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The Federal Laboratory Consortium for Technology Transfer (FLC) is the nationwide network of federal laboratories that provides the forum to develop strategies and opportunities for linking laboratory mission technologies and expertise with the marketplace.

The mission of the FLC is to add value to the federal agencies, laboratories, and their partners to accomplish the rapid integration of research and development resources within the mainstream of the U.S. economy.
Contents

What is the Federal Laboratory Consortium? ............................................................. 2
A Message From Mojdeh Bahar, FLC Chair ............................................................ 3

Technology Transfer
Sandia Bomb-Disabling Technology Protects Soldiers ........................................... 4
Fish Story Has Happy Ending for American Aquaculture and Consumers .............. 6
Packaging That Grows Solves the Problem of Cotton Gin Waste ....................... 8
Oak Ridge’s Population Mapping Tool Sets the Standard .................................. 10
Crash-Avoidance System for Cars and Trucks Saves Lives .................................. 12
Hops Protect Honey Bees From the Scourge of Mites ........................................ 14
New NETL/Boston Scientific Alloy Creates Life-Saving Stents ......................... 16
Argonne Enables Virtual Automotive Design ....................................................... 18
NIST-Industry Collaboration Yields New Applications for Sensor Technology .... 20
ARS Bio-Oils Research Unit Develops Plant-Based Motor Oils ......................... 22
NIAID Diagnostic Test Identifies Norovirus Outbreaks .................................... 24
NASA Takes Solar Power From Earth to Space and Back Again ....................... 26
ECBC Breakthrough Identifies Biological Threats Quickly ............................... 28
PNNL Provides Catalyst for Sustainable Propylene Glycol Production ............... 30
TAC-BIO Protects Soldiers and Citizens From Biological Threats .................... 32
Navy Invents Solvent That Solves Environmental Challenge ............................ 34
ARS Rice Batter Recipe Provides Healthier Fried Food .................................... 36
EPA Advances Process to Remove Metals From Water .................................... 38
Got Milk? ARS Develops Test to Keep It Safe .................................................. 40

STEM (Science, Technology, Engineering, Mathematics)
About STEM ............................................................................................................. 43
High School Students Use Big Machines for Big Science .................................... 44
TARDEC Sponsors STEM Summer Camps at Tribal Colleges ......................... 46
Brookhaven INCREASE Program Levels the Playing Field for Minority-Serving Institutions .......................................................... 48
AFRL Partners With Dayton Regional STEM School ......................................... 50
USAFA’s Evolving STEM Mission Promotes Involvement ............................... 52
NIST’s SHIP Sails for Students and Researchers ............................................... 54

FLC Member Laboratory Directory .................................................................. 56
Tools for Technology Transfer Professionals ................................................... 66
FLC Regions ....................................................................................................... 68
Every day, more than 700 federal laboratories and research centers are working to commercialize innovations that enrich our lives and strengthen our nation. Thanks to the dedication of federal scientists, agency representatives, and technology transfer professionals, the nation’s investment in federal research and development is leading to products that promote public health, protect public safety, conserve energy resources, aid farmers, and support our military—to name just a few.

We understand the need to both serve the public good and increase the nation’s economic prowess. Through partnerships and collaborations, technology transfer supports our economy and our citizens in numerous ways. The true benefit of technology transfer is reflected not only in products put to use, but also in new jobs created. Several recent studies have shown that in just a small sampling of technology transfer efforts, each job directly created by technology transfer indirectly creates two to three additional jobs.

Federal laboratories also play a key role in creating the next generation of scientists and professionals to carry on this tradition. By educating and encouraging students of all grade levels, they replenish our future workforce in order to maintain global leadership. In these pages you will find just a few of the success stories that have come out of the federal laboratory system. Each was chosen because it shows the power and reach of technology transfer. We’re proud of these stories, and we hope that you are as well because they celebrate more than just the federal laboratories: They are also a testament to America’s ingenuity and its spirit of collaboration.
Sandia Bomb-Disabling Technology Protects Soldiers

Soldiers’ lives are being saved in Afghanistan by a remarkable device that disables bombs by cutting through them with a powerful, focused blade of water. The Stingray, developed by Sandia National Laboratories, was named one of Time Magazine’s 50 Best Inventions of the Year in 2010.

Although the concept behind the technology is not new, the Stingray is the first such device to overcome previous limitations—setting the stage for the Stingray to be deployed by the military to disable improvised explosive devices (IEDs) in Afghanistan, and by law enforcement agencies here at home. The Stingray disables bombs placed in a variety of environments, including on the roadside, in the trunks of vehicles, in propane tanks, and in backpacks.

The Stingray is made of clear plastic, and is about the size of a shoebox. It is filled with water, and contains a small controlled explosive charge. When the charge is detonated, it forces the water through a narrow concave opening, creating a high-velocity blade of water that can cut through and disable the bomb so that it does not explode. The water blade is powerful enough to slice through steel.

When researchers designed the Stingray, instead of using traditional explosive charges—which release energy equally in all directions—they used “shaped-charge” technology to mold the explosion so that it can create the water blade. This allows the Stingray to focus its power precisely where it is needed. One key advance over earlier technology is that Stingray is much less likely to detonate the bomb as it disables it. The water blade travels so quickly that it reaches and disrupts the bomb before it can detonate.

The Stingray has a second capability: When its explosive charge is detonated, instead of a water blade it can shoot out a high-velocity wall of water akin to a sledgehammer.

The Stingray is small, durable, and robust enough to be transported in a soldier’s backpack. It can support 24 pounds of pressure, and can be dropped without breaking. The Stingray is also designed to be operated remotely using a robot, which can grab the Stingray without breaking it. Previous bomb-disablement tools that used water blades were not rigid enough to be gripped by a robot.

One of the Stingray’s inventors, Steven Todd, had 21 years of experience in explosive ordnance disposal with the Navy before coming to Sandia. He saw the need for an improved fluid blade disablement tool, and formed a team that developed the Stingray through 50 design iterations and 16 lab prototypes.

TEAM Technologies of Albuquerque, New Mexico, acquired the rights to produce Stingray through a commercial Patent Licensing Agreement with Sandia. TEAM further refined the device, including making it 30 percent better able to withstand compression.

In the licensing agreement, Sandia agreed to refrain from licensing Stingray to any other company for seven years. This provided TEAM with the legal position it needed to protect the capital investment necessary to bring Stingray to market. The agreement included milestones that, in an inherently uncertain environment, were designed to avoid jeopardizing the technology commercialization.

The Stingray commercialization was notable for its speed. Only seven months were needed from the time of the licensing agreement in January 2010 to the delivery of the first Stingrays to U.S. troops. Over 8,000 Stingrays have now been shipped and are saving lives in war zones. At the military’s request, Sandia and TEAM collaborated to develop and commercialize a smaller version that fits in the pocket of a soldier’s cargo pants. Three thousand of these units, called the Tactical Stingray, have been shipped. The military has also expressed interest in a supersize version three times larger than the original Stingray.

Law enforcement agencies are now using the Stingray for various applications, and the U.S. Forest Service is evaluating using it as a water axe to clear dead trees without emitting sparks—an important advantage in fire-prone forests.

For its development of the Stingray, Sandia was presented with an FLC Award for Excellence in Technology Transfer in 2011.
Fish Story Has Happy Ending for American Aquaculture and Consumers

Developing a new formula for rainbow trout food might not, at first glance, seem like a high-profile project. But for a federal laboratory in Hagerman, Idaho, it led to a breakthrough with far-reaching implications for America’s commercial fish industry—and for food supplies in the developing world.

Researchers at a USDA Agricultural Research Service (ARS) lab, working with a commercial partner, demonstrated that rainbow trout can be grown more successfully on a plant-based diet than a conventional fishmeal diet. This is significant because the current practice of feeding fishmeal to farm-grown fish is not sustainable—supplies of the marine species used for fishmeal, such as anchovy, menhaden and herring, cannot keep pace with rapidly growing demand.

Drs. Ken Overturf and Rick Barrows of the Small Grains and Potato Germplasm Research Unit not only developed a successful grain-based food formula, but also cross-bred trout to produce fish that actually grow better with the plant-based formula. “We were coming at it from both sides,” said Overturf, a research geneticist. Those new strains of trout, grown by the commercial partner, Clear Springs Foods of Buhl, Idaho, are already reaching tables in American homes and restaurants. They account for 18 percent of all commercially grown rainbow trout in the U.S.

More than half of the fish consumed in the U.S. now comes from commercial aquaculture. In addition to trout, popular species include Atlantic salmon, sablefish, catfish, tuna and cobia. While the lab’s research focused only on trout, the findings hold promise for commercial farmers of other species as well. Plant-based food, and new strains of fish that thrive on it, will help support the growth of commercial aquaculture in the U.S.

These innovations will also benefit many developing countries, where farm-grown fish supply the only source of protein to much of the local population.

New strains of fish also appear to have a firmer muscle texture. And, he said, they taste “fabulous.” In fact, the lab conducted a blind taste test for fish farmers, and found that they couldn’t tell the difference between the plant-fed and fishmeal-fed trout.

The lab’s plant-based trout diet, in the form of pellets, is being produced commercially by several companies with proprietary formulas. Because the grains used in the feed do not contain Omega-3 fatty acids—a valuable dietary benefit of eating fish—current formulas include fish oil to make up for that deficiency. However, since the fish oil comes from the same marine species as the fishmeal—and those supplies are limited—the lab is now working to breed trout that can convert oil from algae and soy into Omega-3 fatty acids.

As a result of the lab’s successful work with the rainbow trout, it was awarded the “Outstanding Commercial Success” award by the FLC Far West Region.
Dr. Gregory Holt was trying everything he could think of to find a use for the millions of tons of troublesome cotton-gin waste that piles up in America’s Cotton Belt every year.

Holt and his colleagues at an Agricultural Research Service (ARS) lab in Lubbock, Texas, first converted the unused cotton burrs, sticks, and other detritus from the ginning process into roughage for livestock feed. However, that did not prove to be economical.

They then used the gin waste to create hydromulch—the bright blue or green liquid mulch commonly sprayed along the sides of highways to prevent erosion until vegetation grows in. Next, the lab tried using the waste to create fuel pellets for peller-burning stoves. However, neither application used enough of the gin waste to solve the ginners’ problem.

“We were going down the hit list,” said Holt, an agricultural engineer at the ARS Cotton Production and Processing Researching Unit in Lubbock. And then in 2009, the lab found a use that could potentially dispose of all the cotton gin waste generated each year: molded packaging and insulation boards. The result was a Cooperative Research and Development Agreement (CRADA) that has led to a successful commercial product.

Holt’s research on the topic began when he asked members of the Texas Cotton Ginners Association for their top ten concerns, and he learned that gin waste was number two on the list.

After years of trying different uses for the waste, with mixed results, the lab began working with Ecovative Design, a company in Green Island, New York, that actually grows packaging material by combining mushroom fungus with a biomass. The biomass serves as a substrate on which the fungus grows.

As the material is grown, it is molded to fit the desired shape. It is then dried, and the fungal growth is terminated. The 100-percent biodegradable material is seen as an environmentally friendly replacement for the type of polystyrene packaging that is commonly used to ship everything from computers to wine bottles.

Ecovative was having trouble finding the right kind of biomass to use, and asked the lab for some samples of gin waste. The company’s initial experiments were successful, and the CRADA was signed in 2010.

The key, said Holt, was to find the right formulation for the biomass to be used. Starch, gypsum and other materials were added to the gin waste, and different particle sizes in a variety of proportions were tested. Working collaboratively with Ecovative, the lab processed the formulations, which were then sent to the company for testing.

Gin waste turned out to be an excellent biomass, and by the summer of 2010 Ecovative began successfully launching the brand EcoCradle, its molded packaging material, selling it to Fortune 500 companies.

Thanks to the breakthrough with an effective biomass, Ecovative has expanded from two employees to 40, according to Holt.

The lab and Ecovative are exploring a variety of other uses, such as acoustic tiles, for the cotton-gin-waste biomass. “We’re broadening our horizons,” said Holt. The National Oceanic and Atmospheric Administration is even experimenting with using the material for buoys that measure ocean currents and other information. One benefit is that this type of buoy does not contribute waste to the oceans because it eventually becomes waterlogged and sinks, when it is then eaten by fish.
Oak Ridge's Population Mapping Tool Sets the Standard

When tsunamis struck the Indonesian coast in December 2004, the destruction left relief agencies scrambling to locate thousands of stranded people in need of assistance. LandScan, a global population database developed by the Department of Energy's Oak Ridge National Laboratory (ORNL), was a critical part of the response. Relief workers used LandScan population distribution maps to quickly determine the locations and numbers of potential tsunami victims who would otherwise have been cut off from communication.

Formally known as the LandScan High Resolution Global Population Dataset, the dataset was created in the late 1990s, and has since become the gold standard in population mapping tools for public safety, sustainable development, environmental protection, disaster response and humanitarian relief. In 2011, a commercial partner was granted an exclusive license to distribute the product.

LandScan determines the population of every square kilometer in the world over a 24-hour period—the finest resolution available. The technology uses innovative algorithms to determine population based on satellite images of buildings, roads, and other man-made structures. Other sources include local census data, geographical information such as the slope of the land—which can indicate suitability for housing—as well as the intensity of surrounding agriculture.

Population data from LandScan can be overlaid on maps or images so users can quickly visualize where there are large numbers of people, according to Eddie Bright, LandScan project leader at ORNL.

Although LandScan was initially developed for military purposes, researchers at ORNL have encouraged its wider use. After Rand McNally asked to use LandScan information in its maps, "we investigated how to do that," said Bright. Map publishers, as well as The New York Times, bought the earliest commercial versions of the product. Since 2004, the LandScan dataset has been commercially licensed and distributed through CDs.

In 2006, LandScan won an R&D 100 Award from R&D Magazine. Users include educational, humanitarian, research, and corporate organizations, as well as government officials. In the wake of Hurricane Katrina in 2005, for example, LandScan-produced images were used to brief President Bush about the coast's affected population.

Information from LandScan can be particularly valuable in natural disasters, Bright said. "With an earthquake, tsunami or flood, for example, you can tell in a second how many people are affected. You don't have to look up atlases for every little town."

In 2011, East View was granted an exclusive commercial copyright license for LandScan. At the time, ORNL Director Thom Mason said that LandScan has become one of the lab's most successfully licensed products. "This agreement with East View will help put this valuable population dataset into the hands of more users," he said.

East View is a leading provider of authoritative worldwide maps, geospatial data, and geographic information system (GIS) production services. Company founder and CEO Kent D. Lee said that "in addition to being a powerful database for environmental and humanitarian applications, we have seen strong demand from telecom, insurance and avionics customers from around the world." East View, he said, "has already split the LandScan data into regional and country-specific packages and now, as the exclusive distributor, we intend to load the content and offer affordable annual subscriptions."

The LandScan team at ORNL continues to make annual improvements to the population distribution information, using new spatial data, imagery, census information and algorithm improvements.
John A. Volpe National Transportation Systems Center
Cambridge, Massachusetts

The John A. Volpe National Transportation Systems Center in Cambridge, Massachusetts—as part of the U.S. Department of Transportation—has been helping the transportation community solve challenging problems for more than 40 years. Its mission is to improve transportation by anticipating and addressing emerging issues and advancing technical, operational, and institutional innovations across all modes.

Volpe is a unique federal agency fully funded by sponsor projects. It partners with public and private organizations to assess transportation needs, performs comprehensive analyses to inform regulatory and policy decisions, and develops and deploys advanced transportation technologies.

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We expect this type of technology to figure prominently in future safety initiatives in the transportation industry.

- Bob Petrancosta, Vice President of Safety, Con-way

Crash-Avoidance System for Cars and Trucks Saves Lives

Imagine getting a warning from your car when you start to change lanes and there is a vehicle that’s in your blind spot. Or a warning to slow down when you’re going too fast around a curve, or are in danger of hitting the car ahead.

The Volpe Center has played a major role in developing just such a crash-avoidance system—one that provides drivers with situational awareness of their surroundings and can warn them of dangers on all sides.

Through a collaborative research arrangement, Volpe Center and a university-led consortium built and field-tested an onboard safety system for passenger vehicles and heavy trucks. The Integrated Vehicle-Based Safety System (IVBSS) uses radar units and lane-tracking cameras to detect the proximity of other vehicles, as well as the position of the vehicle within its own lane. The sophisticated equipment array also includes gyros, global positioning systems (GPS), digital-map databases, and speed and motion sensors.

Together, these subsystems work to warn drivers of impending crashes due to lane changes, merges, forward collisions, lane drift, or excessive curve speed. And although road safety statistics have actually improved over the past few years, those types of crashes still cause 27,500 traffic fatalities each year, more than half of all crash-related deaths. Traffic safety experts believe that onboard warning systems like IVBSS could save many of those lives.

In 2005, the Department of Transportation entered into the cooperative research agreement with the consortium, led by the University of Michigan Transportation Research Institute (UMTRI). This five-year, $32-million program was groundbreaking: it was the first large-scale initiative to determine whether a variety of technologies could successfully be integrated into a single safety system onboard the vehicle.

To ensure successful technology transfer and deployment, the effort included a wide range of stakeholders from start to finish, including university researchers, federal regulators and policymakers, vehicle manufacturers, and a commercial truck fleet operator. The IVBSS team included: Dr. Wassim Najm, Dr. Mary Stearns, and Emily Nodine of the Volpe Center; and Jack Ference of the sponsoring National Highway Traffic Safety Administration and the Research and Innovative Technology Administration Intelligent Transportation Systems Joint Program Office. Other federal participants were the Federal Motor Carrier Safety Administration and the National Institute of Standards and Technology.

The Volpe team served as an independent evaluator of the IVBSS, and provided expert input on the system’s design and functionality. Based on the data in the field tests, the Volpe Center estimated that between 6 and 29 percent of passenger car crashes and between 2 and 11 percent of heavy-truck crashes could be avoided by using the integrated system.

The industry team outfitted 16 passenger vehicles and 10 heavy trucks with the prototype safety system. Both the car and truck field tests used volunteers driving in normal conditions, with the system recording their responses and other information. For the passenger car test, 108 volunteers recruited in southeastern Michigan each drove IVBSS-equipped sedans for 12 days with the system disabled—to collect baseline data—and another 28 days with the system in use.

The passenger car field test found that there was a significant reduction in the frequency, distance and duration of lane changes with the IVBSS, and that drivers used turn signals more often. One goal of the program was to determine whether drivers would be willing to use an integrated crash-avoidance system. In debriefings after their field tests, the volunteers generally said they liked the system, and would consider it one when purchasing a new car.

The truck field test used 18 volunteer tractor-trailer drivers from Con-way Freight, a trucking company based in Ann Arbor, Michigan. The drivers used the safety system while driving their normal delivery route over a 10-month period. Most reported that the system increased their driving safety, and made them more aware of the environment around them and their position in the lane.

Bob Petrancosta, vice president of safety for Con-way, said the company volunteered to participate in the project because safety is one of its core values. “We expect this type of technology to figure prominently in future safety initiatives in the transportation industry,” he said.

The successful development and demonstration of the IVBSS paves the way for industry to commercialize the technology. Vehicle manufacturers are already incorporating several of the subsystems into some models, with one or two types of crash warning. In the near future, automotive suppliers are expected to improve and bring more of the IVBSS prototype subsystems to market, a key step in making the fully integrated system a safety option in commercial vehicles.
Agricultural Research Service
Washington, D.C.

The Agricultural Research Service (ARS) is the U.S. Department of Agriculture's chief scientific research agency. ARS's job is to find solutions to agricultural problems that affect Americans every day, from field to table. ARS has 1,200 research projects within 21 national programs employing over 6,000 employees, including 2,100 scientists. ARS conducts research to:

- Ensure high-quality, safe food and other agricultural products
- Assess the nutritional needs of Americans
- Sustain a competitive agricultural economy
- Enhance the natural resource base and the environment, and
- Provide economic opportunities for rural citizens, communities, and society as a whole.

www.ars.usda.gov

Hops Protect Honey Bees From the Scourge of Mites

Well-known as a key ingredient of beer, hops are used to balance the sweetness of the malt ingredient and provide aroma. Thanks in part to scientists at the Agricultural Research Service (ARS) in Tucson, Ariz., hops are also protecting the nation's honey bees from their most dangerous foe.

Varroa mites, tiny parasites that feed on the bees' blood-like hemolymph, wipe out nearly one-third of the nation's private and commercial bee colonies each year. The danger to American agriculture is significant—honey bees pollinate more than $15 billion worth of crops annually across the country, according to the U.S. Department of Agriculture (USDA).

Although synthetic miticides have been in widespread use, Varroa populations have become resistant to the chemicals, prompting beekeepers and scientists alike to seek alternative controls. As part of a Cooperative Research and Development Agreement (CRADA) with an industry partner, Gloria DeGrandi-Hoffman and her colleagues at the ARS Carl Hayden Bee Research Center in Tucson demonstrated that hop beta acids (HBAs) can be used safely and effectively as a miticide.

Their studies began in 2005, when BetaTec Hop Products, Inc., a subsidiary of J.I. Haas, approached the lab looking for a use for HBAs, a byproduct of processing hops for beer. BetaTec knew that HBAs can kill mites on plants, and wanted to determine whether the acids might also work for Varroa mites.

Initial petri dish experiments were promising, so the lab entered into a CRADA with BetaTec to expand the studies, conducting colony trials in Arizona and California.

In the process, the researchers tried different application methods, ultimately settling on HBA-coated cardboard strips hung from a frame in the hive's center. Bees walk on the strips, pick up the HBAs, and spread them among the adult population of the hive through bee-to-bee contact. Mites on bees carrying the HBAs die and drop off.

The trials showed that while lethal to Varroa mites, the HBAs had no adverse effect on worker bees, their queens or brood, and are environmentally benign. Because the HBAs are water-soluble, they do not bind to the bees' wax or leave a residue in the comb. This means the strips can even be used during honey flows without affecting flavor or quality. The bees eventually chew up the strips, removing them from the hive. That prevents residual amounts of the miticide from remaining in the hive, which could hasten mite resistance to the compound.

DeGrandi-Hoffman was involved in all phases of the research. She constructed a mathematical model of the population dynamics of Varroa mites in honey bee colonies and used it to determine the best time of year to apply the HBAs so the mites don't overwhelm the colony.

While it is difficult to completely eliminate mites from a colony, all that is needed to protect the hives is to keep the level of mites below a certain threshold, according to DeGrandi-Hoffman. “If you can keep the mites from going into exponential growth, you’re golden.”

The lab also conducted experiments to determine the optimal amount of HBAs that could be used without harming the bees, as well as the right concentrations to put on the strips. BetaTec provided various formulations that were used in the process.

The lab’s work guided the design of the product, which DeGrandi-Hoffman said is an effective miticide. “We need to keep coming up with new ways to control Varroa mites, and this is a tool in our arsenal.”

As a result of work completed under the CRADA, BetaTec began commercializing the miticide under the brand name HopGuard. The product has been approved by the EPA for use under the Section 18 emergency use exemption in selected states, and BetaTec has started a registration process that will enable HopGuard to be used to control Varroa mites in honey bee colonies throughout the U.S.
New NETL/Boston Scientific Alloy Creates Life-Saving Stents

A new alloy developed by metallurgists at the U.S. Department of Energy’s National Energy Technology Laboratory (NETL) is helping cardiologists and their patients worldwide. The novel platinum-chromium (PtCr) alloy is being used by Boston Scientific Corporation, Inc. (BSCI) to manufacture coronary stents that are more flexible and conformable than existing stents, and more visible on X-rays. The result: easier placement by the doctor and more safety for the patient.

A coronary stent is a small, self-expanding, metal mesh tube that saves thousands of lives every year by opening blocked arteries and allowing blood to flow freely again. A crucial issue in the safe and exact placement of a stent is the ability of the doctor to see it clearly as it is pushed through the artery to its destination.

For decades, 316L stainless steel has been used successfully in a variety of commercially available coronary stents. The trend in new stent designs has been to reduce stent thickness so that the stent-delivery catheter, with the stent on it, is more flexible. This allows the stent to be passed through more tortuous arterial paths, facilitating the treatment of obstructions previously untreatable by minimally invasive procedures.

But there was a catch. As the thickness of stent walls decreased, traditional 316L stainless steel became more difficult to see on X-rays. This made it difficult for the doctor, who must place the stent in precisely the right location in the artery, to see what he or she was doing—especially when the doctor needed to insert multiple stents next to each other in a single, extended location, or go back to further expand or adjust the position of a stent after implantation.

Several years ago, BSCI decided to develop a superior stent, one that had a higher radiopacity (X-ray visibility) and yield strength than those in use. BSCI recognized NETL’s metallurgy capabilities and offered to fund the alloy research project. NETL’s Paul Turner, Paul Jablonski, and Ed Argentinier accepted the challenge to design a new platinum-enhanced stainless steel alloy to meet BSCI’s requirements.

“It’s the best part of my job when we start out with an idea, work with great cooperators, and see it all the way to real commercialization—one that I can proudly tell my neighbors when I say that I am from the government and I really helped,” related Turner, team leader for the alloy project.

Working closely with their counterparts from BSCI and funded by a series of contributed funds-agreements, the NETL team set out to develop the innovative alloy formulation. They melted, casted, and fabricated test samples, and characterized the properties of different alloy concentrations.

Part of the work was overcoming the complexities involved in combining the elements in the right concentrations to produce an alloy with optimal properties. Another challenge was the rolling and forming of the extremely strong PtCr alloy.

Ultimately, the NETL team succeeded in developing the innovative PtCr alloy formulation and producing a commercially viable raw material that solves many of the past problems surrounding traditional stents. The addition of platinum gives the stent physical properties that allow it to be both thin and visible on X-rays. The alloy’s increased strength decreases recoil, which reduces the likelihood of constriction after deployment. Platinum also gives the stent a higher corrosion resistance, which augments the stent’s long-term stability within the body. And the PtCr alloy’s ductility gives the stent flexibility that allows easier movement through arterial bends without causing damage.

The NETL team tailored the PtCr alloy for use in coronary stents and transferred the process to produce the alloy to BSCI. BSCI then developed a series of new coronary stents that are superior to existing stainless steel stents. With a thinner profile, improved deliverability during surgical procedures and higher radiopacity, the new stents are easier for surgeons to correctly place and they reduce the potential for accidental damage to the patient’s arteries.

After lengthy clinical trials, BSCI’s stents were approved for sale in November 2009. The stents were first marketed in Europe, the Middle East, and Africa in 2010 as the PROMUS® ELEMENT™. It is expected that PtCr stents will be used with increasing frequency in place of coronary artery bypass surgery, which is much more expensive, invasive, and dangerous. The benefits to doctors and patients in terms of ease of use, cost, safety and, ultimately, longevity make this technology critical.

The critical nature of the PtCr alloy was recognized in 2011 by R&D Magazine, which named it one of the 100 most technologically significant products to enter the market the previous year. The NETL team recently was further honored with a 2012 Award for Excellence in Technology Transfer from the Federal Laboratory Consortium for Technology Transfer.

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Argonne Enables Virtual Automotive Design

It is not an exaggeration to say that the Department of Energy’s Argonne National Laboratory in Lemont, Illinois, is helping make possible the green revolution in cars and trucks.

More than 150 vehicle manufacturers, automotive suppliers, federal agencies and others have been granted licenses to use an Argonne-created computer modeling tool that significantly minimizes the need to build physical prototypes of engines, electric motors, and other powertrain components.

With more than 1,000 possible combinations of technologies for hybrids, plug-in hybrids and electric vehicles, prototyping even a limited number would be prohibitively time-consuming and expensive. Argonne’s software tool, Autonomie, is both copyrighted and has a patent pending, enables automakers to “plug in” the computer model of a particular powertrain component to see quickly and efficiently how its interaction with other components would affect a vehicle’s overall performance, fuel economy, and cost. Since automakers typically need to make tradeoffs among those three attributes, Autonomie helps find the right combinations of systems and subsystems for different vehicles early in the vehicle development process.

In addition to modeling the physical aspects of powertrains and related components, Autonomie also allows engineers to develop low-level controls for components, as well as high-level controls—one that, for example, decide when to switch between the engine and the electric motor in a hybrid.

“The goal is to help engineers and automakers expedite the evaluation process, thereby accelerating the introduction of new technologies.”

One way Autonomie does that is by allowing an automaker’s various design groups to integrate their models. The software not only enables interoperability, but encourages collaboration across an organization, which speeds time to market, said Argonne research engineer Shane Halbach. “If all those groups come together, they can look at it from a whole-vehicle perspective rather than just with their one component.”

Traditional design paradigms in the automotive industry often delay control-system design until late in the process—in some cases requiring several costly hardware iterations. To reduce costs and improve time to market, it is imperative that greater emphasis be placed on modeling and simulation. This is particularly true with the increasing complexity of vehicles and the greater number of vehicle configurations.

Autonomie began as part of a Cooperative Research and Development Agreement (CRADA) with General Motors (GM). GM wanted a next-generation automotive simulation tool to address the increasing need for virtual engineering. In 2007, GM approached Argonne to partner on the development of the new tool. Argonne developed the vehicle simulation tool to handle flexible architectures, while GM provided expertise about software control development and feedback on the tool.

After a successful demonstration with a few targeted programs, GM is now deploying Autonomie worldwide to support production control development. GM has told Argonne that the partnership was one of its most successful ever with the U.S. government.

Among Autonomie’s licensees are universities around the world who use the classroom teaching version. The software is also used by college students who are participating in EcoCAR, a three-year advanced vehicle technology engineering competition, for which teams of students build cars and use Autonomie to compare and select powertrains.

Established by the Department of Energy and GM, the contest is managed by Argonne. Paul Betten of the Argonne Technology Transfer Office said that Autonomie’s use by universities and students is helping to train future engineers and promote energy-efficient transportation systems design.

By building models automatically, Autonomie allows the simulation of a very large number of component technologies and powertrain configurations. Its capabilities include simulating systems, subsystems, or entire vehicles; predicting fuel efficiency and performance; and performing analyses and tests for virtual calibration, verification, and validation of hardware models and control algorithms.

The computer modeling software developed by Argonne is not limited to the automotive industry. Autonomie could be used to model systems in a wide variety of applications, ranging from ships and airplanes to factories and nuclear reactors. Indeed, the modular plug-and-play approach of the tool makes it suitable to analyze any energy-related system.
NIST-Industry Collaboration Yields New Applications for Sensor Technology

Innovative ideas can come in small packages—or, in this case, from a palm-sized package-tracking device. What began as testing by National Institute of Standards and Technology (NIST) researchers on a temperature-sensing device for packages, which was developed by international shipper FedEx, has generated research into several unexpected applications.

It all started when FedEx asked NIST to test the accuracy of temperature measurements made by its newly developed sensor device placed inside packages. The device, called SenseAware, was developed to monitor the environmental conditions of delicate or perishable high-value packages while in transit. It connects to cell phone networks to provide FedEx customers with near-real-time information on a package’s precise location, temperature, humidity, pressure, acceleration, elevation and exposure to light.

NIST researchers conducted performance-based testing on the prototype sensor device and subsequent models as part of its Measurement Services. “The primary function of the device is to monitor temperature-sensitive materials such as medicines and vaccines, tissues, organs, and blood,” said Greg Strouse, leader of NIST’s Temperature and Humidity Group.

NIST’s recommendations to FedEx improved the device, including one of particular significance. According to Strouse, “We tested the beta units when they were transmitting information and when they were simply recording it, and we found that the devices create heat when transmitting, which throws off the measurement. To fix that, we developed performance data and an algorithm that kicks in to correct the temperature measurement when the device is actively communicating.” The devices are now accurate to within 0.02 degrees Celsius.

SenseAware is currently offered by FedEx as an added service that gives customers the “vital signs” of their shipments. It enables customers with sensitive materials, primarily from healthcare and science fields, to stay connected with their shipments through a Web-based interface. A GPS receiver in the device provides location information, and the device sends status updates whenever it obtains a cell phone signal. It even monitors the shipments while aboard airplanes and transmits the data upon landing.

As a result of his firsthand familiarity with the device, Strouse realized the potential for other applications, chiefly climate metrology. NIST is continuing the collaboration with FedEx and the manufacturer that now makes SenseAware for FedEx so the lab can use the technology for climate-change measurements. The goal of the research is to reduce the uncertainty associated with climate-change measurements.

The device’s connectivity and accuracy make it ideal for monitoring surface air temperature, which climate scientists often use to evaluate the performance of their models and to better understand the meaning and uncertainty of historical surface temperature data. Currently, three devices are stationed on the NIST campus in Gaithersburg, Maryland. The near-continuous measurements provide more information than the previous surface temperature measurements that occurred once per day. The sensors transmit data to the NIST researchers in batches every 15 minutes through a GPS system. Phase two of this research, set to begin in spring 2012, will enable NIST to build a more complex climate model by positioning the sensors at different heights. This will help to create a model of conditions such as heat islands or how winds work near the Earth’s surface.

Strouse has identified several other applications for the device that may lead to future research projects. These include safety applications such as early warning of bridge collapses or forest fires. Yet another application seeks to identify potential structural issues related to the pouring of concrete for large-scale structures such as bridge footings and building foundations. An ASTM standard requires that test canisters of concrete be poured at the same time, with temperature monitoring for 30 days during the curing process. Use of the SenseAware device—with its continuous temperature monitoring capability—may provide more complete data about the curing process, which can be used to better predict structural safety problems.

This story of NIST-industry collaboration is one of many examples of how NIST researchers are able to recognize not only the emergence of innovative technology from their mission-oriented measurement-science research, but also to understand its implications for commercial application in multiple, often diverse fields.
ARS Bio-Oils Research Unit Develops Plant-Based Motor Oils

What if all of the petroleum-based motor oil now used throughout the country—not only in cars and trucks, but also in every other kind of engine, from ships to lawn mowers—could be replaced with an even better lubricant made from plant oils like canola, sunflower and soy? That tantalizing possibility could one day become a reality, thanks to the work of scientists at the Agricultural Research Service’s (ARS) Bio-Oils Research Unit in Peoria, Illinois.

In 2011 LubriGreen began commercializing the lubricant, which is currently being used in race cars—a common precursor use for motor oils before they go on the larger market, according to Cermak. LubriGreen has entered into agreements with two large oil companies to distribute the estolide lubricant. The oil companies will buy the base estolide oil from LubriGreen, provide additives, and market their individual brands to consumers, likely sometime in the next few years.

In their search for CRADA partners, and in collaborations with them, Isbell and Cermak provided technical assistance for the pilot production of selected products, provided equipment and data transfers, and conducted physical property testing and distillations of estolide materials.

Though some of these tasks might seem straightforward, no prior methods or procedures had been developed for such new materials. Isbell and Cermak had the difficult task of demonstrating, through the use of scientific data, that estolides could not only equal the performance of petroleum-based materials, but exceed them. In 2011 LubriGreen began commercializing the lubricant, which is currently being used in race cars—a common precursor use for motor oils before they go on the larger market, according to Cermak. LubriGreen has entered into agreements with two large oil companies to distribute the estolide lubricant. The oil companies will buy the base estolide oil from LubriGreen, provide additives, and market their individual brands to consumers, likely sometime in the next few years.

LubriGreen has received a substantial investment from one of the companies to continue the research and development process. For example, it has granted the company, recently renamed LubriGreen BioSynthetics, an exclusive license to the estolide patent rights.

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The National Institute of Allergy and Infectious Diseases (NIAID) conducts and supports basic and applied research to better understand, treat, and ultimately prevent infectious, immunologic, and allergic diseases. For more than 60 years, NIAID research has led to new therapies, vaccines, diagnostic tests, and other technologies that have improved the health of millions of people in the United States and around the world.

NIAID Diagnostic Test Identifies Norovirus Outbreaks

Noroviruses are perhaps best known for ruining cruise ship vacations, but they also wreak havoc in other closed settings such as day care centers, dormitories and nursing homes. Worldwide, they are the most common cause of acute gastroenteritis, an illness that can lead to abdominal cramps, diarrhea, and vomiting in all age groups.

The Centers for Disease Control and Prevention (CDC) estimate that each year noroviruses cause more than 20 million cases of acute gastroenteritis in the United States. Noroviruses are highly contagious; as few as 18 virus particles are thought to be sufficient to cause infection. They are easily spread through contaminated food or water, from person to person, and by touching contaminated surfaces. Symptoms may last only a few days; however, for infants, older adults or people with underlying diseases, the infection can be severely debilitating and require hospitalization. While there is no vaccine to prevent norovirus infection, early detection is critical to controlling the spread of disease outbreaks, especially within a closed community.

Researchers have worked for years to develop diagnostic tools for norovirus. These efforts reached an important milestone recently when the U.S. Food and Drug Administration (FDA) approved the first screening test for the preliminary identification of norovirus. The test, called the RIDASCREEN® Norovirus 3rd Generation Antigen Enzyme Immunoassay (EIA), is based in part on technology developed by National Institute of Allergy and Infectious Diseases (NIAID) scientists.

Human noroviruses cannot yet be grown in the laboratory, making it difficult for researchers to study their interaction with immune cells. Dr. Kim Y. Green and her team in NIAID’s Laboratory of Infectious Diseases used genetic engineering to sidestep this challenge. They modified the DNA of another family of viruses, called baculoviruses, to carry the gene that encodes the protein shell, or capsid, of several norovirus strains. When grown in insect cells, the modified baculoviruses express virus-like particles (VLPs) that mimic the norovirus capsid. The capsid contains antigens that stimulate the immune system to produce antibodies that attack the virus. These VLPs can be purified in large quantities for use as diagnostic reagents and potential vaccine candidates.

Diagnostic manufacturer R-Biopharm AG licensed the recombinant baculoviruses from NIAID in 2004 and used the virus-derived VLPs to create monoclonal antibodies against norovirus. In R-Biopharm’s RIDASCREEN® Norovirus 3rd Generation test, these antibodies serve to capture a norovirus antigen from a stool sample. If the antigen is present, the antibodies bind to it so it can be detected in later steps of the test.

In 2011, the FDA approved the marketing of R-Biopharm’s RIDASCREEN® Norovirus 3rd Generation as the first test for the preliminary identification of norovirus outbreaks. The test is for use in situations where a number of people have simultaneously contracted gastroenteritis and there is a clear potential avenue for virus transmission such as a shared location or food. The ability of the test to detect a norovirus outbreak becomes greater as the number of patient samples increases, so while the test is not recommended for diagnosing norovirus infection in sporadic cases of gastroenteritis, it is useful for the preliminary screening of multiple stool samples.

RIDASCREEN® Norovirus 3rd Generation allows medical workers to identify norovirus infections at or near the location of the outbreak, eliminating the need to send samples to a secondary facility. According to R-Biopharm AG, the test yields results in less than two hours, enabling faster implementation of outbreak control procedures that can halt the spread of illness. In March 2011, the CDC updated its norovirus outbreak management and disease prevention guidelines to reflect the approval of RIDASCREEN® Norovirus 3rd Generation.

NIAID’s contribution to the RIDASCREEN® Norovirus 3rd Generation test is its latest accomplishment in a decades-long commitment to better understand noroviruses and develop new strategies for preventing, detecting, and treating norovirus infections. In 1972, NIAID researcher Dr. Albert Z. Kapikian and his colleagues first identified norovirus, initially called Norwalk virus, as a cause of acute epidemic gastroenteritis. NIAID scientists continue to pursue the development of vaccines and antiviral compounds against norovirus, including research on possible experimental systems to facilitate study of the immune response to norovirus infection in cells and in animals.
NASA Takes Solar Power From Earth to Space and Back Again

A remarkable 30-year partnership between NASA’s Glenn Research Center and a solar panel developer has led to a technology that has transformed solar energy collection in space—and on Earth.

The product of that collaboration, the stretched lens array, uses a thin film lens to concentrate sunlight on a small area of high-efficiency photovoltaic solar cells. The technology significantly reduces the weight of the solar arrays that power spacecraft and space stations, and makes solar power on the ground much more affordable.

The stretched lens array was developed for use on the ground, then redesigned for use in space. A spinoff of the space technology is now being used back on the ground in an advanced solar panel that the commercial partner, Entech Solar of Fort Worth, Texas, plans to commercialize in 2012. Although the materials used for space and on the ground are different, the fundamental design is similar. In space, the primary need is to minimize mass, while the focus on the ground is to reduce cost. The stretched lens array—which won a 2012 FLC Award for Excellence in Technology Transfer—achieves both goals.

“The story of this technology is absolutely about the Entech–NASA partnership,” said Roshanak Hakimzadeh, Deputy Chief Technologist at Glenn. “It was NASA’s need for a smaller, lighter weight, inexpensive technology that drove the work and pushed the envelope to achieve these extraordinary results.”

In the late 1970s and early 1980s, Entech Solar (then Entech, Inc.) developed a solar power concentrator for terrestrial applications that was spun into a concentrator for use in space in the late 1980s. Collaborative work among NASA, the Ballistic Missile Defense Organization, and Entech continued through the 1990s, culminating in a lens array that was used on NASA’s New Millennium Deep Space 1 mission (1999-2001). That asteroid/comet rendezvous mission demonstrated the performance and long-term durability of the solar array design and laid the foundation for further improvements.

The stretched lens array is unique among all solar array technologies in its range of benefits, which include very high efficiency, ultra-light mass density, high-voltage capability, and cost-effectiveness.

Prior to the Deep Space 1 success, the Glenn team, led by Mike Pirznoz, devised innovative and creative ways to test the lens array for performance in space conditions. That included using NASA’s Lear Jet for photovoltaic testing, and funding an array installation at 10,000 feet above sea level on Mt. Haleakala in Hawaii to test the technology in a space-like solar spectrum.

The stretched lens array is unique among all solar array technologies in its range of benefits, which include very high efficiency, ultra-light mass density, high-voltage capability, and cost-effectiveness. Those capabilities are critical for many of NASA’s planned space missions, including orbit maintenance for the International Space Station, and orbit raising and lowering of spacecraft for science missions around the Earth, moon and asteroids.

Glenn’s collaboration with the space industry continues. Ad Astra Rocket Co., of Webster, Texas, is interested in using a version of the technology to support its advanced plasma propulsion system. The stretched lens array “is a spectacularly enabling technology for electric propulsion in space,” said Tim Glover, Ad Astra’s director of development.

On Earth, Entech Solar’s new SolarVolt™ panel recently received International Electrotechnical Commission certification, and is protected by a number of issued and pending patents. The company is completing manufacturing scale-up plans, both in-house and at key suppliers, that will create U.S.-based jobs as it implements its mass production plan for the ground-based system.

The SolarVolt has a number of potential applications, including use in utility-scale power plants, smart-grid systems, communications systems, industrial building power systems, and military power systems. The SolarVolt has zero greenhouse gas emissions, and can generate power at a lower cost per kilowatt hour than many existing photovoltaic systems.

In journeying from Earth to space and back again, the stretched lens array has evolved into a powerful technology that will enable future NASA missions, further the commercial development of space, and help provide inexpensive renewable energy on the ground.
After mass spectrometry data has been obtained, ‘this cutting-edge algorithm enables identification of micro-organisms down to the strain level in minutes, rather than hours.’

**ECBC Breakthrough Identifies Biological Threats Quickly**

With a biological attack or an outbreak of an unknown infectious disease, time is of the essence—warfighters on the battlefield and first responders in U.S. cities must quickly identify the pathogen. A new software algorithm, invented by a U.S. Army laboratory and transferred to a commercial partner, promises to make that identification far more rapid.

The technology, developed by the U.S. Army Edgewood Chemical Biological Center (ECBC), couples a new software algorithm with a novel mass spectrometry-based proteomics method. It largely eliminates the need to culture samples, a time-consuming process. Instead, it uses mass spectrometry to scan samples for unique proteins and then matches those against a database of more than 4,500 different bacteria, viruses and fungi.

Known as the Agents of Biological Origin Identifier, or ABOid, the software was designed to quickly identify biological agents in circumstances where military or civilian users do not know the nature of the threat—or even whether one exists. This capability translates to faster and more targeted implementation of corrective measures.

After mass spectrometry data has been obtained, “this cutting-edge algorithm enables identification of micro-organisms down to the strain level in minutes, rather than hours,” said Charles Wick, a retired researcher at the lab who led the ABOid team. “This proves very successful for infectious disease identification and a range of other potential applications in military, medical, pharmaceutical, food and public-safety areas.”

For example, by identifying the exact microbial pathogen in an infection, clinicians can choose the most effective drugs, reducing healthcare costs and possibly saving patient lives.

This new data analysis approach, which is the basis for ABOid, is patent pending. In 2011, an exclusive patent license agreement was signed by Sage-N Research, of San Jose, California, a global leader in applying mass spectrometry in the field of protein research, or proteomics. The company plans to incorporate the technology into its existing SORCERER system, which is currently used by life-sciences researchers worldwide to rapidly identify proteins.

Sage-N Research vice president Ali Pervez stated, “We are excited to use our core expertise to bring the power of this cutting-edge technology and our SORCERER platform to a wider audience.” The ABOid technology could multiply SORCERER’s current sales volume 50 to 100 times.

The approach gained national attention in 2010, when researchers from ECBC teamed with bee experts from the University of Montana to study honey bee colony collapse, which has wiped out 20 to 40 percent of bee colonies in the USA. “The ECBC approach identified a combination of fungi and virus as possible contributors.

In a 2010 story in *The New York Times*, ECBC’s Wick said that “our mission is to have detection capability to protect the people in the field from anything biological”—and the bee research proved to be a perfect opportunity to see what the Army’s analytical software tool could do. “We brought it to bear on this bee question, which is how we field-tested it,” he said. The story was also featured on the CBS Evening News.

The ABOid software was designed to quickly identify biological agents from mass spectrometry data when the nature of the threat is unknown.
PNNL Provides Catalyst for Sustainable Propylene Glycol Production

Propylene glycol is used to manufacture chemicals that are needed to produce industrial and consumer products found in every household in America and beyond. Liquid detergents, antifreeze, deicers, paints, polyesters, cosmetics, personal care products, pharmaceuticals, and even certain food additives—are things we use every day—all contain propylene glycol.

And, until recently, propylene glycol has been dependent on a nonrenewable source—petroleum—for its production. In fact, each year over two billion pounds of petroleum are consumed to make enough propylene glycol to meet worldwide demand.

Now, propylene glycol can be cost-effectively made from renewable sources using a new catalytic process developed at Pacific Northwest National Laboratory (PNNL) and commercialized by Archer Daniels Midland Company (ADM).

This new safe, sustainable, cost-competitive, and commercially viable alternative to petroleum-based propylene glycol production—called the propylene glycol from renewable sources, or PGRS, process—converts plant-based glycerol or plant sugar alcohols to propylene glycol, which can then be purified to meet a variety of market specifications. The feedstock for this new process is primarily derived from the processing of a variety of crops, including corn and oilseed crops such as soybeans, sunflowers, jatropha, and Canola®, as well as from crop residues.

Another excellent source of raw materials for the PGRS process is the glycerol byproduct from biodiesel production. For every 100 pounds of biodiesel produced, 10 pounds of glycerol are formed. The PGRS process can use this byproduct glycerol as feedstock to produce propylene glycol, a more valuable commodity. This adds significant value to the biodiesel production process, the current U.S. market for which is estimated at one to two billion pounds per year.

Development of the PGRS process began a decade ago with a Cooperative Research and Development Agreement (CRADA) between PNNL and the National Corn Growers Association (NCGA). The collaboration, which was intended to explore a possible process to convert sorbitol to propylene glycol and ethylene glycol, resulted in the development of a new set of catalysts to test for the proposed process. In doing so, the researchers discovered they were able to convert glycerol to propylene glycol—an exciting result that would enable production of propylene glycol entirely from renewable sources.

Although NCGA exercised its option rights and executed a license for the process, it became clear on the heels of this discovery that a commercial partner from the chemical manufacturing sector would be best suited to bring such a product to market. One of the PNNL scientists then introduced ADM to the collaboration.

After a large-scale collaborative effort to optimize the catalyst, PNNL technology transfer staff reached an agreement with NCGA to regain rights to the intellectual property they had licensed—including appropriate compensation to recognize NCGA’s early role—so that work with ADM could continue toward a commercial end.

Around this time, direct funding from the U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy was obtained to accelerate the research with an intensified focus—along with a new CRADA between ADM and PNNL beginning in 2006 on exploring viable ways to bring the process to market. During that same year, ADM licensed the process from Battelle, which operates PNNL for DOE.

The company constructed and operated a pilot plant in 2009, followed by construction of a full-scale production facility in Decatur, Illinois, for the sole purpose of commercially producing PGRS. The new manufacturing facility, which has an annual production capacity of 200 million pounds, was officially commissioned in 2011, and is now producing propylene glycol that meets USP specifications entirely from renewable sources.

Overall, using glycerol-derived propylene glycol from the PGRS process in place of petroleum-derived propylene glycol represents a significant contribution to reducing U.S. petroleum consumption and, ultimately, our nation’s dependence on foreign oil.

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...using glycerol-derived propylene glycol from the PGRS process... [reduces] U.S petroleum consumption and, ultimately, our nation’s dependence on foreign oil.

Because the PGRS process relies on plant-based raw materials—which are safe, abundant, and low cost—production facilities such as the newly built one near ADM’s headquarters in Decatur, Illinois, can be both sustainable and economically competitive.
An Army laboratory developed a portable device that can detect airborne biological threats—and save the lives of soldiers on the battlefield and citizens at home. The device, known as the Tactical Biological detector (TAC-BIO), was designed and developed by the U.S. Army Edgewood Chemical Biological Center (ECBC).

That is good news for America’s warfighters and first responders, who will be able to take advantage of the TAC-BIO’s innovations—it is half the size, weighs 80 percent less and uses only four percent of the power compared with earlier technologies. The TAC-BIO is also significantly more affordable. The lower cost gives the military and domestic agencies the ability to deploy the devices in high density, making it possible to detect small, localized biological attacks and to map events.

In military applications, the TAC-BIO will be deployed to detect and warn downwind personnel of a biological agent attack. Early warning of such attacks can minimize exposure and casualties by alerting warfighters to take protective action. When battery-operated, the TAC-BIO can be remotely positioned to increase warning time.

The technology behind TAC-BIO, which is designed to detect agents such as anthrax, is based on fluorescence and scattering signatures produced by biological threats. When airborne biological agents interact with ultraviolet light, they fluoresce and scatter light in a specific and identifiable manner. In an improvement over previous high-power laser techniques, the TAC-BIO uses an emerging technology called semiconductor ultraviolet optical sources (SUVOS) to detect the bio-agents.

TAC-BIO’s team of inventors included six researchers from ECBC, two from the University of Arizona, and one from Teledyne Brown. A key goal in the initial development of the TAC-BIO was to demonstrate the use of SUVOS for biological agent detection. That was only the beginning of the innovation, which also included the development of optics and optical interrogation techniques to obtain the fluorescence and scattering signals from the airborne threat particles. Ultimately, the TAC-BIO invention team laid the foundation for successful technology transfer by creating a well-engineered and extensively tested device.

After a series of groundbreaking innovations, the TAC-BIO was transitioned to industrial partners for further refinement to be ready for large-scale production. Of even greater importance to the Department of Defense’s (DOD) technology transfer mission, a company was needed to champion TAC-BIO and successfully transition the technology into DOD procurement channels.

Working with the lab’s technology transfer office, the TAC-BIO invention team—led by David Sickenberger, Chief, Chemical and Biological Systems Integration Branch—assembled a marketing and technical package. The team was familiar with the tight-knit chemical biological detection community and provided the technology transfer office with a wealth of contact information. ECBC presented TAC-BIO to industry via email, follow-up telephone calls and teleconferences with the invention team.

About nine months into the process, ECBC decided to employ an important technology transfer innovation—the timed offer. This set a soft deadline for interested parties to submit a patent license application and commercialization plan. The timed offer approach was chosen because it keeps the transfer process moving forward by separating parties with serious interest from those simply “kicking the tires.”

Two industry partners subsequently entered into nonexclusive Patent License Agreements and Cooperative Research and Development Agreements (CRADAs) with ECBC. General Dynamics Armament and Technical Products, a leading U.S. producer of biological and chemical detection systems, and Research International, a company that develops and manufactures sensors and sensing systems with expertise in optical biological sensing and miniature rechargeable batteries. Technology transfer efforts with General Dynamics formally began in October 2009 and with Research International in May 2010.

The CRADA collaborations have substantially improved the TAC-BIO. The system has been simplified, weatherproofed, and ruggedized to stringent military specifications. The unit’s maintenance interval has been significantly extended, and modifications to the detection algorithms have reduced false alarms.

One of the technology licensees has already completed a substantial sale and is poised for a follow-on deal. The TAC-BIO is currently one of the technologies being proposed as a solution for a $117 million DOD acquisition. Licensees are continuing to explore markets with other U.S. government agencies, state and local first responders, and foreign allies. Industrial partners are also working to ensure that TAC-BIO meets the requirements of the U.S. Department of Homeland Security and other detection needs.

The ECBC TAC-BIO team has been honored with a 2012 FLC Award for Excellence in Technology Transfer.
Navy Invents Solvent That Solves Environmental Challenge

Cleaning and degreasing aircraft and automotive parts is a necessary task—one that can be critical to the safety of Navy aircraft. Yet conventional cleaning solvents have presented an environmental and worker-safety problem that the Navy has long sought to alleviate.

Several factors, including tightening environmental regulations, spurred the Navy to develop and license a new environmentally friendly solvent. This solvent could meet the strictest air quality standards in the nation without compromising performance.

The result was NavSolve®, a non-toxic, non-petroleum-based solvent that contains no HAPs and has low VOCs—but works as well as conventional solvents. NavSolve® was invented by Dr. El Sayed Arafat, a chemist with the Materials Engineering Division, Naval Air Warfare Center Aircraft Division.

According to Arafat, “NavSolve’ will allow the Navy to comply with local environmental regulations, while providing a safer cleaner to the fleet.”

Cold solvent cleaning of aircraft parts is done at organizational, intermediate and depot-level maintenance facilities, and usually takes place in either spray sinks or dip tanks. Cleaning carbon residue and grease from those parts is necessary so inspectors can check them for wear and cracks before rebuilding and returning them to service.

During the NavSolve® development process, researchers explored several alternatives; however, each had significant challenges that made them less than ideal. For example, while it was possible to meet the strictest environmental standards by using airtight parts washers, the equipment was very expensive. And though water-based parts washers also meet compliance standards, they do not clean as well and potentially can cause flash rusting.

NavSolve® provides an effective, environmentally benign alternative that is safer for workers to use, noncorrosive, and compatible with both metals and nonmetals. It has been certified as meeting the strictest air quality standards in the nation, as well as the relevant military performance standards.

Despite NavSolve®’s long list of benefits, it is more expensive to produce than competing, petroleum-based products on the market. To encourage manufacturers to produce the product and deliver it to the Navy, the technology transfer team at the Naval Air Warfare Center Aircraft Division, in Patuxent River, Maryland, recommended that the technology be transferred through multiple nonexclusive licenses.

The team identified 25 potential licensees; of those, 12 entered into limited purpose Cooperative Research and Development Agreements (LP CRADAs) to conduct their own evaluation tests of the technology.

Two companies have entered into Patent License Agreements (PLAs) to date. Armick Chemicals, LLC, of Grand Rapids, Michigan, decided to forego the LP CRADA route and instead opted to immediately enter into PLA negotiations to add NavSolve® to its current product line—which includes other Navy cleaning agents—and licensed the technology in 2010.

The following year a license was issued to Ecolink Inc., of Tucker, Georgia, which sells environmentally friendly solvents. While both companies are waiting for their products to undergo the necessary Qualified Products List studies before supplying NavSolve® to the military, they are already marketing the product to private companies.

Because of tighter air pollution regulations, NavSolve® could eventually replace conventional solvents not just in the military, but in the manufacturing, transportation and construction industries. Uses include maintenance of commercial aircraft, as well as automobile and truck fleets.

NavSolve® was chosen by the Office of the Secretary of Defense as the 2011 “Hot Technology of the Year,” and it was also selected for presentation at the 2011 World’s Best Technologies Innovation Marketplace. The NavSolve® team has been further honored with a 2012 FLC Award for Excellence in Technology Transfer.

NavSolve® has truly “solved” the environmental and safety problems related to parts cleaning and degreasing, enabling the Navy to continue to service the fleet even under the strictest environmental regulations.
ARS Rice Batter Recipe Provides Healthier Fried Food

Lovers of fried chicken, fish, vegetables and other foods can thank two Agricultural Research Service (ARS) chemists for inventing a cholesterol-free frying batter that can cut fat content by up to 50 percent—without a loss of crispiness or taste.

Chemists Fred Shih and Kim Daigle of the ARS Food Processing and Sensory Quality Research Laboratory in New Orleans found that batter made from rice flour absorbs far less oil than conventional wheat-flour batter.

The rice batter is a tool in the fight against America’s obesity problem, said Daigle. “Anything we can do to reduce the fat we take in will be an improvement in our diet.” In addition to the lower oil absorption, the batter developed by ARS is free of the eight most common food allergens. It is gluten-free, a particularly welcome benefit for the millions of Americans with wheat allergies and those with celiac disease.

Although the batter was patented in 2003, it was not commercialized for eight years—after it became a project in a technology transfer class at a community college. A professor and four students eventually licensed the technology and formed a company to bring it to market. Their product, Choice Batter, is sold across the country by four major grocery chains, and sales over the next five years are expected to reach nearly $5 million.

This remarkable story of technology transfer began in 2007, when the class, part of the Entrepreneurship Program at Howard Community College in Columbia, Maryland, conducted an in-depth review of the technology and its market potential. During their study, the students consulted extensively with Shih and Daigle. In 2008, the company formed by the professor and his students, CrispTek, received a license for the technology from ARS.

Aided by a $75,000 grant from the Maryland Technology Development Corporation, CrispTek—assisted again by Shih and Daigle—developed a commercialization model. In 2009, ARS and CrispTek entered into a Cooperative Research and Development Agreement (CRADA) to further develop and commercialize the batter.

Though through the CRADA, Shih and Daigle also helped scale up the product for marketing, CrispTek’s success exemplifies how technologies from a federal lab can be fast-tracked to product development and sales when there is close collaboration between researchers and the commercial partner.

The rice batter won an ARS Technology Transfer Award in 2011, and was awarded an honorable mention the same year by the FLC Southeast Region for “Excellence in Technology Transfer.”

Wheat flour, the chief ingredient in most commercial batter products, gives fried chicken, fish, and other foods a crispy, golden coat. But it can also make food greasy, thanks in large part to the gluten it contains. Although this key wheat protein component keeps batter fluffy and firmly attached to food, unfortunately it also binds tightly with oil molecules, boosting the food’s fat content.

Shih and Daigle, who were researching new uses for rice and its products, found that the proteins and starch in rice flour are chemically different from those in wheat, retaining a weaker grip on oil. In experiments, they fried up various rice batter formulations coated on skinless chicken breast nuggets. They then gently peeled off the coating and subjected it to a solvent extraction procedure that whisks away the oil for weighing and analysis.

Early versions of the rice batter cooked well and absorbed substantially less oil than wheat-based batters, but they didn’t puff up as well, nor did they always stay coated on the meat. Shih and Daigle overcame those problems by modifying the rice flour with enzymatic and other treatments.

The result? A better batter.
EPA’s National Risk Management Research Laboratory
Cincinnati, Ohio

NRMRL’s mission is to advance scientific and engineering solutions that enable the EPA and others to effectively manage current and future environmental risks. Environmental risk management seeks to determine what environmental risks exist and then determine how to manage, reduce or eliminate those risks. NRMRL possesses unique strengths and capabilities, and is dedicated to providing credible technological information and scientific and engineering solutions that support national priorities and protect human health and the environment.

www.epa.gov/nrmrl

EPA, EP Agov

This is a great example of how EPA is not only involved in establishing regulations, but is also helping companies meet them.

EPA Advances Process to Remove Metals From Water

To protect our nation’s water supply from harmful industrial contaminants, the Environmental Protection Agency (EPA) has been significantly tightening limits for mercury and arsenic. At the same time, the EPA’s Office of Research and Development is partnering with industry to develop technologies that help meet those standards.

The EPA’s National Risk Management Research Laboratory in Cincinnati played a major role in developing a new material that can quickly and efficiently, and economically strip mercury and arsenic from industrial wastewater streams. Technology developed in the laboratory was licensed to a startup company, which manufactures the product and sells it to refineries, chemical manufacturers, power plants, mining companies and other industries.

“This is a great example of how EPA is not only involved in establishing the regulations, but is also helping companies meet them,” said Dr. Michael Gonzalez, a chemist who was the project’s chief investigator.

The story began several years ago when Metaloy, a recycler of waste materials from the petrochemical industry, was searching for ways to reuse the spent catalyst from a process that removes sulfur from crude oil. The spent catalyst had been used as concrete filler and to line road beds, but Metaloy asked the EPA laboratory whether it might have a better use. Remembering lessons from a college biochemistry class, Gonzalez had the idea that the material might be able to strip metals from water. Tests confirmed that—showing the substance’s ability to remove mercury and arsenic.

To pursue the research further, Metaloy spun off a new company, MAR Systems, and entered into a Cooperative Research and Development Agreement (CRADA) with the laboratory. Because the spent catalyst was not of consistent quality for commercial use—and was not being produced in sufficient quantities—MAR Systems and the EPA focused on reengineering the chemistry behind the catalyst to create an entirely new material.

The laboratory conducted a number of tests and experiments to determine what part of the spent catalyst was responsible for removing the metals.

“Basically, we wanted to know what made it work,” Gonzalez said. “The idea was to break down the chemistry to understand it, and then build it back up to create a much more efficient material.”

Using scanning electron microscopy and other analytical techniques, the EPA determined the active chemistry in the spent catalyst, and the technology was patented and licensed exclusively to MAR Systems. With that information, the company created Sorbster™, which is now being widely marketed.

According to Missy Hayes, Director of Business Development and Product Marketing for MAR Systems, “The laboratory gave us the ingredients, and we created the recipe to make it work.”

Compared with other materials, Sorbster™ removes metals faster and more efficiently, and is more cost-effective, said Gonzalez.

In addition to mercury and arsenic, Sorbster™ has been developed to remove a number of other metals and ions from water, including selenium, hexavalent chromium and fluorides.

“We’re meeting the needs of companies that don’t have other choices,” Hayes said. “Because our product is so inexpensive and easy to use, it helps companies solve the conflict between industry and the environment.”

In 2010, Businessweek named MAR Systems to its list of “America’s Most Promising Startups.”

Sorbster™ has the consistency of fish-tank gravel and is sold by the pound. When it is placed in water filtration vessels, it removes metal contaminants in seconds. It does not leach the adsorbed contaminants over time, and thus can be disposed of conventionally, rather than as a hazardous material.

The laboratory continues to collaborate with MAR Systems through the CRADA as the company explores other commercial uses for Sorbster™, including its potential to remove metals present in air emissions and groundwater.

“Through this CRADA, I am working with a company to solve real-world problems and have a positive impact on the environment,” said Gonzalez. “That’s my reward.”

Sorbster™ Pellets Media
Agricultural Research Service
Washington, D.C.

The Agricultural Research Service (ARS) is the U.S. Department of Agriculture’s chief scientific research agency. ARS’s job is to find solutions to agricultural problems that affect Americans every day, from field to table. ARS has 1,200 research projects within 21 national programs employing over 6,000 employees, including 2,100 scientists.

ARS conducts research to:
• Ensure high-quality, safe food and other agricultural products
• Assess the nutritional needs of Americans
• Sustain a competitive agricultural economy
• Enhance the natural resource base and the environment, and
• Provide economic opportunities for rural citizens, communities, and society as a whole.

www.ars.usda.gov
@USDA_ARC

Got Milk? ARS Develops Test to Keep It Safe

Dairy farmers were crying over spilled milk—15 million tons of it. So Agricultural Research Service (ARS) immunocchemist Larry Stanker decided to do something about it. Stanker invented a method of detecting the residue of a potent antibiotic given to dairy cattle and other farm animals, making testing methods more accurate and saving large quantities of milk from unnecessarily being discarded every year.

Stanker, a scientist with the Foodborne Contaminants Research Unit in Albany, California, developed an antibody that flags traces of ceftiofur, an antibiotic used to treat bacterial infections in dairy cattle, as well as respiratory diseases in cattle, horses and swine. In doing so, he solved a problem that had long bedeviled dairy farmers.

The Food and Drug Administration monitors the amount of antibiotic residue in animal food products, including milk, meat, poultry and eggs. Milk with ceftiofur residue is considered unsafe, and must be discarded. With prior tests, inspectors could not easily distinguish ceftiofur from other potentially less harmful antibiotic residues. As a result, whenever an antibiotic residue was detected, inspectors ordered the milk to be discarded, just to be safe. And because the inspectors did not know whether it was ceftiofur they had found, they couldn’t work with the farmers to pinpoint and solve the problem.

The previous tests were also cumbersome or used expensive equipment requiring highly trained personnel. The ARS antibody can accurately detect the presence of ceftiofur with a simple strip test, which is now commonly used in the field at farms to pre-screen raw milk before it is trucked, and at creameries.

The antibody was patented and licensed to a private company that produces detection kits about 10 years ago, and it is now one of the highest royalty revenue-generators in the ARS patent licensing program.

The ARS initiated a Material Transfer Agreement to transfer samples of the antibody to a commercial immunoassay kit manufacturer, Charm Sciences, Inc., of Lawrence, Massachusetts. Following extensive evaluation supported by Stanker, Charm obtained a license for commercial use of the antibody, and the ARS transferred the antibody cell line to the company. In 2009, the Neogen Corporation received a nonexclusive license to the technology in order to produce its own commercial testing kit.

In addition, Stanker collaborated with the Food Safety and Inspection Service to develop a simple assay that detects ceftiofur residues in bovine and porcine kidney, which is predictive of levels in muscle and meat.

Stanker’s invention takes advantage of the recognition powers of antibodies. When there is an infection, the immune system makes antibodies that recognize and bind to foreign bodies. Stanker created an antibody that is specifically designed to bind with ceftiofur—though not with other antibiotic drugs—and so serves as a flag or marker for that antibiotic. That same concept—using the recognition abilities of antibodies—is used to detect other types of contaminants in food, and has a wide range of other uses, including the diagnosis of diseases.

Stanker has continued his research into the detection of small molecules using monoclonal antibodies. He is now developing novel immunoassays for detection of infectious prions and botulinum neurotoxin, and his research is increasingly attracting commercial interest.

The FLC Far West Region recognized Stanker with an Outstanding Commercialization Success Award for the development of the ceftiofur antibody.
The federal laboratories understand that the future of innovation in America begins with instilling a passion for science and technology in today’s young minds. From elementary school to the university level, federal laboratories and research centers work with students through a variety of outreach programs. These programs involve hands-on scientific adventures in areas such as nanotechnology, aviation, medicine, and environmentally friendly energy development. The next few pages highlight just a small sampling of this work in action. These activities demonstrate how the efforts of the federal laboratories have been set in action to ensure that the United States does not lose its competitive edge in the world of technology.

About STEM

STEM
Science/Technology/Engineering/Mathematics
High School Students Use Big Machines for Big Science

High school science teachers will tell you that students usually learn science best in the laboratory, recreating the experiments that defined modern scientific discovery and theory. Unfortunately, many of the most interesting experiments require instrumentation and equipment that are simply too costly to provide in a classroom laboratory, with price tags that can reach into the millions of dollars.

Through an innovative collaboration, Brookhaven National Laboratory on Long Island has offered local teachers and students access to such tools at the National Synchrotron Light Source (NSLS), where beams of light in the x-ray, ultraviolet, and infrared wavelengths are produced by two synchrotrons for use in experiments. Research conducted at the NSLS has yielded advances in biology, physics, chemistry, geophysics, medicine, and materials science.

Through the program, Introducing Synchrotrons into the Classroom (InSynC), high school teachers and students have access to the synchrotrons from their classrooms through a competitive, peer-reviewed proposal process.

“Working with the scientific staff, we are trying to develop the next generation of scientists and engineers for this country and for the Department of Energy. The workshops show science teachers how they and their students can use these resources—the same multimillion dollar instruments Nobel Prize-winning researchers are using for scientific discovery—to conduct real scientific measurements remotely from the classroom.

In addition, the workshops introduce some real-world scientific problems locally that can be investigated by students. Through generous sponsorship from education and science foundations, the workshops are offered to the community free of charge.

The program trains participants to formulate a hypothesis-driven scientific problem and learn to write a competitive “beamtime” proposal for a set of experiments using conventional and synchrotron-based methods. The beamlines currently equipped for remote access capabilities are used, including U2B (infrared microscopy), X26A (x-ray fluorescence microscopy), and X6A (protein crystallography).

An NSLS Proposal Review Panel, consisting of a mix of synchrotron scientists and science educators, reviews and scores the proposals. Ratings are based on scientific merit and the educational nature of the project. The highest rated proposals are allocated beamtime.

In its first year, the program drew 17 middle- and high-school science teachers to Brookhaven for the intensive, three-day synchrotron training workshop. Then, at the beginning of the school year, the teachers worked with their students to develop scientific hypotheses. Six InSynC research proposals were submitted to an international review panel, and three were allocated beamtime. In its second year, InSynC expanded from Long Island classrooms to those around the nation.

In one project, students studied how biofilms from bacteria, algae, and fungi might be used to clean up toxic levels of copper in fresh water. Each teacher selected a small group of students to conduct the experiment with them at NSLS, while the remainder of the students watched and participated in the study from their schools via Internet-enabled tools.

In another project, students compared the toxins in tobacco from commercial and organic cigarettes using an X-ray fluorescence microscope at NSLS. They found some surprises: the element polonium, which may lead to lung cancer, wasn’t found in either of the tobacco samples. And, the organic cigarettes actually contained higher levels of potentially toxic elements.

InSynC proposals are accepted in all areas of scientific research. Based on the initial suite of beamlines available for this program, experiments in earth and environmental sciences, bioenergy, biomedical imaging, and structural biology are encouraged. In addition, engineering proposals involving the development of robotics for beamline operations will also be considered.

InSynC is an opportunity to introduce synchrotron science to students at a young age. “We are seeing a shortage and a future demand for scientists, engineers, and technicians that are trained to work at a synchrotron,” said NSLS scientist Lisa Miller. “Introduction to these facilities early in academic learning is a way to motivate students to pursue this field of science.”

Support for InSynC is provided by the Office of Workforce Development for Teachers and Students within the U.S. Department of Energy Office of Science.
TARDEC Sponsors STEM Summer Camps at Tribal Colleges

Seeking to provide science, technology, engineering, and mathematics (STEM) education for children of under-represented groups, the Michigan National Defense Education Program (NDEP) Coordination Office, based at the U.S. Army Tank Automotive Research, Development & Engineering Center (TARDEC) in Warren, Michigan, sponsored multiple STEM summer camps at two tribal colleges in 2011. The colleges, located on reservations, welcomed the STEM camps, and 90% of the K-12 students who attended were Native Americans.

Inclusion of a diverse student population within our STEM educational efforts will lead to more STEM careers selected by student members of under-represented groups.

One year earlier, TARDEC had been appointed by the Office of the Secretary of Defense to lead Michigan’s NDEP. TARDEC immediately saw the opportunity to reach out to the state’s Native American population and bring STEM programs to the tribal colleges. TARDEC’s tradition of working with tribal colleges and universities began in the early 1990s, and it was eager to build on that foundation.

TARDEC awarded a contract to the American Indian Higher Education Consortium (AIHEC) in Alexandria, Virginia, to support all of the tribal college STEM summer camps. AIHEC is the headquarters of the 36 tribal universities and colleges located in the U.S., all of which have Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) status. This was lauded as the first contract awarded to tribal colleges by TARDEC in the 71-year history of the command.

The STEM camps covered a variety of topics, including chemistry, forensic science, applied mathematics, physics, robotics and rocketry. TARDEC scientists and engineers were involved in all phases of work related to the camps, from planning to teaching. The two tribal colleges were Bay Mills Community College in Brimley, Michigan, and Keweenaw Bay Ojibwa Community College located in Baraga, Michigan. According to the STEM camp organizers, it seemed as though the entire population of each reservation was aware of the benefit of these camps and TARDEC’s role in funding the camps. And, according to the Brimley newspapers, this was the first such camp for K-12 students residing on the reservation.

Greg Chappelle, the Michigan NDEP STEM Coordinator and nationally recognized STEM educator, stated that “Inclusion of a diverse student population within our STEM educational efforts will lead to more STEM careers selected by student members of under-represented groups.” Both Greg Chappelle and Andrea Simon represented TARDEC at these groundbreaking summer STEM camps, and they worked with the teachers and students to enhance the students’ learning experience. Andrea Simon said, “The use of ‘hands-on’ STEM teaching methodologies was very exciting to the students.”

Chappelle and Simon have been working together on Michigan NDEP STEM projects since 2010. They have teamed to bring NDEP-funded after-school STEM programs to public schools around Michigan and K-12 summer STEM camps to major universities. They have also spearheaded NDEP STEM public service announcements on television. Through their work with the STEM Alliance of Michigan (SAM)—a group of government, industry, and educational stakeholders with a shared focus on K-12 STEM education—the 96th Michigan Legislature passed a 2012 State Proclamation declaring the last week of March 2012 as “Michigan STEM Awareness Week.”

Chappelle said, “We look forward to forging new relationships with the tribes.” Indeed, TARDEC’s vision is to continue to run K-12 STEM summer camps at the tribal colleges and to expand these to include remotely located reservations throughout Michigan.

Al Kuslikis, AIHEC’s STEM Associate, also looks to the future and added, “The summer camp program represents an important direction for collaboration between TARDEC and tribal colleges in all of the states in which TARDEC operates facilities.”
Brookhaven INCREASE Program Levels the Playing Field for Minority-Serving Institutions

The Interdisciplinary Consortium for Research and Educational Access in Science and Engineering (INCREASE) assists minority-serving institutions with gaining access to world-class research facilities. The group also aims to facilitate education and research training, especially for African-, Hispanic-, and Native-American and women. Based at Hampton University and formed at Brookhaven National Laboratory (BNL) in 2007, INCREASE has held yearly workshops with support from BNL’s Photon Sciences Directorate, the Office of Educational Programs, and a National Science Foundation grant through Southern University – New Orleans (SUNO). With features such as hands-on research demonstrations and proposal-writing tutorials, the workshops have taught INCREASE members how to transform themselves and their students into successful users of the National Synchrotron Light Source (NSLS) and the Center for Functional Nanomaterials.

Last year, BNL Deputy Director for Science and Technology Doon Gibbs signed a Memorandum of Understanding on behalf of the Laboratory, along with the presidents of the 11 INCREASE core institutions from the United States, Virgin Islands and Puerto Rico—Alabama A&M University, Delaware State University, Hampton University, Morgan State University, North Carolina A&T State University, Northeastern State University, SUNO, Tennessee State University, Toogaloo College, University of the Virgin Islands, and the University of the Virgin Islands.

“INCREASE is really about leveling the playing field for research and education,” said INCREASE President Eric Sheppard, dean of the School of Engineering and Technology at Hampton University. “We can do it ourselves. It’s about building infrastructure and institutions. It’s also about building people.”

The program has received funding from the National Science Foundation through a SUNO Historically Black College and Universities (HBCU) undergraduate program grant to create workshops that educate faculty from minority groups about the opportunities available at national laboratory facilities. The funding was awarded after INCREASE held three successful NSLS-sponsored workshops. The workshops have been a direct outcome of the Department of Energy’s (DOE) faculty and student team program at BNL.

“This is a very good collaboration for HBCUs because it brings together all of the faculty members from those campuses that do not have the big equipment and resources found at national laboratories,” explained Joe Omojola, one of the founding members of INCREASE and a mathematics and physics professor at SUNO. “This benefits both faculty and students through advancing the research capabilities of faculty members, who then train the students.”

The workshops were designed to increase awareness about BNL facilities and to expand the variety and diversity of projects by providing partnerships and opportunities with different universities. These partnerships, in combination with access to first-rate research equipment, result in significantly more competitive research grant applications for the underserved faculty members.

INCREASE is collaborating with other national labs after its fifth annual Synchrotron Science Workshop at SLAC National Accelerator Laboratory and Lawrence Berkeley National Laboratory in July 2011. This proof of concept will eventually allow INCREASE to hold annual workshops for minority professors throughout the entire DOE complex, creating access and developing new users for these cutting-edge facilities.

The number and diversity of INCREASE workshops also have growth potential. Creative combinations of user facility workshops and expansion to the entire DOE complex are planned for the future.

“ATtracting a talented pool of minority scientists from academia and expanding INCREASE workshops to other facilities beyond NSLS are good indicators that the INCREASE program can be a successful model for meeting DOE’s mission for workforce development and diversity,” said Noel Blackburn, manager of University Relations and DOE Internships.
AFRL Partners With Dayton Regional STEM School

Science, technology, engineering and math (STEM) education is flying high in Dayton, Ohio, thanks to the Air Force Research Laboratory (AFRL) at Wright Patterson Air Force Base. Among the many STEM initiatives AFRL fosters is a key partnership with the Dayton Regional STEM School (DRSS).

Ricardo Negron, Branch Chief of AFRL’s Domestic Partnering Branch, was not only instrumental in spearheading the lab’s partnership with DRSS, he was also part of the team that helped to bring the STEM school to the Dayton region. In 2007, when the Ohio legislature authorized funds for the creation of five regional STEM charter schools, Negron determined that technology transfer statutes would allow AFRL to serve as the technology partner for such a school. He then assisted Wright State University and a nonprofit dedicated to the development of regional STEM talent with writing the winning grant proposal to locate one of the planned STEM schools in Dayton. DRSS first opened its doors to 93 ninth-grade students in August 2009.

At that time, the leadership within the community looked to leverage the region’s resources for collaborations with higher education, government, nonprofits, and private industry. As for a technology collaborator and mentor, DRSS had only to look across the street to its neighbor, AFRL, for assistance. Each year since the school began, DRSS has added two grade levels, and is on track to offer a full combined middle- and high-school campus for grades 6 through 12 by the fall of 2012. The school’s current enrollment is 350 students in grades 7 through 11.

AFRL is an ideal technology partner for DRSS. Some of the nation’s most brilliant scientists and engineers work there on leading-edge research in the areas of sensors, materials and manufacturing, propulsion, human performance, and air vehicles—the five AFRL technology directorates located at Wright Patterson.

STEM education is the key to the Dayton region’s and to our state’s economic future.

DRSS has access to this talented pool of AFRL scientists and engineers through an Education Partnership Agreement signed with AFRL in 2011. The agreement formalizes the partnership that has existed since 2009 and enables the school to work seamlessly with the five AFRL directorates.

“STEM education is the key to the Dayton region’s and to our state’s economic future,” stated Joe Sciabica, AFRL Executive Director. “The quality of life for our citizens, the new technological products that will come to market, and the technological edge our U.S. Air Force will maintain are based on our ability to grow and sustain a technical brain trust right here in Ohio.”

Throughout the year, DRSS teachers request assistance from AFRL. In one class, students were studying the physics of rockets, and the engineering teacher asked AFRL whether there was a “real” rocket scientist at the lab. An Air Force colonel at AFRL fit that job description perfectly, and served as the subject-matter expert for the project, giving students insight into the areas of trajectory, force, and inertia. AFRL scientists and engineers also co-teach when a teacher requests a technology expert.

During the current school year, an Air Force engineer is co-teaching the Principles of Engineering class—part of the nationwide Project Lead the Way curriculum—to 11th grade students. Additionally, AFRL scientists and engineers serve as evaluators for student capstone projects. These projects are developed toward the end of educational units, and community partners are invited to the student presentations. AFRL also supports the school’s career development and growing after-school programs. As a result of the guidance department’s request for job-shadowing and internship experiences, AFRL now hosts groups of students in the various labs at Wright Patterson. And during career fair days, AFRL is always represented to educate students about working at AFRL. Many scientists and engineers provide after-school tutoring to students, and others serve as robotics and Science Olympiad team coaches.

Providing educational leadership since DRSS’s beginning, Ricardo Negron—himself an AFRL engineer—serves on the school’s board in an ex-officio position. Negron has taken an active role in the staffing and continued growth of DRSS. “The Air Force Research Laboratory provides a learning environment for students and teachers, and we are excited to be part of the region’s educational culture and are dedicated to its success,” he said.

Negron and the AFRL STEM program at Wright Patterson have received the 2012 FLC STEM Award.
USAFA's Evolving STEM Mission Promotes Involvement

The U.S. Air Force Academy’s (USAFA) new K-12 STEM Outreach & Research Center is addressing the growing crisis in the science, technology, engineering and mathematics (STEM) workforce.

Colonel Noel Barlow, Chair of the Engineering Division at the Academy and Vice President for Education for the American Institute for Aeronautics and Astronautics (AIAA), chairs the oversight panel for the Center. “The Academy has been a powerful STEM engine for America since it graduated its first class in 1959. We send over 400 STEM graduates annually into the military workforce, and most of those later attend grad school in STEM and have second careers as leaders in government, industry, and academia. Individual faculty members and departments have also been conducting exemplary grassroots STEM activities for decades.” He and the USAFA leadership believe, however, that the Academy’s role must evolve.

Dr. Billy Crisler, associate professor of aeronautics and recipient of the 2011 FLC Mid-Continent Region Outstanding STEM Mentorship Award, directs the Center and continues the story. “We’ve been a STEM consumer, taking the cream of each year’s high school classes from around the nation. From the President on down, our chain of command has made it clear that STEM outreach is everybody’s concern, and that means it’s our concern. We must now become a STEM supplier.”

Dr. Crisler believes the solution to our national STEM workforce and education crisis is a widespread network of local solutions. “Using grants from the National Defense Education Program, we leverage the Academy’s STEM resources to benefit STEM education in southern Colorado. Our strategic vision goes beyond that, however. We want to integrate the efforts and goodwill of local governments, school boards, and nonprofit STEM providers with that of local industry and professional societies, then create a scalable, flexible model that other communities can exploit in defining their own local solutions.”

Colonel Brent Richert, Chief Scientist at the USAFA, points to Plutarch’s maxim, which is the motto for the Center: ‘The mind is a fire to be kindled, not a vessel to be filled.’ “These words echo our quest to provide those singular ‘a-ha’ moments of discovery, when a student moves from lack of awareness or disinterest, to being passionate about STEM and making informed life choices about careers in STEM,” said Richert. “Once that fire is kindled in elementary school, it has to be sustained through middle and high school, and it has to be transitioned to a college experience.”

The Center leverages the Academy’s unique venue, and collaborates with other national and federal agencies to provide continuing education opportunities at the annual K-12 STEM Educator Summer Bootcamp. Colonel Mike Van Valkenburg, formerly Director, Science and Engineering Workforce Strategy at the Pentagon, now Department Head of Chemistry at USAFA and a member of the Center’s oversight panel, finds that his experience at the Pentagon aligns with the Summer Bootcamp methodology. “An outreach effort, like Bootcamp, which targets K-12 teachers, is the most timely and cost-efficient method with the largest payoff to increasing the STEM student supply for our nation. More motivated and knowledgeable educators who are confident in STEM material are likely to pass that excitement and confidence on to the classroom, made up of twenty-five or so possible future scientists and engineers. What a great multiplier!”

This popular, affordable, three-day workshop provides hands-on training in standards-based STEM programs for both classroom and after-school enrichment. Programs have featured SeaPerch remotely operated underwater vehicles, FIRST Robotics, and model rocketry. Previous collaborators include NASA, the Federal Aviation Administration, U.S. Navy, AIAA, and the National Institute of Aerospace. The Center continues to seek to engage other agencies that have a STEM outreach mission.

Photo Credit: Air Force Photo/Photographer Mike Kaplan

An outreach effort, like Bootcamp, which targets K-12 teachers, is the most timely and cost-efficient method with the largest payoff to increasing the STEM student supply for our nation.

The STEM Outreach Center truly makes it possible for USAFA stakeholders—from the cadets to the faculty to partnership organizations in industry and government—to be involved and to accomplish the STEM mission.
NIST's SHIP Sails for Students and Researchers

One way to measure the success of a STEM program is to determine the impact of the program on the participants after the program has concluded. For the students who participate in the Summer High School Internship Program (SHIP) at the National Institute of Standards and Technology (NIST), this impact is evident. In fact, each year more than half of them request to continue their research projects past the conclusion of the summer program and into the school year.

At NIST, this level of student dedication is matched by mentor commitment that also stretches past the end of the summer. Often, the NIST scientists who volunteer as SHIP mentors are rewarded doubly for this dedication—they have the satisfaction of building a STEM mentoring relationship with a student and, in many cases, their own research is furthered by that student’s involvement.

For the SHIP students, they may even have the opportunity to be recognized as co-authors on research studies.

SHIP mentor Dr. Brian Maranville remarked that his “student’s work made a major contribution to the project, and my work since then has built heavily on the base the student provided.”

Dr. Cindy Dennis, the SHIP point of contact at NIST’s Material Measurement Laboratory, is responsible for charting SHIP’s course ahead—gauging the program’s success and applying lessons learned. “Most of the SHIP mentors have been very impressed with their students, and have had very productive relationships with them. In fact, NIST is very proud that three SHIP students have gone on to be INTEL Science Talent Search competition semi-finalists,” she stated.

The semi-finalists were selected based on the research projects they had begun the previous summer at SHIP.

SHIP participants are high school juniors and seniors who have been selected through a competitive process to participate in cutting-edge research at NIST. They work closely with NIST staff scientists and engineers on specific research problems. NIST awards 30 to 40 SHIP internships each summer, and the students must commit to 6 to 8 weeks of summer research.

The summer of 2012 will be the third summer for SHIP. For such a new program, SHIP has many facets that take students beyond their primary research project. SHIP draws on the groundwork of NIST’s Summer Undergraduate Research Fellowship (SURF) program for college students, and shares activities for both sets of students. One of the goals of both SHIP and SURF is to expose the students to a wide range of topics through seminars, networking with other students, and tours of NIST facilities. SHIP also exposes high school students to other government technical careers through lunches with local government scientists and engineers.

According to Dr. Dennis, “What makes SHIP unique is the type and breadth of research that is done at NIST, and therefore the range of subjects to which the students are exposed over the course of the summer.” For example, last summer the SHIP research projects had applications that ranged from genetics to solar cells to neutron reflectometry.

Six diverse labs at NIST in Gaithersburg, Maryland, participate in SHIP—the Center for Nanoscale Science and Technology, the Engineering Laboratory, the Information Technology Laboratory, the Material Measurement Laboratory, the NIST Center for Neutron Research, and the Physical Measurement Laboratory.

During their tenure at NIST, students plan and conduct experiments, record and analyze data, test hypotheses, and document research results. Many of the students use state-of-the-art instruments such as scanning-tunneling electron microscopes and atomic force microscopes, as well as equipment for ferromagnetic resonance force microscopy. For the most part, such experiences are usually only available to graduate students, so the opportunities afforded SHIP students can be life-changing events from a vocational standpoint.

SHIP students get to see and be part of the practice of scientific research and associated engineering problems-solving in a professional rather than an academic setting. They gain valuable insight into what their work would be like should they choose careers in research, engineering, or technology management.

Dr. Dennis said that SHIP’s student participants give the program high ratings and consider the program valuable to their education and future careers. She is also pleased to see many SHIP alumni continuing their relationship with NIST by applying to the SURF program. It is apparent that SHIP will have a long-lasting effect upon the students. SHIP mentors are clearly meeting the challenge to encourage the next generation of our nation’s scientists, engineers, inventors and technology-oriented executives. The program is a model for NIST’s investment in the future, and it is moving full steam ahead.
FLC Member Laboratory Directory

**Department of Agriculture**

- **Agricultural Research Service**
  - www.ars.usda.gov
- **Animal and Plant Health Inspection Service**
  - www.aphis.usda.gov
- **Forest Service**
  - www.fs.fed.us
- **APHIS - National Wildlife Research Center**
  - www.aphis.usda.gov/ars/mwrc
- **ARS - Beltsville Area**
  - www.ba.ars.usda.gov
- **ARS - Children’s Nutrition Research Center**
  - www.hcm.edu/cnrcc
- **ARS - Cropping Systems Research Laboratory**
  - www.lhbc.ars.usda.gov
- **ARS - Grassland, Soil & Water Research Laboratory**
  - www.ars.usda.gov/spa/gswrl
- **ARS - Grand Forks Human Nutrition Research Center**
  - www.gfhrcc.ars.usda.gov
- **ARS - Grazinglands Research Laboratory**
  - www.ars.usda.gov/main/site_main.htm?modecode=62-18-00-00
- **ARS - Lincoln Location**
  - www.ars.usda.gov/main/site_main.htm?modecode=54-40-00-00
- **ARS - Mid South Area**
  - http://mma.ars.usda.gov

**ARS - Midwest Area**
- www.mwa.ars.usda.gov
- **ARS - National Animal Disease Center**
- **ARS - National Center for Agricultural Utilization Research**
  - www.ncuar.usda.gov
- **ARS - National Seed Storage Laboratory**
  - www.ars.usda.gov/main/site_main.htm?modecode=54-02-05-00
- **ARS - North Atlantic Area**
  - www.naa.ars.usda.gov
- **ARS - Northern Great Plains Research Laboratory**
  - www.mandan.ars.usda.gov
- **ARS - Northern Plains Agricultural Research Laboratory**
  - www.ars.usda.gov/npra/npral
- **ARS - Northern Plains Area**
  - www.ars.usda.gov/main/site_main.htm?modecode=54-00-00-00
- **ARS - Pacific West Area**
  - www.ars.usda.gov/main/site_main.htm?modecode=53-00-00-00
- **ARS - Plant Genetic Research Unit**
  - www.ars.usda.gov/main/site_main.htm?modecode=62-00-00-00
- **ARS - South Atlantic Area**
  - www.ars.usda.gov/main/site_main.htm?modecode=66-00-00-00
- **ARS - South Central Agricultural Research Laboratory**
  - www.lane-ag.org
- **ARS - Southern Plains Area**
  - www.ars.usda.gov/main/site_main.htm?modecode=62-00-00-00
- **ARS - Southern Regional Research Center**
  - www.ars.usda.gov/ussrc/srrc
- **ARS - Southwestern Cotton Ginning Research Laboratory**
  - www.ars.usda.gov/Main/docs/docid=17426

**FS - Forest Products Laboratory**
- www.fpl.fs.fed.us
- **FS - Missoula Technology & Development Center**
  - www.fs.fed.us/eng/techdev/mtdc.htm
- **FS - Northeastern Area**
  - www.nfa.fs.fed.us
- **FS - Northern Research Station**
  - www.nrs.fs.fed.us
- **FS - Pacific Northwest Research Station**
  - www.fs.fed.us/pnwr
- **FS - Rocky Mountain Research Station**
  - www.fs.fed.us/rm
- **FS - San Dimas Technology & Development Center**
  - www.fs.fed.us/eng/techdev/sdtcd.htm

**FS - Southern Research Station**
- www.sfs.fs.fed.us

**National Institute of Standards and Technology**
- www.nist.gov

**NOAA - Earth System Research Laboratory**
- www.esrl.noaa.gov

**NOAA - Geophysical Fluid Dynamics Laboratory**
- www.gefml.noaa.gov

**NOAA - National Geophysical Data Center**
- www.ngdc.noaa.gov

**NOAA - National Marine Fisheries Service - Galveston Lab**

**NOAA - National Marine Fisheries Service - Northeast Fisheries Science Center**
- www.nmfs.noaa.gov

**NOAA - National Severe Storms Laboratory**
- www.nssl.noaa.gov

**NTIA - Institute for Telecommunication Sciences**
- www.itrs.blm.doc.gov

**Air Force - 30th Space Wing**
- www.sandsberg.af.mil

**Air Force - 311th Human Systems Wing**
- www.brooks.af.mil

**Air Force - Aeronautical Systems Center**
- www.wpafb.af.mil

**Air Force - Air Armament Center**
- www.ceg.af.mil

**Air Force - Air Combat Command**
- www.acc.af.mil

**Air Force - Arnold Engineering Development Center**
- www.arnold.af.mil

**Air Force - Ogden Air Logistics Center**
- www.hill.af.mil

**Air Force - Oklahoma City Air Logistics Center**
- www.tinker.af.mil/units

**Air Force - Warner Robins**
- www.robins.af.mil

**Air Force Academy**
- www.usafa.af.mil

**Air Force Center for Environmental Excellence**
- www.afee.af.mil

**Air Force Civil Engineer Support Agency**
- www.acesa.af.mil

**Air Force Electronic Systems Center**
- www.hanscom.af.mil

**Air Force Flight Test Center**
- www.edwards.af.mil

**Air Force Information Operations Center**

**Air Force Institute of Technology**
- www.afti.edu

**Air Force Intelligence, Surveillance and Reconnaissance Agency**
- www.aisr.afrl.mil

**Air Force Logistics Management Agency**
- www.lama.hq.af.mil

**Air Force Office of Scientific Research**
- www.wpafb.af.mil/AFRl/afosr

**Air Force Packaging Technology & Engineering Facility**
- www.wpafb.af.mil/units/afptef

**Air Force Space and Missile Systems Center**
- www.lasangels.af.mil

**Air Force - Rocky Mountain Research Station**
- www.fs.fed.us/rm
Missile Defense Agency  
www.mda.mil

National Geospatial-Intelligence Agency  
www.nga.mil

Naval Air Systems Command  
www.navair.navy.mil/nawcad

Naval Aerospace Medical Research Laboratory  
www.med.navy.mil/sites/nmrc

Naval Air Warfare Center Aircraft Division - Lakehurst  
www.navy.mil/lakehurst

Naval Air Warfare Center Aircraft Division - Patuxent River  
www.navair.navy.mil/nawcad

Naval Air Warfare Center Training Systems Division  
http://awcmd.navair.navy.mil

Naval Air Warfare Center Weapons Division - China Lake and Pt. Mugu  
www.navair.navy.mil/navwcd

Naval Facilities Engineering Command  
https://portal.navfac.navy.mil

Naval Facilities Engineering Service Center  
https://portal.navfac.navy.mil/NFESC

Naval Health Research Center  
www.med.navy.mil/sites/nhrc

Naval Medical Center - Portsmouth  
www.nmcp.med.navy.mil

Naval Medical Center - San Diego  
www.med.navy.mil/sites/nnmcd

Naval Medical Research Center  
www.nmrc.navy.mil

Naval Postgraduate School  
www.nps.edu

Naval Research Laboratory  
www.nrl.navy.mil

Naval Safety Center  
www.safetycenter.navy.mil

Naval Sea Systems Command  
www.navaux.navy.mil

Naval Submarine Medical Research Laboratory  
www.nhrc.navy.mil/nmrl

Naval Surface Warfare Center - Carderock Division  
www.dvr.navy.mil

Naval Surface Warfare Center - Crane Division  
www.crane.navy.mil

Naval Surface Warfare Center - Dahlgren Division  
www.nwsc.navy.mil

Naval Surface Warfare Center - Indian Head Division  
www.hi.navy.mil

Naval Surface Warfare Center - Panama City Division  
http://nwcpa.navaux.navy.mil

Naval Surface Warfare Center - Port Hueneville Division  
www.phinwsc.navy.mil

Naval Undersea Warfare Center - Division Keyport  
www.keyport.kpt.nwsc.navy.mil

Naval Undersea Warfare Center - Division Newport  
www.nwsc.navy.mil/nppt

Naval War College  
www.nwc.navy.mil

Navy - National Naval Medical Center  
www.berthesda.med.navy.mil

Navy - Naval Mathematics and Oceanographic Command  
www.nmcoc.navy.mil

Navy - Office of Naval Research  
www.onr.navy.mil

Navy - Portsmouth Naval Shipyard  
www.nps.navy.mil

Navy - Space and Naval Warfare Systems Center Atlantic - Charleston  
http://www.public.navy.mil/spawar/atlantic

Navy - Space and Naval Warfare Systems Center Atlantic - New Orleans  
www.public.navy.mil/spawar/atlantic

Navy - Space and Naval Warfare Systems Center Atlantic – Norfolk  
http://www.public.navy.mil/spawar/atlantic

Navy - Space and Naval Warfare Systems Center Pacific  
http://www.public.navy.mil/spawar

Navy - U.S. Naval Academy  
www.usna.edu

Navy - U.S. Naval Observatory  
www.usno.navy.mil

Navy Clothing and Textile Research Facility  
www.navsup.navy.mil/navsup/outtrea/nexcom/prod_serv/nctrf

Uniformed Services University of the Health Sciences  
www.usuhs.mil

U.S. Joint Forces Command  
www.jcom.mil

U.S. Transportation Command  
www.tcom.mil

Department of Energy
Ames Laboratory  
www.amslab.gov

Argonne National Laboratory  
www.anl.gov

Brookhaven National Laboratory  
www.bnl.gov

Chicago Operations Office  
www.ch.doc.gov

Fermi National Accelerator Laboratory  
www.fnal.gov

Hanford Site  
www.hanford.gov

Idaho National Laboratory  
www.inl.gov

Kansas City Plant  
www.kcp.com

Laboratory of Structural Biology and Molecular Medicine  
www.doe-mbi.ucla.edu

Lawrence Berkeley National Laboratory  
www.lbl.gov

Lawrence Livermore National Laboratory  
www.llnl.gov

Los Alamos National Laboratory  
www.lanl.gov

National Energy Technology Laboratory  
www.netl.doe.gov

National High Magnetic Field Laboratory  
www.nhmf.gov

National Renewable Energy Laboratory  
www.nrel.gov

Nevada Site Office  
www.sve.doe.gov

New Brunswick Laboratory  
www.nbl.doe.gov

Oak Ridge National Laboratory  
www.ornl.gov

Oak Ridge Operations Office  
www.ookridge.doc.gov

Office of Scientific & Technical Information  
www.osti.gov

Pacific Northwest National Laboratory  
www.pnl.gov

Pantex Plant  
www.doeal.gov/pxso

Princeton Plasma Physics Laboratory  
www.princeton.edu/plpl.gov

Rocky Mountain Oilfield Testing Center  
www.rmoc.doe.gov

Sandia National Laboratories  
www.sandia.gov

Sandia National Laboratories – California  
www.ca.sandia.gov

Savannah River National Laboratory  
http://srnl.doe.gov

Stanford Linear Accelerator Center  
www.slac.stanford.edu

Thomas Jefferson National Accelerator Facility  
www.jlab.org

Y-12 National Security Complex  
www.y12.doe.gov

Department of Health and Human Services
Centers for Disease Control and Prevention  
www.cdc.gov

Food and Drug Administration  
www.fda.gov

National Institutes of Health  
www.nih.gov

CDC - National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention  
www.cdc.gov/nchhstp

CDC - Nat. Ctr. for Immunization and Respiratory Diseases  
www.cdc.gov/ncird

CDC - Natl. Ctr for Preparedness, Detection, and Control of Infectious Diseases  
www.cdc.gov/kpndcd

FEDERAL LABORATORY CONSORTIUM FOR TECHNOLOGY TRANSFER
FLC Member Laboratory Directory (Cont.)

CDC - National Center for Zoonotic, Vector-Borne, and Enteric Diseases (ZVETD)
www.cdc.gov/nczved

CDC - National Institute for Occupational Safety and Health
www.cdc.gov/niosh

CDC - NIOSH - National Personal Protective Technology Laboratory
www.cdc.gov/niosh/lpptdl

CDC - NIOSH - Pittsburgh Research Laboratory
www.cdc.gov/niosh/im-prr.html

CDC - NIOSH - Spokane Research Laboratory
www.cdc.gov/niosh/im-srl.html

CDC - NIOSH - Health Effects Laboratory Division
www.cdc.gov/niosh/im-held.html

FDA - Center for Biologics Evaluation and Research
www.fda.gov/cber

FDA - Center for Devices and Radiological Health
www.fda.gov/cdrh

FDA - Center for Drug Evaluation and Research
www.fda.gov/cder

FDA - Center for Veterinary Medicine
www.fda.gov/cvm

FDA - Center for Food Safety and Applied Nutrition
www.cfsan.fda.gov/list.html

FDA - National Center for Toxicological Research
www.fda.gov/ntctr

NIH - Center for Information Technology
www.cit.nih.gov

NIH - Clinical Center
www.cc.nih.gov

NIH - Fogarty International Center
www.fc.nih.gov

NIH - National Cancer Institute
www.cancer.gov

NIH - National Center for Complementary and Alternative Medicine
http://nccam.nih.gov

NIH - National Center for Research Resources
www.ncrr.nih.gov

NIH - National Eye Institute
www.nei.nih.gov

NIH - National Heart, Lung, and Blood Institute
www.nhlbi.nih.gov

NIH - National Human Genome Research Institute
www.genome.gov

NIH - National Institute of Allergy and Infectious Diseases
www.niaid.nih.gov

NIH - National Institute of Arthritis and Musculoskeletal and Skin Diseases
www.niams.nih.gov

NIH - National Institute of Biomedical Imaging and Bioengineering
www.nibib.nih.gov

NIH - National Institute of Child Health and Human Development
www.nichd.nih.gov

NIH - National Institute of Dental and Craniofacial Research
www.nidcr.nih.gov

NIH - National Institute of Diabetes, Digestive and Kidney Diseases
www.niddk.nih.gov

NIH - National Institute of Environmental Health Sciences
www.niehs.nih.gov

NIH - National Institute of General Medical Sciences
www.nigms.nih.gov

NIH - National Institute of Mental Health
www.nimh.nih.gov

NIH - National Institute of Neurological Disorders and Stroke
www.ninds.nih.gov

NIH - National Institute of Nursing Research
www.ninr.nih.gov

NIH - National Institute on Aging
www.nia.nih.gov

NIH - National Institute on Alcohol Abuse and Alcoholism
www.niaaa.nih.gov

NIH - National Institute on Deafness and Other Communication Disorders
www.nidcd.nih.gov

NIH - National Institute on Drug Abuse
www.nida.nih.gov

NIH - National Library of Medicine
www.nlm.nih.gov

NIH - Office of Research Services
www.ors.od.nih.gov

NIH - Rocky Mountain Laboratories
www.nml.nih.gov/about/organizations/dir/rml

Department of Homeland Security

Coast Guard R&D Center

Environmental Measurements Laboratory
www.eml.st.dhs.gov

National Biodefense Analysis and Countermeasures Center
www.dhs.gov/files/labs/gc_1166211221830.shtm

Plum Island Animal Disease Center
www.ars.usda.gov/plum/

Transportation Security Laboratory
www.dhs.gov/ars/labs/editorial_0903.shtm

Department of the Interior

Bureau of Reclamation
www.usbr.gov

U.S. Geological Survey
www.usgs.gov

BR - Water Quality Improvement Center
www.usgs.gov/sy/yuma/facilities/wqic/yuq_facilities_wqic.html

USGS - Alaska Science Center
http://alaska.usgs.gov

USGS - Arizona Water Science Center
http://az.water.usgs.gov

USGS - Arkansas Water Science Center
http://ar.water.usgs.gov

USGS - Astrogeology Research Program
http://astrogeology.usgs.gov

USGS - Biological Services Discipline - Central Regional Office
http://biology.usgs.gov/cra/

USGS - Biological Services Discipline - Western Regional Office
http://biology.usgs.gov/wro

USGS - California Water Science Center
http://ca.water.usgs.gov

USGS - Caribbean Water Science Center
http://cw.water.usgs.gov

USGS - Colorado Water Science Center
http://co.water.usgs.gov

USGS - Columbia Environmental Research Center
www.cerc.usgs.gov

USGS - Florida Integrated Science Center
http://fisc.ex.usgs.gov

USGS - FISC - Center for Coastal and Watershed Studies
http://coastal.ex.usgs.gov

USGS - FISC - Water Resources of Florida - Tallahassee
http://fl.water.usgs.gov

USGS - Forest and Rangeland Ecosystem Science Center
http://fres.usgs.gov

USGS - Georgia Water Science Center
http://ga.water.usgs.gov

USGS - Great Lakes Science Center
www.glc.usgs.gov

USGS - Idaho Water Science Center
http://id.water.usgs.gov

USGS - Illinois Water Science Center
http://il.water.usgs.gov

USGS - Indiana Water Science Center
http://in.water.usgs.gov

USGS - Iowa Water Science Center
http://ia.water.usgs.gov

USGS - Kansas Water Science Center
http://ks.water.usgs.gov

USGS - Kentucky Water Science Center
http://ky.water.usgs.gov

USGS - Louisiana Water Science Center
http://la.water.usgs.gov

USGS - Maine Water Science Center
http://me.water.usgs.gov

USGS - Maryland-Delaware-District of Columbia Water Science Center
http://md.water.usgs.gov

USGS - Massachusetts/Rhode Island Water Science Center
http://ma.water.usgs.gov

USGS - Michigan Water Science Center
http://mi.water.usgs.gov

USGS - Michigan Water Science Center
**FLC Member Laboratory Directory (Cont.)**

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Tools for Technology Transfer Professionals

FLC Technology Locator

For industry and other technology seekers, the FLC Technology Locator Network serves as a point of entry to federal laboratory expertise and technology. In meeting this need, the network also handles requests from other organizations working with the private sector. These organizations include NASA's Regional Technology Transfer Centers, the National Technology Transfer Center, and state-funded economic development centers.

Through its network of representatives, the FLC puts a potential partner in contact with a federal laboratory with expertise and capability in a specific area of interest. Once the FLC identifies the contact, the arrangements for the technical exchange are between the user and the laboratory. The network does best when the user makes the request as specific as possible and identifies considerations such as technical need, constraints, and intended use. A central FLC Technology Locator helps the network match user technical requests for expertise and facilities with appropriate federal laboratory capabilities.

How It Works

- Identifies laboratory technical resources that can respond to specific requests
- Provides referrals to other federal resources
- Uses an FLC Technical Specialist System to complement information sources and network expertise
- Publishes directories that focus on special needs such as automotive materials or defense conversion partnerships
- The unique network structure of the FLC, the person-to-person technical linkages, and the central FLC Technology Locator are vital factors in linking user needs to a federal laboratory person with a special expertise or capability.

More Information

Frank Koos
856-667-7727
fkoos@utrs.com
www.federallabs.org/locator

Education & Training

The FLC provides education and training on all aspects of technology transfer. This service includes fundamentals, intermediate, and advanced training courses offering continuing education units (CEUs); a wide range of publications and resources; a training resources database; and an online T2 curriculum.

FLC Online Laboratory Profiles

To learn more about, and connect with, its more than 300 member laboratories, the FLC has created a web-based, searchable database utility for displaying laboratory profiles. The tool allows the user to search based on various criteria, including by agency, technology area, and geographical region. Information displayed includes laboratory contact, history, technology focus, mission, website, and facilities. For more info, visit www.federallabs.org/labs.

Laboratory State Profiles

The spirit of American innovation is alive and well at over 300 federal laboratories nationwide. Each year, through the efforts of over 100,000 federal researchers and scientists, the United States makes a significant investment in research and development (R&D). The FLC’s Laboratory State Profiles webpage provides information on federal research being conducted in each state. To see what’s happening in your state, go to www.federallabs.org/state_profiles/.

www.federallabs.org

The FLC website makes it easy to find people, capabilities, and applications within the FLC’s network of federal labs and centers. The site publicizes T2 news and technology trends and provides a gateway to FLC products and services.

Fed Labs RSS News

From new inventions to available technologies for license, the nation’s federal laboratories are doing great things that you need to know about. Keeping up-to-date on 300-plus laboratories isn’t easy. To help, the FLC has created a Fed Labs RSS page. The site displays RSS fed news as it is posted by the federal laboratories. The searchable feeds include “Available Technologies,” “CRADAs,” “Lab News,” and more. You can even sign-up to have the news you choose sent straight to your email.

FLC Publications

Federal Labs and State & Local Governments

A publication detailing the successes and process for conducting federal technology transfer to aid state and local government needs.

FLC Planner

An annual collection of images from the federal laboratory system.

T2 Desk Reference

The desktop essential for T2 pros and laboratory representatives.
FLC Regions

To manage the technology transfer efforts of the FLC, the U.S. is divided into six geographical regions. Each of the regions is run by a Regional Coordinator and Deputy Regional Coordinator.

**Far West**
Regional Coordinator: Ida Shum
Lawrence Livermore National Laboratory
(925) 423-9724
shum3@llnl.gov
www.flcfarwest.org

**Mid-Atlantic**
Regional Coordinator: Paul Fritz
Naval Air Warfare Center Aircraft Division
(301) 342-5586
paul.fritz@navy.mil
www.flcmidatlantic.org

**Mid-Continent**
Regional Coordinator: J. Susan Sprake
Los Alamos National Laboratory
(505) 665-3613
sprake@lanl.gov
www.flcmidcontinent.org

**Northeast**
Regional Coordinator: Lewis Meixler
Princeton Plasma Physics Laboratory
(609) 243-3009
lmeixler@pppl.gov
www.flcnortheast.org

**Southeast**
Regional Coordinator: Dr. Andrew Watkins
Centers for Disease Control and Prevention
(770) 488-8610
awatkins@cdc.gov
www.flcsoutheast.org
The Federal Laboratory Consortium for Technology Transfer (FLC) is the nationwide network of federal laboratories that provides the forum to develop strategies and opportunities for linking laboratory mission technologies and expertise with the marketplace.

The mission of the FLC is to add value to the federal agencies, laboratories, and their partners to accomplish the rapid integration of research and development resources within the mainstream of the U.S. economy.

Contributors

Prepared by the FLC Management Support Office in conjunction with FLC Communications Co-Chairs Sara Baragona and Al Jordan.

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Contributors:
Sara Baragona
Sarah Bauer
Paul Betten
Aviva Brecher
Donna Cannella
Gregory Chappelle
Erin Chmel
Kay Condit
Mike Crane
Cindi Dennis
Peter DiSante
Cindy DreherBio
Paul Fritz
Marcia L. Graeff
Jenny Hakun
Julie Imada
Al Jordan
Katie Klos
Ali Madison
Morgan McCoole
Thomas Moreland
Emily Nodine
Jack Pexnstein
Linda Schilling
Andrea Simon
David Sims
Jan Szezkwie
Linda von Boetticher
Cynthia Wlodarski

Editorial:
Denise Bickmore
Scott Flander
Karen Stallone

Layout and Design:
Denise Wainer
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