A new type of electrochemical sensor that uses a unique surface chemistry to reliably and accurately detect thousands of differing biomolecules on a single platform is being developed by a Sandia research team led by Susan Brozik (1714).

The new bioagent detection system could be applicable in homeland defense, safeguarding warfighters, and clinical diagnostics.

"A problem with the majority of existing biosensors is that they only look for one type of biomolecule [DNA or protein] at a time," says Jason Harper, research team member, "This can often lead to inaccurate or inconclusive results and limits the use of the sensor. Where our sensor differs is that multiple characteristics of several bioagent targets can be tested on a single chip. Identification of several DNA sequences and protein markers are needed for detection of multiple targets and will allow for accurate discrimination between similar bioagent threats."

For example, instead of using only one antibody that binds to the surface of an anthrax spore, the new Sandia sensor could test for several DNA sequences and internal and external proteins unique to anthrax. This provides numerous positive readings for the target agent or agents, significantly increasing confidence in the sensor results.

The new Sandia sensor will be able to simultaneously detect thousands of biomolecules on a single platform. By integrating antibodies, DNA, and other biomolecules on a single device, the number of lab instruments, volume of reagents required, time for analysis, and the cost of effectively performing thousands of tests are all reduced.

The platform, a microfabricated chip, is just one inch by one inch in size. Several technological advances in microfabrication processes have increased the numbers of electrodes that can be produced on a sensor platform. A major challenge is how to pattern different biomolecules onto closely spaced micrometer-sized electrodes. Brozik's group believes the answer lies in the electrophoresis of ary diazonium salts.

The surface chemistry, produced by team members David Wheeler and Shawn Dirk (both 1714), possesses several advantages over currently used.

**Patternable surface chemistry makes for robust, versatile, and accurate biomolecule detection**

**Sandia system will allow for simultaneous detection of thousands of proteins, DNA, whole cells, pathogens**

By Chris Burroughs

Uses may include faster cancer diagnosis, rapid detection of biotoxins...
Weapons complex employees donate more than $11 million to fund drives across US

Note: This story is based on information from the Feb. 2007 issue of NNSA Newsletter. (Sandia’s total includes $50,000 from Lockheed Martin. Los Alamos’ total includes a dollar for dollar company match.)

Contractor and federal employees of NNSA and its facilities throughout the nation donated $13,280,643 last year in the Combined Federal Campaign, the largest single year of giving by local, regional, and national charities and nonprofit organizations in contributions through the Combined Federal Campaign and local United Way-affiliated fund drives.

Sandia employees in Albuquerque pledged a record-breaking $3,175 million to the United Way of Central New Mexico. The total for Sandia, including the SHARE campaign in California and the Employee Caring Program in Carlsbad, N.M.; Las Vegas, Nev.; and Amarillo, Texas, was $3,586,579.

Overall, NNSA’s contractor employees at all facilities pledged $10,522,316 to community fund drives and federal employees contributed $766,277 to the Combined Federal Campaign. Here are the totals for the other NNSA facilities and federal offices:

- Los Alamos National Laboratory — $15 million to Northern New Mexico United Way
- Lawrence Livermore National Laboratory — $1,472,086 for HOME (Helping Others More Effectively) campaign
- Savannah River Site — $1,926,791 (Washington Savannah River Company, Bechtel Savannah River Inc., Energy Solutions Savannah River Corporation, BWXT Savannah River Company, and Ch2 Savannah River Company employees; total includes a WRC $50,000 corporate gift)
- NNSA Headquarters — $238,221
- Livermore Site Office (Calif.) — $34,069
- Los Alamos Site Office — $17,600
- Sandia Site Office (N.M.) — $27,000
- NNSA Service Center (N.M.) — $200,000

Retiree deaths

James Howard Scott (age 79) Jan. 1
John Albert Larson (93) Jan. 2
Rachael O. Duncan (88) Jan. 3
Charles J. Pugliesi (89) Jan. 4
Maciocco S. Suazo (92) Jan. 4
Edward L. McKeelvey (68) Jan. 5
C. Hilmar Deser (59) Jan. 5
Charles E. Rohrige (84) Jan. 7
Adam Trujillo (76) Jan. 7
Haitel J. Edom (90) Jan. 7
William E. Walker (80) Jan. 8
Edward B. Braas (74) Jan. 8
Thomas Orin Meyer (87) Jan. 10
J. Lloyd Williams (88) Jan. 10
Basil K. Laskar (85) Jan. 14
Alice J. O’Meara (92) Jan. 17
Doyle K. Morgan (77) Jan. 23
John W. Wood (79) Jan. 28
Jormahn A. Koski (91) Jan. 28
Jose Demus Jojola (90) Jan. 28
Herbert L. Webster (90) Feb. 12
Jose M. Dernicke (87) Feb. 17
John Albert Larson (93) Feb. 24
William E. Walker (80) Feb. 25

Writing an ethical will

Rabbi Min Kantowitz will be at Sandia on April 19, Bldg. 810 auditorium from noon to 1 p.m., to explain writing ethical wills, which are like living wills, the values, not just possessions. They can help relate life stories and convey values held dear. The presentation is sponsored by the Sandwich Support Group. Questions to Dick Steele (10004) at 284-4353 or rsteele@sandia.gov, Debra Babb (4227) at 845-0686 or dbabb@sandia.gov, and Bonnie Harpole (10749) at 844-1417 or bharpole@sandia.gov.
Employee death

Greg Thomas remembered as respected, influential leader

No one better embodied ‘exceptional service in the national interest,’ says former California VP Mim John

“Greg graced everything he did with innate goodness, integrity, and humility. He didn’t wear his good character on his sleeve—he radiated it,” said John. “Although right now it is hard for me to imagine working without Greg, I’m sure that in time, I’ll draw deeply and often from my memories of him for inspiration, guidance, and strength.”

Like many at Sandia, John Hinton (8112) knew Greg as a colleague and close personal friend. Grazing at Jonathan’s wedding was a groomsmen at the upcoming wedding of John’s daughter.

“Greg’s passion at work was contagious to the right thing, even if it was unpopular, or uncomfortable. These are the days that type of courage and resolve is sorely needed and hard to find,” says Jim Handrock (8810).

Pat Smith, acting VP of Human Resources Div. 3000, recalls that “As Site Operations director, I’ve had the opportunity to get to know the VP deputies quite well. Greg herded us cats admirably, giving us the necessary jolts of reality that we sometimes needed and always deserved. He used his sharp wit to cut to the chase and to challenge us to do better.”

Greg gracefully incorporated his deep faith into everything he did, from his work at Sandia to serving as a counselor at a church youth camp. He was very active in Cedar Grove Community Church, where he played many roles, including chairman of the elders.

Tim Shepodd (8778) says he remembers most “not what Greg said, but rather what he was able to share of his family and faith with all those who walked through his office doors.”

GREG THOMAS with daughter Andrea, wife Susan, and son Jonathan.

Dental diagnosis

(Continued from page 1)

ily require time-consuming manual handling by many people, into a single automated device.

Because the amount of sample fluid needed for testing is very small, Amy sees further applications in other disease areas—including potential improvement of diagnosis of prostate and breast cancers and measurement in medical diagnostics for serum in animal models employed in vaccine development research.

“Sandia has sparked commercial and university interest in the technology,” says Singh. “This technology also has great promise for Sandia’s efforts in homeland defense. We have on-going efforts to use the diagnostic platform to detect biothreats and other markers in bodily fluids to be able to diagnose exposure to a biological agent.”

“We’ve filed patents and technical advances to protect the work,” Amy says. “The study has sparked commercial and university interest in our inventions. Our team—a interdisciplinary group of internal and external collaborators—believes Sandia’s contributions in this area could advance personalized medicine. So we’re motivated to extend the limits of Sandia’s lab-on-a-chip tools.”

A “lab on a chip” refers to an entire automated laboratory on an area the size of a computer chip, able to perform chemical analyses on minute amounts of material.

How it works

While components of the saliva-detection technique were reported earlier by Sandia, this is the first comprehensive study of Sandia’s integrated clinical method.

The basic principle: “Biomedical researchers have long suspected that saliva contains minute amounts of protein markers in disease diagnosis,” says Amy. “Our current work with a particular enzyme in saliva supports that hypothesis regarding periodontitis disease progression.”

Aiding dental practitioners, the pocket-sized device measures the state of biomarkers to determine how much the disease has been set back. Its progress may be cloaked, silently advancing or retreating without showing any signs.

“Periodontitis can be episodic in nature,” says Amy. “You need to know the stage of disease progression to diagnose and treat the illness most effectively. The enzyme [biomarker] that we monitored decreased or stabilized if the treatment was working well.”

Often, owing to the time and expense involved, practitioners formerly had not been able to perform extensive biochemical investigations.

The work, funded by the National Institute of Dental and Craniofacial Research (NIDCR) — one of 20 institutes in the National Institutes of Health — is the first application using micro-liters of saliva, a painlessly and easily secured fluid. The real-life alternative for the most part has been quasi-subjective physiological measurements, such as gum recession and gum bleeding on probing, to diagnose periodontal disease.

Unlike Sandia’s MicroChemLab — its patented version of a lab on a chip, which reports multiple protein signatures in fluids of interest, the clinical diagnostic instrument described in PNAS is a lab on a chip designed to quantify the amount of a specific protein (or panel of proteins) present in oral biological fluids. Monitoring quantities of specific proteins makes the tool useful as a clinical diagnostic.

Using a disposable lab-on-a-chip cartridge, the device makes use of a polyethylene-gel gel. The location of the sieving in the microfluidic chips is determined using photolithographical methods adapted from the semiconductor industry. The sieving gel is porous, with very small openings. A low electrical current (measured in micro-amps) is passed through the gel and a process called electrophoresis moves charged proteins through it.

The gel has a Jell-O-like consistency and, by using the passage of smaller molecules and slowing the passage of larger ones, quickly separates proteins contained in the saliva. Prior to this separation, the proteins are brought into contact with specific antibodies chosen for their ability to bind to the biomarkers. The antibodies are pre-labeled with fluorescence molecules attached to them. Interrogation by laser of these combined molecules — fluorescent antibody and fluorescent antibody bound to the biomarker — determines the amount of biomarker present, indicating the degree of periodontitis.

Sandia authors of the study, in addition to Amy and Anup (the NIDCR project primary investigator), include Anson Hatch, Daniel Throckmorton, James Brennan (all 8321), and Huu Tran (8755), as well as Will Gillam of the School of Dentistry at the University of Michigan, Ann Arbor.

More information can be obtained at the Sandia website at biotechnology/nih2.html.
change with particular significance for Sandia and how Sandia is addressing those changes.

- The nuclear weapons complex, which grew to maturity in a bipolar Cold War environment, will by necessity undergo an “amazing transition,” assuming a shape more in line with 21st century deterrent requirements. The national debate about the future of the stockpile (and the related issue of the future of RRW) will be healthy one for a free society; its outcome will influence the shape of the complex. The Labs has been charged to play a key leadership role in the transformation of the complex.

- Concerns over the proliferation of nuclear materials have assumed a sense of urgency in the post-9/11 world. Sandia is deeply invested in developing means to get a handle on proliferation.

All-hands
(Continued from page 1)

Moving people to work
Note: See related story beginning on page 1.

The Managed Workforce Transition process—the process of moving people to work—is spot on in one area and still being worked in another. Tom Hunter told an audience of Sandians at last week’s all-hands meeting in the Steve Schiff Auditorium that the Labs, in anticipation of and response to a changing mix of work, realized that it needed to move people to work to match the Labs’ current needs. To that end it devised the Managed Workforce Transition plan.

“If you recall,” Tom said, “the plan was to have about 300 people move into the work that is neither indirect nor nuclear weapons. Under the plan, about 200 people in nuclear weapons and about 150 in the indirect world would move over to support Al Roning, Les [Shepard], Paul [Horrniet], and Jerry [McDowell] in the ITS [Integrated Technologies & Systems] work.”

The movement of the 200 people from nuclear weapons to ITS has been successful.

“We’ve done it; it basically has happened,” Tom said. “We are not going to do about that? In some of these areas, like computing, we are world class. In integrated microsystems, we just invested more than $400 million; we classified areas work class there. In pulsed power, we are world class; in our national testing capabilites—at least in the national security area—we are second to none in many cases. In nanotechnology [we are leaders]. And there are others. As we move from less dependence on nuclear weapons as the provider of the largest part of that capability, we will have to figure out a way to be sure we will maintain those capabilities and keep them world class.”

— Labs Director Tom Hunter

“As we move from less dependence on nuclear weapons . . . we will have to figure out a way to be sure we will maintain [our] capabilities and keep them world class.”

Sandia taking a proactive role

In every area of change (and Tom mentioned others; those listed above represent some of the highlights) Sandia has taken a proactive role, Tom said. He noted that the 2007 Strategic Plan, unveiled early in the FY07 fiscal year, reaffirmed that, even in a changing environment, the Labs retains its highest goal: “To become the laboratory for the nation’s science and engineering resources in a global talent pool with a well-prepared workforce.”

“As the work balance shifts, will Sandia be able to maintain the capabilities that allow it to claim authoritatively to be one of the world’s great laboratories?”

We have to think about our capabilities,” Tom said. “We can’t be everything to everybody, but in some areas we can be world class. In some areas we are world class. What are we going to do about that? In some of these areas, like computing, we are world class. In integrated microsystems, we just invested more than $400 million; we classified areas work class there. In pulsed power, we are world class; in our national testing capabilities—at least in the national security area—we are second to none in many cases. In nanotechnology [we are leaders]. And there are others. As we move from less dependence on nuclear weapons as the provider of the largest part of that capability, we will have to figure out a way to be sure we will maintain those capabilities and keep them world class.”

Innovation corridor

Tom concluded his prepared remarks by noting that the vision for the nearly completed Mesa complex has evolved into a more ambitious concept, which he called the innovation corridor. He showed a brief video that described the innovation corridor, an area encompassing Red Storm, the Computational Engineering Facility, the Weapons Integration Facility, the MicroLab and MicroFab, the new Center for Integrated Nanotechnologies, and other facilities. The video characterized the innovation corridor as a place where Sandia and its partners will collaborate in state-of-the-art facilities to develop innovative solutions to key technical challenges. “We are committed to a strong integration of knowledge, education, collaboration, and problem-solving that makes our world a better, safer, place,” the video narration stated.

“The innovation corridor,” Tom said at the close of the video, “will support what we call a Discovery Institute, which we are putting forward as a place to create new partnerships all around the country in response to the competitiveness initiative the president announced about a year ago. So stay tuned; a lot to be seen there.”
Sensor

(Continued from page 1)

tive product that is detected by the electrode. “sandwich.” These secondary labels form an elec-
the other end of the target biomolecule, forming a

tion, the array is washed and treated with a differ-

are also investigating a new electrochemical detection method, using electrocatalytic
nanoparticles, that we hope will eliminate the
extra washing and labeling steps. This will greatly simplify the end

tody of this work was
recently featured in an article in Langmuir, published by the
American Chemical Society. Diazonium chemistry was used to selectively deposit the
enzyme horseradish peroxidase, which was then used to electro-
chemically detect hydrogen

process are “based on a clear vision of Sandia’s future size and budgets.”

SOON-TO-BE SANDIA CRADA partner
CombiMatrix’s 12,544-electrode array, patterned by Susan Brozik’s team to form a T-bird and the CombiMatrix logo. Bright pixels correspond to pro-
tain detected on patterned electrodes.

process team members

Principal investigator — Susan Brozik (1714)
Electrochemistry — Jason Harper, Ronen Polsky (both 1714)
Surface chemistry — David Wheeler, Shawn Dinh (both 1714)
Link to Langmuir paper: http://pubs.acs.org/acs/journals/doilookup?in_doi=
10.1021/la062916a

MWT process

(Continued from page 1)

As a result, senior managers across the Labs recently began the more aggressive “brokering” stage of the MWT process to find additional matches between people’s skills and available jobs, says Esther Hernandez (3010), Deputy to the VP for Human Resources.

‘Brokering’ begins

MWT, which helps the Labs adjust to evolving customer and mission needs, is part of a larger strategic staffing systems approach expected to be an annual process. It is about establishing an intentional, managed approach to aligning the workforce with the work to be done, says Esther.

On April 3 at Sandia/New Mexico, Labs Deputy Director Tom Hunter said the staffing targets that prompted the MWT

MWT and Signatures team

Says team member Ronen Polsky (1714), “We

this interest of commercial sensor companies. The

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CombiMatrix’s 12,544-electrode array, patterned by Susan Brozik’s team to form a T-bird and the CombiMatrix logo. Bright pixels correspond to pro-
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MWT process

(Continued from page 1)

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Winning photos tell Sandia’s environmental story

From New Mexico to Tonopah Test Range to Kauai Test Facility - Here are the winners of the 2006 Annual Site Environmental Report photo contest

Mark Rumsey, a field test engineer in Sandia’s Solar Technologies Dept. 6333, made a breathtaking photo of colleague Wesley Johnson (6333) working 300 feet above the plains of Eastern Colorado atop a wind turbine. Michael Pacheco (10827) captured the decisive moment as demolition contractors turned Bldg. 805 into history. And technologist Jeff Zirzow (6338) found beauty in a rusty bolt.

Mark, who isn’t particularly afraid of heights, says the key to working on the wind farm projects is being in shape. “I was very involved in the project and there was a lot of climbing up and down,” he says. He, Wesley, and other team members instrumented turbines in the Colorado Green Wind Farm to measure nighttime stresses on the structure in special meteorological conditions.

First Place – Tonopah Test Range (TTR): Jim Galli listened to a coworker describe a TTR locale with profuse wildflowers and then headed off at sunrise to capture it. He used two exposures to get both the shadow detail and the highlights.

Second Place – TTR: Steven Feador (2915) captured this quiet moment with a small herd of mustangs on the test range.

First Place – Kauai: Dean Manning (5402) found this mother albatross guarding her egg during an annual migration of the “gooney birds” to Kauai. As a safeguard, the birds and their eggs are typically moved by state officials to a preserve across the island.

Second Place – New Mexico: Michael Pacheco (10827) was doing his job of documenting the destruction of Bldg. 805 when he caught this action.

Third Place – New Mexico: Jeff Zirzow (6338) spotted this rusty bolt on a World War II-vintage sled at the ARM Climate Research Facility in Barrow, Alaska.

Third Place – TTR: Jim Galli, who doesn’t get a lot of time from his photometrics duties for “pretty pictures,” took an hour to explore an unusual occurrence of hoarfrost on the test range.

These were some of the stories of the winners in the 2006 Annual Site Environmental Report photo contest. Photos entered in the contest are used in an environmental annual report and other web and printed publications of Environmental Management Dept. 10331.

Tess Goering and Stephanie Särnje, 10331, coordinated this year’s contest. Lab News photographer Randy Montoya and writer Will Keener judged the contest. Winning entries from this and other years can be seen at this website:

Employee death

John Stephens’ ‘positive, let’s do it attitude’ will live on
Nationally recognized metallurgist dies at age 51 from complications of cystic fibrosis

Over the nearly 20 years John Laing (1522) knew and worked with John Stephens, he always appreciated his coworker’s ‘positive, let’s do it attitude’ — whether for mechanical testing or a strenuous scramble up Cabezon Peak near Rio Puerco Valley. Laing is just one of the many people who will follow his death March 22 from complications of cystic fibrosis at the age of 51. John worked at Sandia as a metallurgist for more than 20 years. At the time of his death, he was in Materials Reliability Dept. 1825.

Laing particularly remembered one hike he took with John at Cabezon Peak.

“I recall that John told us about getting his hiking boots down from his home attic after some years of storage,” Laing says. “An hour or so into the hike, John’s boot heels debonded from the soles and were flapping just as we were starting up the chimney crevice. John didn’t want to abandon the hike short of the summit, so we lashed the heels on with athletic tape. We had just enough time for ongoing repairs to make it to the summit and return to the trailhead.”

John had many personal interests, notes his father, John J. Stephens, Sr. He was an avid numismatist. He also loved financial investing and playing blackjack, an interesting combination. He was especially supportive of the Stanford Cardinals football program.

John had a distinguished career in metallurgy at Sandia. He received a BA degree in physics from Cornell University (1977), an MS in metallurgy from Stevens Institute of Technology (1980), and a PhD in material sciences from Stanford University (1984). He was a Fellow of ASM International, the American Welding Society, the Minerals, Metals, and Materials Society, and the American Society for Testing Materials, and the Minerals, Metals, and Materials Society.

He was a principal scientist and engineer at Sandia and well published with many citations, patents, and awards for scientific papers. He was also acknowledged through employee team recognition, quality, and nuclear weapons program awards, particularly for his work in advanced braing and high-temperature mechanical properties of engineering alloys.

Survivors include Linda, his wife of more than 18 years; parents John J. and Anna Stephens; brother Nick Stephens of Bronxville, N.Y.; nephews Zack and Richard Stephens of Bronxville, in-laws Bill and Wilma Brown of Millwauke, Ore.; and uncle Thomas Stephens of Columbus, Ohio.

His family would appreciate any anecdotes from his friends and collaborators at Sandia to use in their service Sunday, April 22, at St. Maron Parish at 11 a.m. Send your stories to Jill Glass at sjglass@sandia.gov or Mike Hosking at fmfhocks@sandia.gov.

— Chris Burroughs

Sandia signs memorandum of understanding with U of Illinois

Agreement formalizes relationship between two institutions

A memorandum of understanding between Sandia and the University of Illinois at Urbana-Champaign was signed at an official ceremony April 3 at the Urbana-Champaign campus.

The agreement formalizes the relationship between the two institutions and describes common fields of research interest in nanoscience, cognitive neuroscience, information technologies, cyber technologies, high-performance computing, energetic/combustion, complex systems/system-of-systems, and high-frequency imaging and communications.

Sandia Senior Manager Russ Sokolove (6340), who earned his BS, MS, and PhD in mechanical engineering at Illinois, serves as Sandia’s lead representative involved with developing the agreement.

Dave Carlson, director of Nuclear Weapons Planning, Operations, and Integration Center 200, serves as campus executive for the U of I relationship. He says the agreement will allow Sandia and the university to develop and pursue joint research initiatives that leverage both institutions’ strengths and infrastructure.

“The general area of collaboration include activities to support complementary institutional goals and share and leverage specialized research facilities and equipment,” says Dave, an Illinois alumnus with MS degrees in astronomy and nuclear engineering. “The agreement will also increase the number of students involved in collaborative engagement of faculty, staff, and students.”

“By joining our resources together with those of Sandia National Laboratories, we can have a significant impact on an incredibly broad range of research,” says Ilesanmi Adesida, dean of the College of Engineering at the University of Illinois.

Pierre Willitzius, director of the Beckman Institute for Advanced Science and Technology, notes that historically the University of Illinois and Sandia have had a very strong relationship in the physical sciences and engineering.

“We are very much looking forward to expanding our interactions with Sandia into new areas including cognitive sciences, neurosciences, and human and computer speech and vision,” says Willitzius. “This expansion will also engage faculty and students from the College of Liberal Arts and the University of Illinois’ strategic initiatives of the Beckman Institute and the University of Illinois.”

Sandia and the University of Illinois will publish an updated org chart to reflect those changes.
THE LAST TIME THE LAB NEWS published an organizational chart, in September 2006, the big change was that Mim John had retired and was replaced by Paul Hommert as acting director. For the time being, all three positions have been replaced with acting appointments. The changes are detailed in a story on page 8.
Retirees: Intel International Science & Engineering Fair needs volunteer judges May 15 & 16
Certain categories in critical need

Calling all retirees...if you have a technical degree and expertise in certain fields of math and science, the Intel International Science & Engineering Fair (ISEF) 2007 desperately needs you.

Some 1,500 precollege students from around the world, winners in their regional competitions during the past several weeks, are gearing up their projects and booking flights to Albuquerque to participate in the Intel ISEF in Albuquerque May 13-19.

All they need now are qualified judges to evaluate their work. More than 125 Sandia employees have volunteered to serve as judges, along with another 700-plus technically trained New Mexicans.

Host committee judging cochair Len Duda (5715) says judging shortages remain in the following categories: biochemistry, microbiology, animal science, behavioral & social sciences, plant sciences, medicine & health, environmental science, chemistry, math, and materials & bioengineering.

"We are in good shape in the other categories," he says. "To put on a first-rate science fair, we need more help in these areas."

Christnas judging cochair John McBrayer (5715) says judging shortages remain in the following categories: biochemistry, microbiology, animal science, behavioral & social sciences, plant sciences, medicine & health, environmental science, chemistry, math, and materials & bioengineering.

"It's a tough but rewarding experience," says Len. "You get a chance to talk to students who are very self-motivated and enthusiastic about their work."
This past week, Swarmy the robot completed his cleanup assignment — removing the last drum-full of thick sludge from the bottom of a deeply buried storage tank in Area 5.

The 47-year-old tank's shape, depth, and position had made cleanup efforts difficult. Its low-oxygen, confined-space environment had precluded manned entry and inspection.

The tank bottom had a thin layer of old sludge on it that tested positive for extremely small but detectable amounts of radioactive forms of uranium, cobalt, and cesium; additionally, nonradioactive chemicals such as arsenic and cadmium were measured in extremely low concentrations. The sludge had to be removed before the tank could be closed.

"It took a year to find the right process," says Paul Raglin (1380), senior manager for nuclear facilities operations. "The amount of work that got done once we found the right one is amazing."

In only a few weeks, Swarmy removed almost fourteen 50-gallon drums of sludge from the tank in preparation to meet New Mexico Environment Department closure requirements.

The robot was recycled from one of John Feddema's (6473) DARPA programs and pressed into service removing the sludge from the old wastewater storage tank.

Doug Evans, John Montoya, and Jason Garner, all from J.B. Henderson Construction, guided Swarmy remotely as it first pulled a scoop through the sludge and in the final efforts vacu-umed the sludge from the tank bottom with a modified Shop-Vac®.

The sludge-free tank will be removed from operation and monitored, awaiting eventual demolition when the building it served is also decommissioned.

Swarmy the robot, the engineers who modified him, and the operators who guided him, Paul says, helped Sandia solve a problem that could have been expensive and dangerous to fix if human beings had to enter the tank and clean it by hand. Swarmy, he says, did it quickly and at a very low cost.

Perhaps, Paul muses, some grateful Sandian should nominate Swarmy for this year's Employee Recognition Awards in appreciation for the robot's exceptional service.

DOUG EVANS INSPECTS SWARMY after its tour of duty in the wastewater storage tank.

LOOK CLOSELY — J.B. Henderson employee Doug Evans and Sandia Site Office water quality program manager Karen Agonino observe the final drum of sludge.