



TRIFECTA — An ARAV (Aegis Readiness Assessment Vehicle) sounding rocket leaves the pad at the Kauai Test Facility June 14, one of three successful Sandia launches in a nine-day period. More photos and information about the launches on page 4. (Photo by Michael Bejarano and Rob Shields, both 1535)



Sandia Lab News

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Managed by Lockheed Martin for the National Nuclear Security Administration

Self-assembled nanostructures function better than bone as porosity increases

Improved possibilities for microelectronics, membranes

By Neal Singer and Jeff Brinker

Naturally occurring structures like birds' wings or tree trunks are thought to have evolved over eons to reach the best possible balance between stiffness and density.

But in a June paper in *Nature Materials*, the Brinker and Fan groups at Sandia and the University of New Mexico (UNM), in conjunction with researchers at Case Western Reserve and Princeton universities, show that nanoscale materials self-assembled in artificially determined patterns can improve upon nature's designs.

Finer scale than found in nature

"Using self-assembly we can construct silica materials at a finer scale than those found in nature," says principal investigator Jeff Brinker (1002). "Because, at very small dimensions, the structure and mechanical properties of the materials change, facile fabrication of stiff, porous materials needed for microelectronics and membrane applications may be possible."

Nuclear magnetic resonance and Raman spec-

(Continued on page 4)



SANDIA RESEARCHER Jeff Brinker.

Sandia to play key role in Bay Area-based DOE bioscience center

BioEnergy Institute one of three research centers selected

By Mike Janes

A partnership of three national laboratories — including Sandia — and three research universities in the San Francisco Bay Area has been chosen to host one of three national bioenergy research centers, Secretary of Energy Samuel Bodman announced last week.

The center will be funded by DOE through its Biological and Environmental Research Genomics:

(Continued on page 3)



Hi-tech cannon

Sandia/California researchers are key players in a state-of-the-art Army program to perfect a new high-caliber, self-propelled cannon system with unprecedented capabilities. Story on page 5.



Like winning the lottery

Alicia Littlewolf was raised on the Northern Cheyenne reservation in rural Montana. After several summers as a Sandia intern, she says she felt like she won the lottery when she was hired on full time. Story on page 8.



Fun in the sun

School's out for the summer, but that doesn't mean the learning stops. Sandia brings science to the schools in a program that keeps kids involved. Story and photos on page 12.

What's what

If you can get away from work during the noon hour next Monday (July 9), don't miss the opportunity to hear the World War II reminiscences of Manhattan Project veteran Leon Smith, a retired Sandia director who still keeps busy around here as a Weapon Intern Program mentor.

He'll talk about his experiences with the 509th Composite Bombing Group at Wendover Field, Utah, and on the island of Tinian preparing the Little Boy and Fat Man bombs for their role in ending the war. He later served as weaponeer on the first post-war nuclear test, the Able shot of Operation Crossroads (see story at right).

Part of a new historical series within the Technology Symposium program, Leon's talk will be presented in the Steve Schiff Auditorium from noon-1 p.m. MDT, and video-linked to Sandia/California's Bldg. 915, Rm. N132, 11 a.m.-noon PDT.

* * *

Sandia's Student Internship Programs homepage notes the value student interns provide in meeting both short- and long-term Labs goals. They do real work while they're here temporarily, and some of them return as permanent employees when they finish their professional training.

You'll find a perfect example in Iris Aboytes' page 8 story about Alicia Littlewolf. Alicia grew up on the Northern Cheyenne reservation in Montana, pretty far from pretty much everything. While working on an undergrad degree from Rocky Mountain College, she spent three summers as a Sandia intern, and was so impressed by the work here that after earning a graduate degree, she came back to work full time.

It's a fine story about a great addition to the staff, but also illustrates the value of the internship program.

* * *

And about that internship program, our group has been fortunate in having terrific interns for several years, and none better than the two now resident here. Darrick Hurst, who's been with us a year or so, is approaching college graduation and Jacqui Cieslak, who just arrived, is fresh out of high school and college-bound in the fall.

Both jumped in quickly with contributions to the *Lab News* and both are fun to have around. Jacqui had a signed piece in the previous edition, written almost immediately after she landed here. Darrick has written a number of stories and even had a story written *about* him when his band recently was a winner of two New Mexico Music Awards.

Nothing is absolute, of course, but Sandia's internship program is more than a pro forma, make-work project for kids to pick up a little cash. They really work. They really learn. And some of them hang around.

* * *

Working as we do in a world of acronyms and initialisms, they sometimes whistle by without registering immediately. Like lab-related LAPD, which popped up in a couple of overheard conversations lately. Late Afternoon Pizza Delivery? Laser Amplified Peripheral Destruction? Los Angeles Police Department? What's LAPD?

— Howard Kercheval (844-7842, MS 0165, hckerch@sandia.gov)

Leon Smith recounts Fat Man and Little Boy preparations

Retired Sandia director and current Weapon Intern Program mentor Leon Smith was present at the dawn of the Atomic Age. As part of the 509th Composite Bombing Group at Wendover Field, Utah, and Tinian Island in the Pacific, Leon was involved in preparing the Fat Man and Little Boy bombs that were dropped on Hiroshima and Nagasaki to end World War II. At a July 9 Tech Symposium at the Steve Schiff Auditorium (noon to 1 p.m.), Leon will talk about his involvement in those historically pivotal events as well as his involvement as a weaponeer on the first post-war nuclear test, the Able shot of Operation Crossroads. Leon's talk will be video-linked live to Sandia/California's Bldg. 915, Rm. N132 beginning at 11 a.m. PDT.



LEON SMITH

After his military service, Leon joined Sandia's bomb fuzing group in 1947 (while it was still attached to Los Alamos Scientific Laboratory). During his Labs career, Leon initiated systems engineering in 1955

and directed the components, weapons development, and monitoring systems groups before retiring in 1988.

During his talk, which will be illustrated with about 70 of his personal photographs, Leon will discuss:

- His selection in 1944 for the seven-member fuzing group assigned to the US Army's 509th Composite Bombing Group and his subsequent experiences at Wendover, Utah, as the group undertook design and flight testing activities under technical direction from Robert Brode, head of the Fuze Development Group at Los Alamos.

- The fuzing group's experiences on Tinian in the summer of 1945, where they continued flight testing activities and prepared Little Boy and Fat Man for delivery.

- His role as a weaponeer for the first post-war nuclear test, the Able drop test of Operation Crossroads in 1946.

- His answer to the question, "How did you feel when the bomb was dropped on Hiroshima?"

Leon's talk is the first in a new historical series within the Technology Symposium program, presented in conjunction with Sandia's History and Archives group.

The Historical Series expands on the Technology Symposium's educational mission by offering insight into Sandia's origins and a fuller understanding of the Labs' evolution. Speakers bring first-hand experience with historical events that may shed light, or at least perspective, on current issues.

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Sympathy

To Sandy Smallwood (3330), on the death of her father, Earl Stewart, who passed away June 22.

Lab News Reader Service

The *Sandia Lab News* is distributed in-house to all Sandia employees and on-site contractors and mailed to all Sandia retirees. It is also mailed to individuals in industry, government, academia, nonprofit organizations, media, and private life who request it.

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Retiree Social set for Aug. 24

The 2007 Retiree Social will be held Aug. 24, 6 to 8:30 p.m. at the Rio Grande Botanic Garden, where last year's event was also held. Sandia will also provide a park and ride service. An invitation with event details will be sent to retirees via mail in late July.

July Thunderbirds meeting

Guitarist José Salazar will perform at the July 9 meeting of the Sandia Thunderbirds (Sandia's retiree organization) at the Mountain View Club on Kirtland Air Force Base.

The monthly Thunderbird Club business meeting starts at 1:30 p.m. with the flamenco program following at 2 p.m. For information, contact Genelia Boenig at 836-6977.



Biofuels

(Continued from page 1)

GTL research program in the Office of Science.

Lawrence Berkeley National Laboratory (Berkeley Lab) will lead the new center, which will be known as the DOE Joint BioEnergy Institute (JBEI). It is expected to receive \$125 million in DOE funding over its first five years.

The DOE JBEI's other partners are Lawrence Livermore National Laboratory (LLNL), the University of California (UC) campuses in Berkeley and Davis, and Stanford University. Plans call for the center to be headquartered in a leased building in the East Bay area, central to all partners. Initial work will take place at the West Berkeley Bio-center in Berkeley.

"The DOE bioenergy research centers will provide the transformational science needed for bioenergy breakthroughs to advance President Bush's goal of making cellulosic ethanol cost-competitive with gasoline by 2012, and assist in reducing America's

gasoline consumption by 20 percent in 10 years," Bodman says. "The collaborations of academic, corporate, and national laboratory researchers represented by these centers are truly impressive and I am very encouraged by the potential they hold for advancing America's energy security."

Two Sandians on management team

Two Sandians will serve on the JBEI management team: Blake Simmons (8755) as vice president of deconstruction and Kathe Andrews-Cramer (8333) as vice president of strategic

integration. Other members include Jay Keasling, CEO of Berkeley Lab, vice president of fuels synthesis; Harvey Blanch, Berkeley Lab/UC Berkeley, chief science and technology officer; Wolf Frommer, Stanford University, vice president of feedstocks; and Paul Adams, Berkeley Lab, vice president of technology.

Research at the institute will focus on biofuels — liquid fuels derived from the solar energy stored in plant biomass. Harnessing even a tiny fraction of the total solar energy available each year could meet most if not all of the nation's annual transportation energy needs.

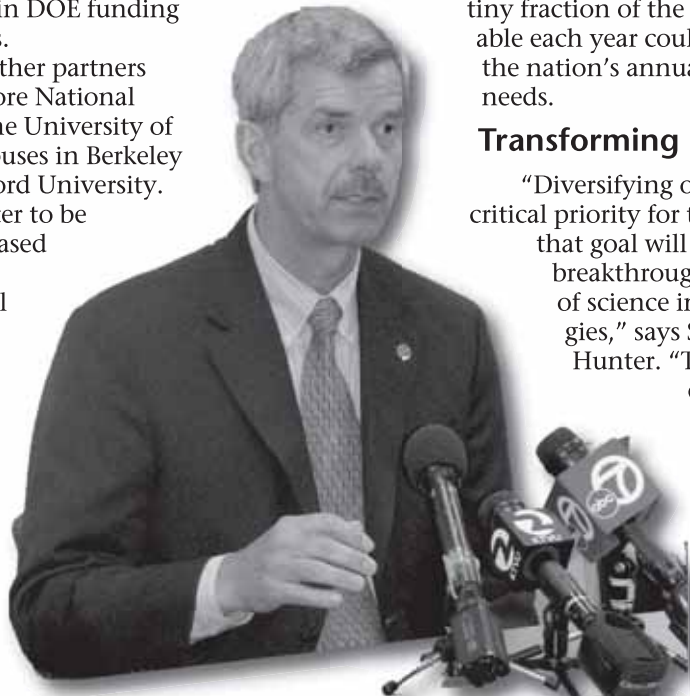
Transforming biofuels research

"Diversifying our energy supply is a critical priority for the nation. Achieving that goal will require new scientific breakthroughs and rapid translation of science into scalable technologies," says Sandia President Tom Hunter. "This partnership will enable a synthesis of bio-sciences and engineering that will transform the nation's biofuel research capabilities. With the Joint BioEnergy Institute, Sandia joins California's extraordinary national laboratories and leading research universities as we move forward to set a new standard for renewable energy research."

Sandia's role in the center will build on the Labs' expertise in science-based engineering, computational science, and microsystems.

Sandia's capabilities in enzyme engineering, systems biology, membrane transport, protein expression, and hyperspectral imaging are expected to contribute significantly to the JBEI mission.

Sandia's Center for Integrated Nanotechnologies (jointly operated with Los Alamos National Laboratory), the Microsystems and Engineering Sciences Applications (MESA) complex,



TERRY MICHALSKE, director of Biological and Energy Sciences Center 8300, speaks at a news conference during the announcement of the formation of the DOE Joint BioEnergy Institute. (Photo courtesy of LLNL)

"Diversifying our energy supply is a critical priority for the nation.

Achieving that goal will require new scientific breakthroughs and rapid translation of science into scalable technologies."

Sandia Labs Director Tom Hunter

and the Combustion Research Facility will play leading roles. Current bioenergy-related research at Sandia expected to enhance DOE JBEI efforts includes the examination of the photosynthetic properties of various plants and microbes; analysis of extremophile enzymes; and related engineering methods that can facilitate the processing of cellulosic biomass.

Scientific studies have consistently ranked biofuels among the top candidates for meeting large-scale energy needs, particularly in the transportation sector. However, the commercial-scale production of clean, efficient, cost-effective biofuels will require technology-transforming scientific breakthroughs.

Converting biomass to biofuel

Researchers at the DOE JBEI intend to meet this challenge through the conversion of lignocellulosic biomass into biofuels. Lignocellulose, the most abundant organic material on the planet, is a mix of complex sugars and lignin that gives strength and structure to plant cell walls. By extracting simple fermentable sugars from lignocellulose and producing biofuels from them, the potential of the most energy-efficient and environmentally benign fuel crops can be realized.

Researchers will tackle key scientific problems that currently hinder the cost-effective conversion of lignocellulose into biofuels and other important chemicals. They will also develop the tools and infrastructure to accelerate future biofuel research and production efforts, and help transition new technologies into the commercial sector. The goal of the center is to achieve measurable success within the next five years.

The organization of the center will feature four interdependent science and technology divisions:

- **Feedstocks**, aimed at improving plants that serve as the raw materials for ethanol and the next generation of biofuels.
- **Deconstruction**, aimed at investigating the molecular mechanisms behind the breakdown of lignocellulose into fermentable sugars.
- **Fuels synthesis**, in which microbes that can efficiently convert sugar into biofuels will be engineered.
- **Cross-cutting technologies**, which will be dedicated to the development and optimization of enabling technologies that support and integrate DOE JBEI research.

In addition to maintaining an Industry Partnership Program, research at the center will be guided by an Industry Advisory Board whose membership will come from key sectors, including feedstocks, enzymes, fuels production, biotechnology, genetics, and chemistry.

Each of the member institutes of the DOE JBEI brings unique capabilities to the partnership. The national laboratory partners operate state-of-the-art scientific instrumentation and research facilities. In addition to the Sandia facilities, other assets include the Molecular Foundry, the Advanced Light Source, and the National Center for Electron Microscopy at Berkeley Lab; and the Center for Accelerator Mass Spectrometry and the MicroArray Center at LLNL.

The other two DOE Bioenergy Research Centers are the DOE BioEnergy Research Center, led by the Oak Ridge National Laboratory in Oak Ridge, Tenn., and the DOE Great Lakes Bioenergy Research Center, led by the University of Wisconsin in Madison, Wisc., in close collaboration with Michigan State University in East Lansing, Mich.

For more information on DOE JBEI, visit www.jbei.org.

Sandia California News

SNIFFER goes indoors

By Patti Koning

In April, the SNIFFER system attended its first professional hockey game.

For three days, the detect-to-warn chemical monitoring system was deployed at the HP Pavilion in San Jose for a series of San Jose Sharks hockey games as well as one SaberCats Arena Football League game.

This was the first indoor test for SNIFFER, which was deployed earlier this year at the Rose Bowl 2007 in Pasadena.

Previously, the system had been tested at the San Francisco International Airport as well as a series of Oakland A's baseball games at McAfee Stadium in Oakland.

"Indoor deployments present a unique set of challenges from increased chemical noise, which increases the potential for false alarms," explains Ben Wu (8124), SNIFFER project manager. "Wireless communications are also more challenging indoors than outdoors."

The confined indoor environment typi-

cally exhibits higher background noise than that found in the large outdoor venues where SNIFFER has previously been tested.

The detector must weed out chemical cleaners, floor wax, perfume, food odors, and anything else that might be floating around in the air to detect an authentic chemical release.

A huge learning value

"We are happy with how the system performed," says Ben. "This deployment provided a huge learning value."

The team is at work making improvements based on this experience and preparing the system for its next deployment.

The SNIFFER system, which is the ground segment of the air/ground Rapidly Deployable Chemical Detection System, was developed for the Department of Homeland Security as a detect-to-warn system for special events. The system detects 40 acutely toxic chemicals, including chemical warfare agents and toxic industrial chemicals.



Flight tests at Kauai Test Facility

Sandia successfully launched three target rockets from the Kauai Test Facility (KTF) in a nine-day period June 14-22, says Al Lopez, Manager of KTF & Remote Ranges Dept. 5419.

Two ARAV (Aegis Readiness Assessment Vehicle) sounding rockets were launched 70 seconds apart on June 14 as part of a tracking exercise for the Aegis Ballistic Missile Defense program (photo below and on page one). The launches simulated a dual missile attack from a rogue country.

Aegis is the sea-based component of the US Missile Defense Agency's (MDA) Ballistic Missile Defense System.

In a third flight test June 22, Sandia launched a medium-range ballistic missile from KTF (photo at left). The target warhead separated from its booster in flight, and a missile launched from a Navy destroyer intercepted the warhead six minutes after launch.

Sandia conducted the launches, part of the MDA's Flight Test Standard Missile-12 (FTM-12) series, jointly with the US Navy.

— John German

(Photos by Michael Bejarano and Rob Shields, both Diagnostic Applications Dept. 1535.)



Nanostructures

(Continued from page 1)

Microscopic studies performed by Roger Assink (ret.) and Dave Tallant (1822), along with molecular modeling studies performed by Dan Lacks at Case Western Reserve University showed that, as the ordered porous films became more porous, the silica pore walls thinned below 2 nm, rearranging the silica framework to become denser and stiffer.

Less sensitive to increasing porosity

While the stiffness of evolved optimized bone declines proportional to the square of its density, mechanical studies performed by Thomas Buchheit (1814) working with UNM student Christopher Hartshorn showed that the stiff-

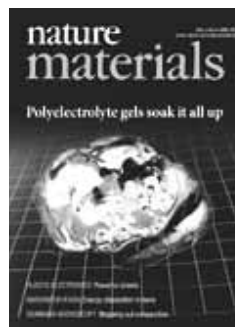
ness/modulus of self-assembled materials was much less sensitive to increasing porosity: For a material synthesized with a cubic arrangement of pores, the modulus declined only as the square root of its density.

The silica nanostructures — basically a synthetic analogue of bone-like cellular structures, replicated at the nanoscale using silica compounds — thus may improve performance where increased pore volume is important.

These include modern thin-film applications such as membrane barriers, molecular recognition sensors, and low-dielectric-constant insulators needed for future generations of microelectronic devices.

"Bone, closely examined, is a structured cellular material," says Jeff, a Sandia Fellow and chemical engineering professor at UNM. "Because, using self-assembly, we had demonstrated the fabrication of a variety of ordered cellular materials at the nanoscale with worm-like (curving cylinders), hexagonal (soda straw packing) and cubic sphere arrangements of pores (*Lab News*, Oct. 6, 2000, we wondered whether the modulus-density scaling relationships of these nanoscale materials would be similar to the optimized evolved materials [like bone].

"We found that both material structure and pore sizes matter," says Jeff. "At all densities we observed that the cubic arrangement was stiffer



"We found that both material structure and pore sizes matter. At all densities we observed that the cubic arrangement was stiffer than the hexagonal arrangement, which was stiffer than the worm-like."

Researcher Jeff Brinker

Annual student symposium

The Student Internship Program (SIP) staff invites anyone interested to participate in the 12th Annual Sandia Internship Symposium at the Embassy Suites Hotel Tuesday, Aug. 7. The symposium provides students a forum to "show their stuff" to graduate school, corporate and government agency recruiters. With an emphasis on career development, students, laboratory staff and management and symposium exhibitors will have an opportunity to view and to participate in workshops and student presentations. University and fellowship representatives will have an opportunity to share graduate school programs and funding opportunities. For more information and/or to register, go to the symposium website on the internal Web at <http://www-irn.sandia.gov/hr/staffing/sip/symposium.htm>.

than the hexagonal arrangement, which was stiffer than the worm-like."

For each of these structures, increasing porosity caused a reduction in modulus, but the reduction was less than for theoretically optimized or naturally evolved materials due to the attendant stiffening of the thinning nanoscale silica walls resulting from the formation of small stiff silica rings.

"This change in ring structure only happens at the nanoscale," says Jeff.

Hongyou Fan (1815-1) created cubic, cylindrical, and worm-like (or disordered) pores to evaluate differences in stiffness resulting from these differently shaped internal spaces.

Other paper authors include Dave Kissel of UNM, Regina Simpson (1822), and Salvatore Torquato of Princeton.

Funding was provided by DOE's Office of Science and Sandia's Laboratory Directed Research and Development office.

Non-Line-of-Sight cannon



THE NLOS CANNON, developed by BAE Systems, is fully automated and can fire at a sustained rate of six rounds per minute. (Photo courtesy of BAE Systems)

Sandia team supports development of US Army's new lightweight, high-caliber, self-propelled cannon system

By Mike Janes

Researchers at Sandia/California have emerged as key players in a US Army program that focuses on the design and manufacture of a lightweight, high-caliber, self-propelled cannon system.

The weapon system, known as the Non-Line-of-Sight Cannon (NLOS cannon), is fully automated and can fire at a sustained rate of six rounds per minute. The artillery system, once completed, must be light and agile enough to fit three vehicles comfortably onto a C-17 cargo aircraft.

According to project manager Nipun Bhutani (8774), Sandia's primary contribution in the program to date has been a critical adjustment to a laser ignition system that serves as the heart of the NLOS cannon vehicle. The cannon is part of Future Combat Systems (FCS), the Army's premier modernization program.

BAE Systems is developing this system as part of The Boeing Company/SAIC-led FCS program.

The laser ignition system was developed by the Army's Armament Research, Development, and Engineering Center (ARDEC), in collaboration with Kigre, Inc. The ignition unit is mounted on the back of the cannon's gun barrel, where a laser beam is fired through an opening mechanism (the breech) to ignite a charge and launch an artillery shell.

However, says Nipun, the recoil force and shock of the projectile (bullet) discharge had caused an increase in observed failures during early prototype testing.

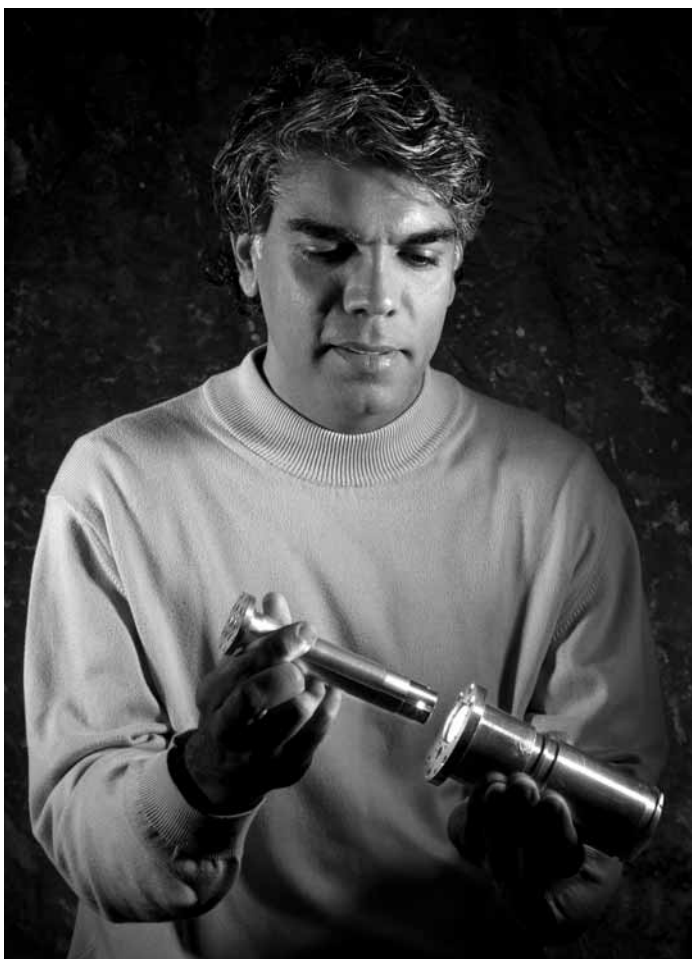
"The laser ignition system offers much better precision, rapid fire, and automation than the mechanical method, and it's safer," Nipun says. "But it's obviously not going to be an effective long-term solution if reliability cannot be maintained."

Instead of abandoning the laser ignition concept in favor of traditional, mechanical ignition, the Army called in experts at Sandia who deal with shock issues surrounding a wide range of components.

To absorb the force from the discharge, Sandia proposed a new isola-

"The laser ignition system offers much better precision, rapid fire, and automation than the mechanical method, and it's safer."

Researcher Nipun Bhutani



NIPUN BHUTANI examines the NLOS cannon's laser ignition unit. Nipun is leading a team of researchers in developing an isolation system to reduce shock levels. (Photo by Randy Wong)

tion system between the laser and the breech. Vibration isolation systems are widely used to protect sensitive devices from vibrations or shock produced in their environment. Typical examples include isolating delicate laboratory experiments from floor-borne vibrations, or isolating a car body or airplane frame from engine vibrations.

Sandia, in collaboration with BAE Systems and ARDEC, is developing an isolation system for the NLOS cannon that acts much like a filter and results in much lower shock levels.

In addition to working on the isolation system, Sandia researchers have applied the Labs' modeling and experimental capabilities to hardening the laser igniter.

In an effort to develop the most effective isolation system possible, the Sandia team needed to model the physics and inner workings of the laser system components. This involved modeling the gun loads and other physical dynamics inside the laser ignition system, particularly as it is fired.

"In keeping with Sandia tradition, we developed an entire systems approach to the problem," says Nipun. That approach included not only analysis and modeling of the isolation system but building a prototype and further researching the system's performance and reliability. Sandia also did modeling work on the laser and breech. Sandia is supporting BAE Systems' test efforts.

One of Sandia's long-term objectives with its NLOS cannon work, says Nipun, is to enhance its reputation for customer service and strengthen alliances with BAE Systems, ARDEC, Benet Laboratories, and others.

The art & science of Fireworks

Fireworks fascination: Sandian explains the science behind Fourth of July displays

Story by Julie Hall

It's one of the most American of traditions: trekking to a stadium or park — or sometimes to a well-positioned hill or your own backyard — to watch the annual display of fireworks in celebration of Independence Day, usually after a day of barbecues and maybe a holiday parade.

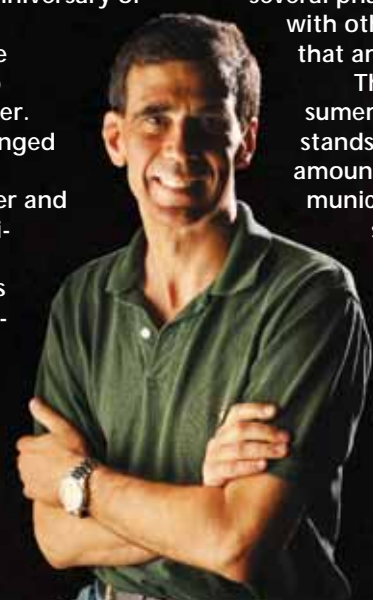
In fact, fireworks have been associated with the Fourth of July holiday since the first anniversary of the adoption of the Declaration of Independence in 1777. Fireworks were invented by the Chinese, who are also believed to have invented black powder.

"The technology really hasn't changed much in a thousand years," says Mark Grubelich (700), a mechanical engineer and pyrotechnics expert who became fascinated with rockets and fireworks as a young boy growing up in New Jersey's Hudson River Valley. The basic components of a fireworks shell — "stars," a bursting charge, a fuse, and a container — have remained fairly constant over the centuries, although the ability to manipulate and control them to produce new colors, shapes, and even sounds has advanced, he says.

The basic ingredients

In commercial fireworks, the container is a shell casing made of plastic, paper, or an easily ruptured material. Inside are stars (pyrotechnic pellets) and a bursting charge. The stars, consisting of a fuel and an oxidizer, are doped with various chemicals to produce the desired colors and effects when ignited. Hundreds of stars may go into a single fireworks shell. The stars are produced by using a seed particle on which pyrotechnic material is applied. The seed particle typically consists of an actual seed (harkening back to the days of the Chinese inventors). The pyrotechnic materials are applied inside a rotating drum, much like layers are built up on a candy jawbreaker.

Shells are typically launched from a tube known as a mortar. A major fireworks display might involve hundreds of mortars. Once ignited, either manually by lighting a fuse or electrically with an electric match or squib, the lift charge in the tube propels the shell out of the tube. Time-delay fuses enable the shell to reach appropriate altitudes prior to igni-



MARK GRUBELICH

Photo by Randy Montoya

tion. The burst charge ignites the stars and ruptures the shell casing, scattering the stars into carefully designed directions and patterns. The patterns (geometric shapes and figures are a fairly recent development) created in the sky depend on the precise arrangement of stars inside the shell.

More complicated "multibreak" shells burst in several phases. They may consist of a shell filled with other shells or may have multiple sections that are designed to ignite sequentially.

The principal difference between "consumer" fireworks (the ones sold at fireworks stands) and commercial versions is the size and amount of energetic material, Mark says. Many municipalities have banned the sale and use of some consumer fireworks within their boundaries. In addition, the US Department of Transportation and the Bureau of Alcohol, Tobacco and Firearms have regulations governing transportation and storage of commercial fireworks.

Creating colors, sounds

Creating and controlling the colors in fireworks is a complex endeavor — part art, part science. At the most basic level, the colors of fireworks come from one of two mechanisms: incandescence or luminescence.

Incandescence is light generated from heat (think sparkler or your standard incandescent light bulb). Heat applied to a substance causes it to glow — first red, orange, yellow, and finally white at high temperatures.

Luminescence is produced when energy is absorbed by an electron, causing it to become excited and unstable. When the electron drops back to a lower energy state it emits a photon (unit of light).

Manufacturers use these phenomena, coupled with the addition of certain chemicals, to control the colors of fireworks. "You see a lot of reds because they're real easy to do with strontium compounds," Mark says. Yellow is created with sodium compounds, blues with copper compounds, and greens with barium compounds.

"Occasionally you'll see pastels. Those are very difficult to do because you have to pick very specific chemicals and be careful about the formulation," he says.

If impurities enter into the manufacturing process, desired colors can be overpowered by other colors, or by smoke.

"The goal is very intense and pure colors," Mark says.

The sounds that accompany fireworks are also the result of chemical reactions that rapidly produce large quantities of gas. The sounds, which range from gut-felt booms to whistles (produced by oscillating, unstable combustion phenomena), are produced and controlled by using various fuel and oxidizer blends.

But let's get something straight: The loud "thumps" you hear (and often feel) technically are not the result of detonations. Fireworks don't detonate — they deflagrate, or burn at very high rates. High explosives, which detonate, are banned from fireworks.

The grand finales frequently employ spherical or cylindrical shells filled with flash powder, a mixture of potassium perchlorate and aluminum powder. The composition rapidly deflagrates in a confined space, producing an explosion and intense flash of light. This is the same mechanism behind the Mk141 diversionary device (aka flash-bang grenade) developed at Sandia by Paul Cooper and Ed Graeber (ret.). Several years ago, Mark developed another type of diversionary device that uses an explosive source that fans out as an airborne combustible powder before it ignites, making it less dangerous to the user.

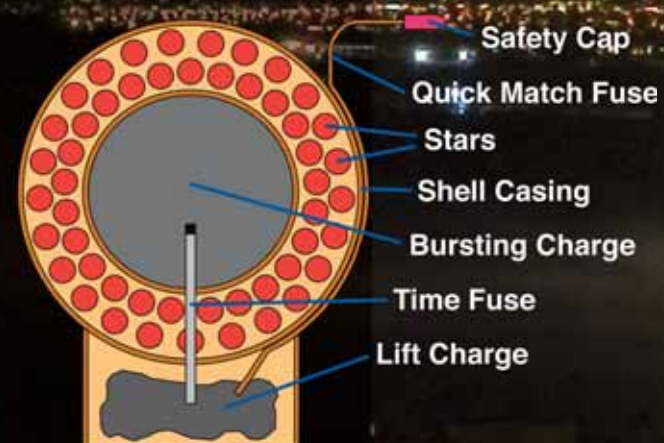
Future fireworks

Despite the strong resemblance of today's fireworks to their ancient cousins, the increasing infiltration of technology is inevitable. In particular, computer hardware and software are increasingly playing a role in the development of the pyrotechnics and in designing and controlling displays. Multimedia simulation software allows pyrotechnicians to preview and adjust their displays on their computer screens without lighting a single match. Other software allows them to synchronize the firing of thousands of fireworks from a single control panel.

Perhaps on one Fourth of July in the future, a Red Storm-like computer will be used to develop and coordinate a fireworks display unlike any other humankind has ever seen. And the response from the audience? The same "oohs" and "aahs" you hear today.



Spherical Display Shell



Display Shell Illustration by Michael Lanigan

BACKGROUND PHOTO — Aerial shell explodes above ships from many nations involved in the Rim of the Pacific 2006 exercise during the 4th of July celebration held at Pearl Harbor, Hawaii. (Photo courtesy of Dept. of Defense)

Getting an education and learning new things are gifts for Alicia Littlewolf

By Iris Aboytes

Constant challenge and learning brought Alicia Littlewolf (9515) from the Northern Cheyenne reservation in Montana to Sandia. As a Sandia intern for three summers, Alicia loved the learning environment.

"Because of the nature of their mission," says Alicia, "Sandians take pride in the work they do. I wanted to be a part of that."

Alicia's internship at Sandia involved chemical engineering. She was able to see the many aspects of the Labs' work, including some of its cutting-edge computer science research. After Alicia earned a degree in environmental science from Rocky Mountain College in Billings, Mont., and a graduate degree in computer science from Montana State University, she returned to Sandia permanently.

"My mother would take my sister and me to the library once a week," says Alicia. "We really looked forward to that."

"Before Sandia, the positions I found in environmental science did not have the learning potential I wanted," says Alicia. "I wanted a field that was constantly changing. I wanted to work where I would always learn new things."

Alicia's hometown, Busby, Mont., has a population of about 300 people. Billings, the nearest and largest city in Montana — it's about a fifth the size of Albuquerque — is an hour away. As Alicia was growing up, her family did not have cable television or a lot of other things that kids have today, so they spent a lot of time outdoors and reading. "My mother would take my sister and me to the library once a week," says Alicia. "We really looked forward to that."

"My reservation is an economically poor place," she says. "We are not like a lot of the native tribes around New Mexico. Every native tribe is different; our tribe doesn't have casinos. We have very limited economic opportunities due to it being so rural. There are drug, alcohol,



RESPECTING THE OLD WAYS — Alicia Littlewolf and her grandmother in Busby, Mont.
(Photo courtesy of Alicia Littlewolf)



ALICIA LITTLEWOLF recalls that as a child the high point of her week was the family trip to the library. The native of the Northern Cheyenne reservation in Montana honors her tribe's history by living the way her forebears did, never giving up in the face of obstacles.
(Photo courtesy of Alicia Littlewolf)

inadequate housing, and high unemployment problems. I was very fortunate that my parents made smart decisions for a better life and shielded me from harmful things."

"Despite all these things, I am proud to be Cheyenne from Montana," says Alicia. "I have a strong history. We faced many obstacles as a tribe and never gave up. That is how my parents taught me to approach my life today — if you have obstacles, work around them, don't give up."

Her father, Leonard, a reservation Head Start administrator, and mother, Linda, a special education teacher, encouraged and supported Alicia and her sister, Erica, in whatever they wanted to do. Alicia grew up loving both math and science. "I was always considered the smart one in class," says Alicia. "However, there were much smarter people than me who did not go to college. I was able to succeed because of the support I had from my family."

"One of the most important things my dad taught me was how to adjust," says Alicia. "Culture shock is very hard for many native students. My dad has always said that a part of a native's history is adjustment. In my tribe's history, we

"In my tribe's history, we changed our lifestyle from farmers in the Great Lakes region to Plains Indians lifestyle. Every time I got discouraged, [my Dad] told me I was Cheyenne and had the ability to adjust and I just needed to use it."

"Sandians are so helpful. I am able to ask questions and learn from those around me. I love the diversity, I love that I am not the only woman, as was the case in many of my graduate classes."

changed our lifestyle from farmers in the Great Lakes region to Plains Indians lifestyle. Every time I got discouraged, he told me I was Cheyenne and had the ability to adjust and I just needed to use it. He taught me how to be comfortable in the world outside of the reservation. He told me that education and learning new things were gifts. That is what kept me studying late at night or working on projects."

"Sandians are so helpful," she says. "I am able to ask questions and learn from those around me. I love the diversity, I love that I am not the only woman, as was the case in many of my graduate classes. At Sandia there are always new things to learn."

"My husband, Gernell Killsnight, and I love it here," says Alicia. "We are enjoying raising our little girl, Neveah. Albuquerque is warmer than Montana but still close to the mountains. New Mexico has many beautiful places. My parents are planning to move here when they retire."

"My family is the most important thing in my life," she says. "Sandia is very sensitive to its employees and their family needs. To me, working at Sandia feels like I have won the lottery."

Alicia was recently featured in *Diversity/Careers in Engineering & Information Technology* magazine as a Native American soaring in technology.

An ounce of prevention . . .

By knowing what your plan covers, you can help your doc help you save money

By Margaret Lovell

Each of the health care plans available to Sandia employees and retirees provides valuable preventive benefits to help you maintain a healthy life. While all the plans have unique features, each medical plan provides full or nearly full coverage when you use in-network providers for certain preventive health care services. Taking advantage of these benefits will not only improve your health, it may also save you money. Staying healthy is much, much cheaper than getting healthy.

Using the preventive care benefits

In 2006, nearly 8,000 Sandians, retirees, and their dependents took advantage of the UHC well-child and well-adult routine physicals. UHC also covered about 4,200 mammograms, 300 PSA tests, 2,750 Pap tests, and 6,900 vaccinations and flu shots.

The UHC/CIGNA medical plans cover well-baby visits and annual routine well-child, well-adolescent, and well-adult physical exams at 100 percent. In addition, the plans cover routine immunizations and flu shots at no cost to you when you use in-network providers. If you are a subscriber to these plans, you are eligible for a routine physical exam once a year.

To provide an example of how your preventive benefit works, let's say you are covered by UHC or CIGNA and during a routine physical exam, you complain of fatigue. Your in-network doctor determines that your blood pressure is too high. As a follow-up to the exam, your doc wants you to have a diabetes screening, lipid panel, and thyroid screening. If the physician identifies these services with a preventive code when billing your medical plan, you would receive these services at

no cost to you.

Take another situation: You take your 12-month-old son to an in-network pediatrician for his well-baby visit and immunizations. During the appointment your doc sees that your son has an ear infection. If you are a UHC/CIGNA member, the immunizations would be covered at 100 percent; however, you would be responsible for the cost of the office visit if the physician charges extra for that. If the physician only charges for the well-baby visit and codes it as well-baby, the claim would be paid at 100 percent.

Your medical plan will provide full coverage under the preventive care benefits when you use in-network providers for certain cancer screenings — as long as the provider bills it with a preventive code and you meet the age or test-frequency limitations specific to your policy. These screenings usually include an annual Pap test or prostate antigen (PSA) test, a mammogram, and a sigmoidoscopy or colonoscopy.

Sandia's medical plans also provide other preventive care such as bone density testing and pregnancy-related screenings. Your UHC/CIGNA medical plans cover the Zoster vaccine for shingles at 100 percent for members 60 and over. The human papilloma virus (HPV) vaccine, otherwise known as Gardasil, is a preventive benefit for female members who are between the ages of 9 and 26. Refer to your Summary Plan Description for complete information on your preventive health benefits.

To get the most from your preventive health care benefit, make sure you use an in-network provider, confirm with the doctor's staff that the annual physicals and screenings and lab work are coded as preventive, and follow up with the provider and your insurance company if claims for preventive care are denied or not paid at the appropriate coverage level.

In addition to taking advantage of your pre-

The doctor will see you now

Sandia's onsite medical services for employees include urgent care and preventive care, labs and X-rays, behavioral health, programs for expectant and new parents, and support for Sandians caring for parents. Other services are also available for international travel, disease management, and tailored programs for your work group. You can meet with exercise physiologists, registered dietitians, certified diabetes educators, and even a podiatrist. There are screenings for cholesterol, blood pressure, and glucose. Employees can get many of their preventive care needs met without leaving work.

In New Mexico, contact HBE at 844-4237 or go see them in Building 831. Appointments can be scheduled by phone; walk-ins are accepted only for medical emergencies, work-related injuries, the allergy clinic, and blood-pressure checks. Contractors will be seen only for medical emergencies and work-related injuries. In California, contact health services at 294-2700.

ventive care benefit through your medical plans, log on to either myuhc.com or mycigna.com to take the Health Risk Assessment to learn how healthy you are and how you can get healthier.

If you have any questions about your preventive health care benefits, call UHC at 877-835-9855, CIGNA at 800-244-6224, or Kaiser at 800-464-4000.

Taking responsibility for your own health care by getting regular check-ups is an important step in staying in good shape. Preventive care provisions in Sandia's various medical plans make it easy and economical to take that step.

Feedback

Social Security numbers and employee ID numbers

Q: I have to tell you that this entry in the Sandia Daily News does nothing but infuriate me.

"PeopleSoft SSN to Sandia ID conversion: Because Sandia understands the risks of having Social Security numbers in too many hands, Human Resource Information Systems has begun the PeopleSoft SSN to Sandia ID

conversion project as part of the program to replace the use of SS numbers with Sandia-issued IDs. The conversion will require no action by anyone other than affected application developers. The only time users will be affected by the conversion project will be when it moves to production, scheduled for the weekend of May 12. During that weekend, users will not be able to view information in the PeopleSoft system (e.g., HR Self-Service) or update and enter new data. For more information, go to this website."

Why am I angry? Sandia, Lockheed Martin, and DOE did not understand or care about these risks when the SSN for personal ID was put in place in spite of the strong objections of many of us employees. As I recall, we were told that this is the way it will be and we should sit in the corner and play with our crayons.

So the question is this: Is Sandia ever going to just give it to us in straight talk instead of this political speak? I could have respect for an SDN entry that said, "At last a grievous error is being corrected and we will cease and desist using SSNs for employee identification purposes."

By the way, there are still Sandia forms and procedures that require the SSN to be entered. I personally do not fill these out and challenge the author or owning organization to prove to me that the SSN is needed before I will use the form. After this "new" rule goes into effect, I hope all Sandians will use the rule to kill the SSN tag.

A: Identity theft is affecting millions of people every day, including Sandians. Sandia is taking precautions to limit exposure of employees' Social Security numbers by reinstating the Sandia employee identifier.

In hindsight, it would have been easier to keep the old Sandia employee identifier but the primary argument at the time was based on achieving efficiency by using a single identifier, commonly known as the "national identifier" or Social Security number. Social Security numbers will continue to be used, in a restricted manner, where the business dictates

"In hindsight, it would have been easier to keep the old Sandia employee identifier but the primary argument at the time was based on achieving efficiency by using a single identifier, commonly known as the 'national identifier' or Social Security number."

— Gary Concannon

usage (i.e., payroll taxes, IRS filings, etc.). Other systems and Sandia forms must be converted to the Sandia employee identifier (Sandia ID) by March 2008.

— Gary Concannon (4544)

Q: Now that we are going back to the original concept of employee

ID numbers, I'm obligated to point out that the present method of controlling those ID numbers leaves Sandians vulnerable, and financially accountable if someone else uses that ID number. There is at least one corporate process where this is true. There might be others. Why not take the number off our personal Sandia directory listing and make it at least as private as our corporate credit card numbers; i.e., only accessible by a limited/trusted few people — secretaries, travel agencies, and such?

A: Your suggestion actually was acknowledged during the conversion from SS numbers to the new Sandia ID. The Sandia ID is a unique numeric identifier for every person who has a relationship with Sandia, whether they are an employee, contractor, or visitor.

The Sandia ID is not and should not be considered confidential and access to the numbers will not be controlled within the Sandia Directory on the Sandia Restricted Network. There are several reasons why we feel the Sandia ID does not need to be controlled.

There are no corporate systems that use Sandia ID for authentication of a person within a corporate application. All corporate applications use the email user-id for authenticating along with some form of credential to identify a user.

The credentials include passwords, one-time tokens, or digital certificates. We would expect that all noncorporate systems and third-party administrators would also use an approved authentication method. In addition, all corporate systems are role-based and require authorization for data access after authenticating the identity of the person. For all of these reasons, and others, we believe there is no private data accessible without proper authentication and authorization. If you need more information, contact Tracy Jones (10756) at 844-7046.

— Tana Lucy (4540)

Mileposts

New Mexico photos by Michelle Fleming



Larry Stephenson
45 1132



Lewis Bartel
40 6314



Mary Beth Tidwell
30 4018



Dannie McNeill
35 5424



Nathan Bixler
25 6762



Nick Dereu
25 12341



Ray Shaum
25 6786



Diana Helgesen
22 5419



Nancy Lee
16 9535



Patrick Smith
25 2625



Terrance Smith
25 2431



Michael Furnish
20 1647



Ed Hoffman
20 8964



Bob Nilson
20 8755



Gary Hux
15 8518

Recent Retirees

Feedback

IJS job-level criteria concerns; vision plan question

Q: I would like to propose a question concerning an apparent IJS "level inflation" that is occurring within my division. Currently the Technical Staff IJS level criteria as published on the internal web represent the floor attributes and responsibilities that employees must demonstrate in their jobs for classification at each level. These level criteria are by design and necessity somewhat vague. However, it appears that the floor of one level (SMTS, for example) does not represent the ceiling for the previous level (MTS, in this example).

While I understand that directors can and should adjust level criteria within their division to ensure fairness and parity and to manage their level populations, some problems arise if these additional criteria exceed the difference in criteria that define the floors of the different IJS levels. One problem is that staff cannot determine with any precision what is expected of them to be eligible for promotion to any level above their own. A second problem is that the descriptions of the levels occupied by staff no longer accurately reflect their actual work, but because their pay relative to the rest of Sandia and to the outside world is based on comparisons described by their level descriptions, salaries are also not commensurate with their actual work.

I interpret the additional level criteria and the absence of a ceiling on the IJS levels as an attempt to employ and promote only the most capable staff available, but the effect appears to be the institution of a pay disparity for staff and an increase in the ambiguity and arbitrariness that staff must consider when planning their career trajectory.

Is there no fixed description or range of skills and responsibility that staff can use as a reference to gauge their potential for promotion into the next higher IJS level? While a line manager may concede that a staff member's qualifications, responsibilities, and expectations are well above the floor descriptions of an IJS level, at least in my division this is not sufficient evidence to ensure a promotion to that level.

A: Thank you for a thoughtful question about a very important topic. It's important that our employees understand the IJS criteria and their application.

The level criteria are written as floors, not as

typical descriptions of work. While an employee may occasionally meet a given criteria, the knowledge, skill, or ability must be a regular, accepted part of the work to meet the floor level for that level.

Thus, an SMTS may be a principal investigator on occasion, but it is a PMTS that is regularly identified as having principal investigator responsibility. When a manager places an employee at a given level, all of the floor criteria must be met, not four out of five, for example. While the IJS employee design teams looked at a number of sources when developing a methodology for differentiating levels, the primary source for level criteria was external market surveys.

The level criteria in place are consistent with the floors that other companies use to match their positions to market surveys. If you have specific examples where you feel the floor of one level does not meet the ceiling of the next, let us know and we will discuss this with the salary survey companies. In addition, in industry, employee populations are usually scattered across levels, not concentrated into one single level. While the majority of the population may fall in the SMLS level in a given occupation, for example, we would expect to see some SMLS and, depending on the work, some PMLS level.

The criteria devised for a given ladder were meant to cover all of the staff in that given ladder. For example, there are thousands of technical staff members and it would be a difficult task to try to devise a more detailed description of criteria for every individual as a reference for movement into a higher level. Since your manager is in a better position to know your work relative to others in the department, center, or division, the manager is in the best position to make an assessment of the appropriate level, taking into consideration the level charts as a guide and considering the following:

- Does the employee meet all level criteria established in the level charts, and
- Has the employee consistently demon-

strated performance commensurate with the new level, and

- Does long-term work exist commensurate with the level criteria.

Human Resources is responsible for establishing and maintaining the various components of IJS from a corporate perspective. However, it is not unusual for division-specific criteria to be established to ensure consistency at the division level. Your management can advise you of any division-specific criteria necessary for advancement. Additionally, employees and managers are encouraged to have discussions regarding career development goals. A career development section is included in the Performance Management Form (PMF) to facilitate such discussions.

Your manager is best able to facilitate opportunities for growth and development when short- and long-term career goals are known. Your Human Resources Consultant is also available to provide guidance on career development opportunities.

— BJ Jones (3500)

Q: If an employee's ergo assessment, doctor, or optometrist has determined that he/she needs prescription lenses for use while working on a computer (to prevent eye strain or glare), is this an expense that Sandia will reimburse if the person's primary job involves working in front of a computer? I know that Sandia has a vision package that some employees may participate in that would cover the cost of the glasses. However, what about the deductible cost or the fact that not all employees participate in this vision plan? Or, what if the person has already used the one-time-per-year glasses purchase for another need (i.e., night-driving glasses)?

A: In ordinary circumstances, computer glasses fall into the same category as other office ergonomic tools, and their purchase should remain at the discretion of the individual manager. If the manager decides not to cover the cost, the purchase of the computer glasses is the responsibility of the employee, and he/she should work through his/her vision care provider to obtain them.

— Bryan Drennan (10322)



Fun in the sun

Photos & story by Randy Montoya

"This stuff is so cool. I like when you guys come to my school," says one eager grade-school boy while building an electric motor to launch a flying propeller disk (see photo above). He was one of 50 children attending Sandia's Fun in the Sun science program at Valle Vista Elementary School. The educational program, now in its fourth year, is part of Community Involvement's K-12 Education Partnerships.

"We go to nine elementary schools and community centers all over the city," says program manager Cheryl Garcia (3552). "The kids are so excited when they are doing the activities that they sometimes don't realize that they are learning about science."

The activities range from the chemical reaction of Harry Potter Potion to building battery-powered electronic devices.

Fun in the Sun has four more stops this summer: at the Westside Community Center on July 10, Barcelona Elementary on July 12, San Antonito Elementary School on July 19, and Raymond G. Sanchez Community Center on July 26.

