Lisa Doreen Glukhovsky, 17, a junior from New Milford High in New Milford, Connecticut, has always loved astronomy. She spent a year conducting research at the John J. McCarthy Observatory in Connecticut where she developed a new method for determining the distance of asteroids from Earth. (She was at the observatory so often, she was given her own key to the facility.) The method she developed compares images of asteroids taken at distant locations. Using astrometry software and images taken by amateur astronomers, her method determines the target asteroid's positional coordinates. Glukhovsky's approach could lead to better warning or even prevention of cosmic impacts in the future. When she's not gazing at the sky, Glukhovsky enjoys playing the piano and violin, reading, and traveling.



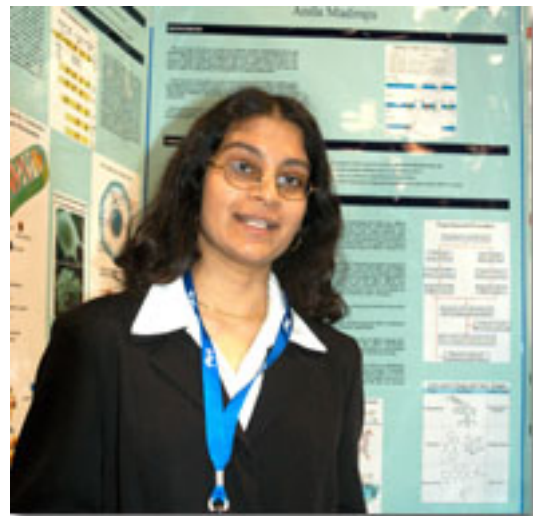
### **Elena Leah Glassman: Communicating With Brainwaves**

Elena Leah Glassman, 16, a junior from Central Bucks High School West in Doylestown, Pennsylvania, has developed a program that may one day enable a person with muscular disabilities to use brainwaves to control a computer keyboard. From the first time she heard about brain-computer interfaces and understood their potential for enabling communication by persons with muscular disabilities, Glassman knew she wanted to contribute to their development. Her project involves creating a method and corresponding computer program for interpreting EEG (electroencephalograph) signal commands from the user. A three-year finalist at ISEF, and also a trumpet and Frisbee player, Glassman says she is "fueled by the wonder of a new problem, the exhilaration of development, the satisfaction of its solution, and its real-world application."



### **Anila Madiraju: Targeting Cancer Cells**

Anila Madiraju, 17, a senior from Marianopolis College in Montreal, Quebec, Canada, set out to solve one of medicine's persistent challenges: how to treat cancer patients effectively without destroying their healthy cells. She applied the cutting-edge technology of RNA interference, or RNAi, in a project that may contribute to a less toxic therapy against cancer. Her project is a continuation of research that she began in 2000, when she studied a compound from birch trees as a possible treatment for melanoma. She has had to keep up with rapid advancements in the field of biotechnology to continue her work, which may lead to treatments that specifically target cancerous cells and result in fewer side effects.





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# Student Projects Reveal Wide Interests

## Renato Angulo Chu: The Multibike

In Renato Angulo Chu's native city of Lima, Peru, many homes are without electricity. This 16-year-old student from Holy Trinity School has applied the principles of mechanical engineering to turn an ordinary bicycle into a human-powered machine to perform a variety of tasks that normally require electrical power.

Chu calls his invention the Multibike. It's a fitting name for a machine that can do everything from blending fruit drinks to sharpening knives to cleaning city streets. The power source is the person who turns the pedals. As Chu explains, "This offers a way to create new jobs for people without requiring electricity." The result, he hopes, will be an improved standard of living in his country.



Renato Angulo Chu: The Multibike

Chu has designed the Multibike to work either as a stationary bike or as a bicycle capable of traveling on city streets. That means the user can get exercise while performing a mechanical task. He also sought out inexpensive materials so that his product could be accessible to a large portion of the population.

Chu plans to continue refining his project and hopes to study mechanical engineering in college.

## Matthew Klaber: Modified Keyboard

Innovation sometimes comes from personal experience. In the case of Matthew Klaber, a 17-year-old from Mankato West High School in Mankato, Minnesota, it was a friend's experience that led him to develop a modified computer keyboard, accessible to those with motor skill impairments.

"A friend had lost his limbs due to bone cancer," Klaber explains. "I wanted to create something to make it easier for him to type than holding a pen in his mouth." Existing devices for adaptive technology are too expensive for many people to afford for home use, so Klaber made it a goal to create a cost-effective product.

His new keyboard design features nine large buttons that are easy to manipulate by users with fine motor skill impairments. Klaber had to construct the necessary hardware along with software to interpret the keyboard's signals. Although he says he has always been interested in computers, he had to teach himself a new programming language to get his keyboard to work. He also sought advice from a computer science professor who has multiple sclerosis, "so he sees the need for this."

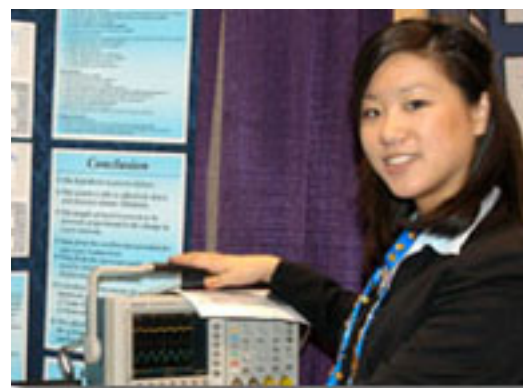
Klaber is considering college studies in computer science, political science, or biomechanics.

## Michelle Louie: Sensing System

For Michelle Louie, a 16-year-old from Kings Park High School in Kings Park, New York, the World Trade Center tragedy unfolded at close range. As she watched the search for survivors stretch out for days, she felt frustrated by the lack of technology to locate victims. "I began to research current devices and found they all had faults," she said. Soon, she was using her basement to engineer a more reliable sensing system.

Her design uses small lasers, optical fiber, and a photon detector. “This won’t melt, burn, or break,” she says, even under extreme conditions. And because her design makes use of optical fiber, it is not restricted by walls that curve. Louie sees potential applications to measure vibrations and monitor security at airports, in buildings, even on battlefields. “If a building collapses, you could use this as a probe to locate victims without having to excavate the whole site to find them.”

Louie, whose father is an engineer, says she grew up learning to design and build things. “I’ve been engineering all my life,” she says. She borrowed lab equipment to work on her project and didn’t hesitate to pick up the phone to seek advice from technicians. She says she’s keeping her options open for the future, “but engineering is always going to be a big part of my life.”



Michelle Louie: Sensing System

#### Chelsea Lei and Sisi Liang: The Age of Fossils

Chelsea Lei, 16, and Sisi Liang, 18, share an interest in science, especially archaeology. When a science teacher at their school, Robert F. Kennedy High School in Flushing, New York, suggested they participate in a summer research project involving fossils, they jumped at the chance. Working alongside expert researchers, they used cutting-edge technology to determine the precise date of fossils excavated from a high-elevation cave in Russia.

“The fossils from this cave are between 420,000 and 423,000 years old,” Lei says, making the cave the oldest archaeological site in Eastern Europe. Because tools were also found in the cave, the site offers tantalizing clues about ancient human history.

The students used a technology called electron spin resonance, or ESR, to date the fossilized deer teeth. ESR allows dating as far back as 5 million years. Carbon dating, in contrast, is limited to about 40,000 years.

Mathematical computations were required to do the analysis. “I did this project before I took calculus. That made it challenging,” says Lei. It was not a coincidence that she had Liang, a senior, as her teammate. Their school makes it a practice to team up sophomores and seniors. The seniors act as mentors, and the sophomores can continue with the research in future years. The students especially enjoyed the opportunity to work alongside professors and other experts. “They treat us as colleagues,” says Liang. “We do feel like scientists—real scientists.”

#### Ron Neuman: Detecting Water Safety

Ron Neuman, 16, from Ohel Shem High School in Ramat-Gan, Israel, remembers the day that he and 2 million fellow Israeli citizens had to avoid drinking water because the central water system had been poisoned. 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’s project involved 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 rapid accurate assessment of water safety.



Ron Neuman: Detecting Water Safety

The student researcher sees his project 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. Neuman’s device allows for mobile testing. “It’s small, cheap, mobile, easy to operate, but most important, reliable.”

**See More Student Research Projects** 



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# Student Projects Reveal Wide Interests

**Daniele Vilella, Giulio Pennetta, and Marco De Candia: Genetic Research**  
A team of three Italian students from Bari, Puglia, have conducted genetic research that may contribute to the development of diagnostic tools for early assessment of PKU in newborns. The students, Daniele Vilella, 18, Giulio Pennetta, 18, and Marco De Candia, 19, attend Liceo Classico Statale Socrate.

After a classroom introduction to genetics, the students were eager to learn more about the field. A professor in biotechnology gave them access to his laboratory for conducting their research. "Day by day, he permitted us greater access to the instruments," said one of the students.



Daniele Vilella, Giulio Pennetta, and Marco De Candia: Genetic Research

The student researchers discovered a new gene mutation, expanding the knowledge base about both PKU and the broader field of genetics. "We contribute to the national research and accelerate process of knowledge," said a team member. Better understanding of PKU at the genetic level can lead to early assessment and diet therapy to prevent negative outcomes.

Attending Intel ISEF has meant the first visit to the U.S. for the Italian students. Their reaction? "We have met people from all over the world, all cultures. But we are united by a love of science."

## Seung Kyun Ryu: Curing Obesity

Like millions of people around the globe, a South Korean student named Seung Kyun Ryu, 15, has had concerns about weight. Drawing on his longstanding interest in computer science, he has developed an interactive computer program called "Mr. Fatty" that provides an individualized weight-loss program based on diet, exercise, and behavior, while also incorporating the science of Oriental medicine.

Ryu attends Jangyoungsil Science High School in Busan. Although only 15, he has been studying at Pusan National University for two years.

His program prompts a user for inputs such as physical body data and goals, then offers individualized advice on diet, exercise, and behavior. As the user changes behavior, such as increasing exercise levels, the new information is fed back into the system, resulting in updated recommendations.

## Andrea Axtell: Walking in Circles

Andrea Axtell, a 16-year-old competitive swimmer from James Bowie High School in Austin, Texas, has heard stories about people who become lost in the desert or wooded areas. Literature also has plenty of tales about people who lose their way. "They all talk about wandering in circles," she says. That expression got her wondering about directional clues, so she designed a test to evaluate whether there's any truth to the feeling of "walking in circles."

Axtell recruited volunteers who agreed to put on a blindfold then make their way across a football field. At five-yard intervals, she placed obstacles. She recorded their progress each step of the way. Using statistics to analyze her data, she found that right-handed subjects angled off to the right when they encountered an object and left-handed subjects angled to the left. Further, height played a statistically significant role. Shorter subjects walked in a tighter arc. Axtell's use of mathematical modeling

showed that if subjects had continued walking, they would have walked in a circle or an ellipse.

The information has applications for outdoor enthusiasts, search-and-rescue teams, and possibly even military strategists. Explains Axtell, "You could train people to prevent curving by alternating right and left when they go around obstacles." Knowing whether a lost person is right-handed or left-handed, as well as the person's height, could help define search areas.

#### Lukas Vidensky: Physics of Tibetan Bowls

Lukas Vidensky, 19, from Grammer School in Brno, Czech Republic, remembers the first time he heard someone playing music on Tibetan bowls. "I liked the sound and wanted to play on them," he says. He also wanted to understand the physics that produce such distinctive acoustics. Libraries and the Internet offered plenty of information about the science of pianos, violins, and other musical instruments, but nothing about Tibetan bowls.

Vidensky developed the knowledge base himself, designing a research project that involved analyzing the sounds produced by the bowls. "I describe from a physical point of view how the Tibetan bowls behave," he explains. He also made acoustic spectra of these instruments, using laboratory equipment and a microphone connected to a computer to collect and analyze data.

He has posted his findings on the Internet so that others who are curious about the instruments can locate the information that he had to discover for himself. His interest in the science of Tibetan bowls has not dampened his love of performing on them. "I didn't find Tibetan bowls," he says. "The bowls found me."

#### Ridhwaan Suliman: Aerosols Over Africa

Ridhwaan Suliman, 16, a 12th-grader at Pretoria Boys High School in Pretoria, Gauteng, South Africa, set out to investigate whether aerosols over the Highveld of Southern Africa could be contributing to global cooling. "I found this idea interesting, exciting, and new, and took it up as a project," he explains.

Although most people are more aware of global warming, Suliman learned through research that aerosols may be contributing to global cooling by reflecting solar radiation back into the atmosphere and interfering with water droplets. Far from being a welcome solution to global warming, Suliman says, aerosols are associated with serious health effects such as asthma and bronchitis.

Suliman gathered measurements using a handheld haze meter, then sent his data to NASA for further analysis. Results show that the aerosols over the Highveld are occurring as a result of biomass and industrial activity. Suliman hopes that his research will lead to greater understanding of these issues and help lead the way to future solutions.



Andrea Axtell: Walking in Circles



Ridhwaan Suliman: Aerosols Over Africa

 [Back to More Student Research Projects](#)



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# Meet the Educators of Excellence 2003

Intel ISEF Excellence in Teaching Award Finalists

Promoting inquiry and inspiring students to engage in authentic research are themes found in excellent science classrooms around the world, according to an international panel of exceptional teachers. The six educators from China, Brazil, Russia, and the United States are finalists for the Intel ISEF Excellence in Teaching Award for 2003.

## An Inspiring Year

Josette Biyo, winner of the 2002 Intel ISEF Excellence in Teaching Award, promotes scientific research wherever she goes.

Finalists received an all-expense-paid trip to Cleveland for the week along with cash awards of \$1,000. Judging interviews took place during the week, and the grand award went to Zeng Guoshou from the First Middle School of Xiamen in Fujian, People's Republic of China. He receives a laptop computer, \$5,000 cash award, and grant for \$20,000 to implement his proposal.

To be considered for the award, entrants submitted a description of their teaching methods and a proposal for implementing these methods within a larger community of teachers. The entries are judged both on the current success of the method and its potential to benefit teachers and students.

The teachers shared highlights of their successful programs with other educators during a special presentation at Intel ISEF.

Zeng Guoshou of Xiamen, Fujian, People's Republic of China

Zeng Guoshou is a 31-year teaching veteran from the First Middle School of Xiamen in Fujian, People's Republic of China. Using nearby mountains and sea areas for field study, his students carry out scientific investigations and develop what Zeng calls "students' science nature." Fostering an environment of inquiry encourages students to be innovative. Zeng and his students have established a Biology and Environment Society, with experts and professors serving as advisors. He also has created a well-equipped laboratory, the Youth Science Education Base, where students carry out experiments and conduct analysis. Zeng encourages students "to be suspicious, to ask questions, and to put forward original ideas in their research process." Such activities help students develop the lifelong habit of "asking why."

Robert Pavlica of Armonk, New York, USA

Robert Pavlica of Byram Hills High School in Armonk, New York, began teaching science research in 1990 because one student asked for the opportunity to pursue independent research. Currently, 81 students are enrolled in Pavlica's three-year science research course, offered as an elective and open to students of diverse abilities. Pavlica has trained teachers from 170 school districts to adopt his approach, which he calls the Authentic Science Research in the High School Program. Pavlica, who has a Ph.D. in biochemistry and 32 years of teaching experience, says students should pursue research questions that come from "their areas of interest." The teacher's role is not to be an expert in all disciplines, but "to teach the process of research. The process is the lifetime message."



Russ Fisher-Ives of Rio Rancho, New Mexico, USA

Russ Fisher-Ives, an 18-year classroom veteran, teaches at Rio Rancho High School in Rio Rancho, New Mexico. He heads a program called SciMatics Academy, which embeds mentored student research into all math and science classes. Twice a year,



the school hosts a Student Research Expo featuring as many as 500 student projects. A turning point in developing the program came about when Fisher-Ives attended a previous Intel ISEF and met a 16-year-old student researcher whose enthusiasm was contagious. "It came from a genuine interest in her work. I knew that our kids were capable of being sparked, too, so we altered our program from what we wanted kids to research to what they wanted to do." Professional development on how to teach inquiry has helped teachers adopt new strategies. As he explains, "We now teach content through the process of questioning."

Alexander Leontovich of Moscow, Russia

Alexander Leontovich of Moscow founded an innovative Russian high school known as Lyceum 1553, affiliated with the Moscow State Educational Center of Creativity of the Young. He directs the secondary science program, which aims to create "a research way of thinking." Many students participate in research expeditions, where they pursue active investigations of their own interests in the company of scientists. Such opportunities build a sense of community and introduce students to the culture and traditions of the scientific world. To give students an opportunity to share their research, Leontovich organized the annual All-Russian Conference.

Hélio Luiz Brochier and Alberto Dal Molin Filho Novo Hamburgo, Rio Grande do Sul, Brazil

Hélio Luiz Brochier and Alberto Dal Molin Filho lead a multidisciplinary program at Fundação Escola Técnica Liberato Salzano Vieira da Cunha in Novo Hamburgo, Rio Grande do Sul, Brazil. They are the organizers of a large science fair called MOSTRATEC, which draws participants from across South America and has sparked student interest in scientific research. They observe that students who conduct research projects learn to plan, think, and create, skills which can improve their quality of life. They are also involved in training other teachers in Brazil in the methods that foster student inquiry.



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# An Inspiring Year

Josette Biyo, Winner of the 2002 Intel ISEF Excellence in Teaching Award

When Josette Biyo won the 2002 Intel ISEF Excellence in Teaching Award, she hoped to use the accompanying grant as a springboard to encourage more educators in the Philippines to teach scientific research. At Philippines Science High School in Western Visayas, Biyo has seen the benefits firsthand when her students are immersed in what she calls “the culture of science.”

During the past year, Biyo has managed to take her message to thousands of teachers in the Philippines. And at this year’s Intel ISEF in Cleveland, Ohio, she took advantage of another opportunity to inspire educators from around the world by addressing the Educators Academy.



Biyo, a 23-year teaching veteran who holds a Ph.D. in biology, encourages her students to pursue interesting questions that often lead to sophisticated research projects. Teaching in the relatively rural region of Western Visayas does not limit opportunities for research. Biyo’s students find good questions all around them, from studies involving the diversity of sea grasses and coral to explorations of mangrove forests.

As her first step to encourage more schools to offer science research classes, Biyo organized a fair at her school to showcase student projects. The event drew hundreds of teachers and younger students from throughout the region. Students from Philippines Science High School presented their original research in fields ranging from computer science and robotics to physics to oceanography. “It was beautiful!” says Biyo. “Teachers flocked to our school. They had the opportunity to feel what it is like to create a scientific culture among our students.”

The fair was the kick-off event for a series of professional development workshops Biyo organized for teachers. Some of the most successful events have engaged teachers in hands-on activities, such as identifying coral or learning procedures for microbiological assay. “Some teachers have not learned standard procedures yet, so we focused on procedures for studying terrestrial communities and marine communities.”

The workshops have given educators a taste for the excitement of doing real-world research. Biyo enlisted some of the top scientists in the Philippines to give presentations for teachers. She often connects her students with researchers as knowledgeable mentors.

Palpable excitement about science is what Biyo has managed to create at her school, where students often take field trips to visit research labs and work on independent projects under the guidance of mentors. Philippines Science High School Western Visayas, with about 360 students, is part of an elite network of public high schools devoted to teaching high-powered classes in subjects such as math, science, and computer science.

Biyo often enlists her students to help while she conducts her own field studies. “As a teacher, I feel I should be actively doing research because it’s the best way for my students to learn, also. They gain self-esteem and a certain sort of prestige, because they are working with a ‘real’ scientist. My methods become more credible because I am not just a teacher, but also a researcher.”

Being the winner of the Intel ISEF Excellence in Teaching Award has meant an especially busy year for Biyo, but her energy seems boundless. And her goal is clear. “We want to develop the scientific culture in our country,” she says. It’s happening already. Many of Biyo’s former students have gone into scientific fields. Indeed, many stay in touch and send her research

materials to use with her students. "Science research is not just teaching," she says. "It's mentoring."



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Intel ISEF

# Esteemed Scientists Share Their Wisdom

Panelists Field Students' Questions at Intel ISEF

What does it take to reach the heights of scientific discovery? A panel including five Nobel Laureates offered insights from their own life experiences during a special event of Intel ISEF 2003.



The rapt audience for the question-and-answer session included an international assembly of approximately 1,300 young scientists and mathematicians who are Intel ISEF finalists. The teenagers learned from the experts that great accomplishments come about through a rare blend of persistence, curiosity, hard work, intuition, courage, and even luck.

Richard Roberts, who won the Nobel Prize for medicine in 1993, advised students to “ask good questions. Ask big questions. Look for things that are unusual.” In the matter of luck, he added, “The key is to take advantage of luck when it comes along.”

Leon Lederman, a 1988 Nobel Laureate in physics, offered a tantalizing glimpse of the moment of discovery: “It usually happens at 3 in the morning. Suddenly, you become aware of a fact or a process that no one on the planet knows. You’ve learned something important. There are signs. Your palms sweat. You get chilled.” The next step, he said, is deciding who to awaken with a phone call. “Call some important to you.” The experience, he added, “may not happen often. Maybe once in your life. But it’s unbeatable.”

Carl Wieman, a 2001 Nobel Laureate in physics, explained that such moments of discovery are not the end point of research. “Have the guts to pursue it, once you see you’ve discovered something new and different. Have the courage and confidence to follow up, and then announce it to the world.”

## Lessons For Teachers

The seven members of the Excellence in Science and Technology Panel also offered insights for educators.

Jocelyn Bell Burnell, a renowned astronomer from the University of Bath and president of the Royal Astronomical Society, advocated for classrooms where students “are actively involved in the learning process.” She reminded the audience that “different people learn in different ways,” and cautioned against being “too prescriptive.” In response to a question about the role of imagery in her research, she added, “That’s extremely important and often underrated. In the West, science is the white coat, the scientific method. But where does the hypothesis come from? That’s intuitive. The discovery process is one hell of a mess.”



Robert Curl, who won the Nobel Prize in chemistry in 1996, pointed out that educators must reach a wide range of learners. For the students who pursue independent research projects for Intel ISEF, motivation is not a problem. “But we also must teach the average individual who professes to have no interest in science.” All learners would benefit from more engaging classroom experiences, he suggested. “What science is about is experimenting, not memorizing definitions.”

Dudley Herschbach, 1986 Nobel Laureate in chemistry, continues to teach general chemistry classes for freshmen at Harvard

University. He criticized teaching science and mathematics as a purely analytical, left-brain activity. “Students get the mistaken notion that science and math is about getting the right answer.” To counter that, he’s been known to assign students to write poems in his science classes. He also reminded the audience of the importance of passion as a force for discovery. “Indulge your capacity for getting excited and falling in love with a problem.”

Lawrence Roberts, who won the Charles Stark Draper Prize in 2001 for his engineering research that created the Internet, was the only panelist who recalled participating in science and mathematics competitions during his own youth. “That experience was important. It taught me the importance of carrying through. That carries on into later life.”



Not surprisingly, students were eager for advice about which fields to pursue and how to prepare for successful careers.

Burnell advised them to consider interdisciplinary research. “Watch the areas between disciplines.” Biology and math come together, for example, in research about how diseases propagate. “There are fertile collaborations where subjects meet.”

Richard Roberts offered “a pitch for biology,” pointing out that in his field, “our ignorance is immense.”

Herschbach encouraged students to follow their own interests as they choose fields for deeper exploration. “Find an area where your temperament and talent seem to match.”

New technologies may open areas for further research, Wieman suggested, by creating new tools for discovery and exploration.

For today’s students preparing for careers in science, math, and technology, the future appears bright. As Lederman said, “Science has never been more active and vibrant. The universe is full of mysteries,” just waiting to be explored.



Intel ISEF

# Celebrating 100 Years of Flight

Astronauts Share Highlights of Space Travel

Five astronauts who have viewed Earth from the lofty perspective of space described the risks and rewards of being an explorer scientist during a special presentation of Intel ISEF 2003. The event gave the audience of science, engineering, and mathematics students the chance to find out from the experts what it takes to prepare for a career in space exploration and to learn where the astronauts of tomorrow may be heading.

Guion Bluford Jr., the first African American to travel in space, told students, “To be an explorer requires a willingness to take risks, a desire to learn more and achieve more, setting high goals and being persistent enough to achieve them, and having a personality that allows you to be a good team member.”

Joining the elite company of NASA astronauts may require repeat efforts, according to Donald Thomas, a current astronaut and veteran of four space flights. Thomas applied to NASA four times before he landed an interview. It wasn't until the fifth try that he got the offer that led to his dream career. “Never give up,” he told students, “and start applying when you are young so NASA gets familiar with you.” In between his rounds of applications, Thomas worked hard to improve himself as a scientist.



Although the popular image of astronauts is about having “the right stuff,” these panelists suggested it's just as important to have “the smart stuff,” with a deep understanding of science. Harrison “Jack” Schmitt, who flew the last Apollo mission to the moon and later became a senator, says it was his love of geology that propelled him into a space career. When NASA asked for volunteers for the Apollo mission, Schmitt said, “I knew I'd regret it if someone else went to the moon. This experience gave me the chance to practice field geology in space.” He never planned to be an astronaut, he added, “but you have to be ready to take advantage of opportunities.”

Franklin Chang-Diaz, a current astronaut and veteran of seven space flights, reminded the international audience that “the adventure of space is now worldwide,” and includes people of all cultures and religions. A native of Costa Rica, he became a U.S. citizen before joining NASA. Being on a multicultural crew for extended missions “means you have to learn to respect one another's beliefs and have mechanisms to settle disagreements. That's the only way to survive,” he said, adding to laughter, “You can't just walk out the door.”

Kathryn Sullivan, the first American woman to perform a space walk and a veteran of three shuttle missions, admitted that being a space explorer “is dangerous stuff.” But the time to think about danger “is before you fill out the application.” When the moment of launch comes, she said, “I’m mainly excited to get to go.” Sullivan said the rewards of space exploration “have transformed our sense of ourselves and of our shared humanity.” Back on Earth, she sometimes still dreams about the experience of floating at zero gravity.

As the world celebrates the 100th anniversary of flight this year, current and veteran astronauts are considering where space exploration might lead next. A mission to Mars or a base on the moon were two of the possibilities the panelists described. Debates about the value of investing in space exploration are taking place at the political level. Funding future missions may require private sector investments and entrepreneurship, Schmitt suggested. But at the emotional level, the longing to explore remains powerful. As Chang-Diaz said, “We share a desire to keep pushing, to open the frontiers.”

The experience of traveling into space “helps us realize how small our own planet is,” added Bluford. From the perspective of space, “I didn’t see countries or boundaries. We all share this rock, and we all have to take care of this place together.”





# Intel ISEF

## The Best Week

Intel ISEF Finalists Enjoy Every Moment

Serious student research is the cornerstone of Intel ISEF, but the nearly 1,300 finalists who come together for the weeklong event pack plenty of fun into the experience. What do students do when they aren't on the exhibition floor fielding questions from expert judges?

In Cleveland, Ohio, for the 2003 event, students toured the Rock and Roll Hall of Fame and visited the Great Lakes Science Center. They danced into the night at a party that featured music from around the world. They listened to Ohio native and astronaut John Glenn describe space travel and stress the importance of curiosity. They traded pins with new acquaintances from other countries. Some took in an American baseball game while others headed to the movie theaters to catch a showing of "The Matrix Reloaded." And all week, they traded stories with peers who share their passion for science research.

"It's amazing," said a student from South Africa. "There are so many new people to meet."



An Italian finalist enjoyed strolling around downtown Cleveland and looking up at skyscrapers. "Everything here is so big. At home, we have buildings of seven or eight stories."

Although the judging experience is intense, many students find they enjoy the opportunity to talk with experts who ask detailed questions about their research. "The judges are cool," said a finalist from the Czech Republic. "They were so interested in my work." A boy from the Philippines said he had to catch his breath after back-to-back judging rounds, but gained some new ideas as a result of judges' questions.

Being surrounded by "peers who share your passion" was a highlight for a girl from the U.S. Getting acquainted was easy, she said, "especially if you like computer games. That's the golf of science geeks—it's how we relax."

With finalists representing all corners of the world, students had opportunities to make connections across cultures. "We come from everywhere," one finalist said, "but we are united by a love of science."

John Glenn inspired the students to continue their pursuit of new ideas. "You are a curious group," he said, "and I mean that as a compliment. All progress began with someone being curious."

[See More Photos](#) 







# Intel ISEF Photo Album

Building Life-Long Interest in Scientific Research

Parties, special events, and chatting with new friends from around the world were among the highlights for finalists attending Intel ISEF 2003.

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## Greetings From Glenn

Astronaut John Glenn welcomed students to Ohio.



## A Sea of Ideas

Project booths offered a visual summary of the research that students have been conducting for months.



## Getting Acquainted

Informal get-togethers and meals offered chances to get acquainted.



### **Pin Exchange**

Just like Olympic athletes, Intel ISEF finalists traded pins from their home countries.



### **Rock and Roll**

Cleveland's Rock and Roll Hall of Fame was the venue for a welcome event.



# Intel ISEF Photo Album

Building Life-Long Interest in Scientific Research

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## Seeing the Sights

When they weren't answering judges' questions, students explored the city sights.



## On the Floor

Cleveland Convention Center was the place for students to share their work and check out other students' projects.



## Sharing Their Work

Student scientists explained their projects to thousands of visitors.



### Visitors from Space

NASA exhibits gave students a close look at space-age gear. Current and former astronauts shared highlights of their adventures during a special panel presentation.



### Celebrating Science

Many finalists describe Intel ISEF as “the best week of my life.”