Making History . . .

Ernest O. Lawrence

Lawrence Livermore National Laboratory was founded in 1952 by Nobel Prize-winning scientist Ernest O. Lawrence and renowned physicist Edward Teller. Our Laboratory originally was established to further America's nuclear weapons science and technology. Over the course of our history, we have made major breakthroughs in defense-related research.

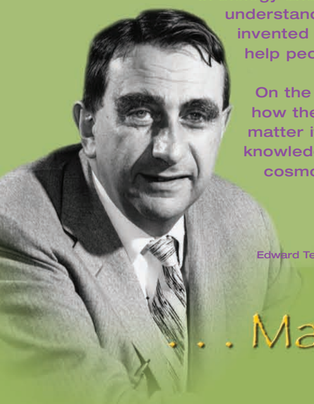
Today, our Laboratory is managed by the University of California for the U.S. Department of Energy. Our primary focus remains national security. We help ensure the safety and reliability of the country's nuclear stockpile. We work to prevent the spread and use of weapons of mass destruction in the world. And, our research strengthens U.S. military forces and homeland security.

The scientific expertise we've developed in our national security work has allowed the Laboratory to make contributions in a wide range of other areas of research as well.

In energy and the environment, we've helped protect and preserve the natural world, and advanced the hunt for future sources of energy.

In biology and health, we have improved the understanding of the building blocks of life. We've invented revolutionary medical technologies to help people lead healthier, happier lives.

On the fundamental questions of how the universe evolved and what makes up matter itself, our researchers are advancing knowledge of the world and its place in the cosmos.



Edward Teller

. . . Making a Difference

Knowledge

Ambition

Vision

Integrity

Our People Make the Difference

Sacrifice

Commitment

Achievement

Hope

- Nobel Prize winner
- Presidential Medal of Freedom winner
- Glenn Seaborg Award winner
- Five Enrico Fermi Award winners
- Fullbright Scholar Award winner
- Twenty-Five E.O. Lawrence Award winners
- One Hundred and Six R&D 100 Awards
- Beatrice Tinsley Prize winner
- Hero of U.S. Manufacturing Award
- Twenty-Six Federal Laboratory Consortium Awards
- MacArthur Award winner
- Presidential Early Career Awards for Scientists and Engineers
- Secretary of Defense Outstanding Public Service Award winners
- American Association for the Advancement of Science Fellows
- American Physical Society Fellows

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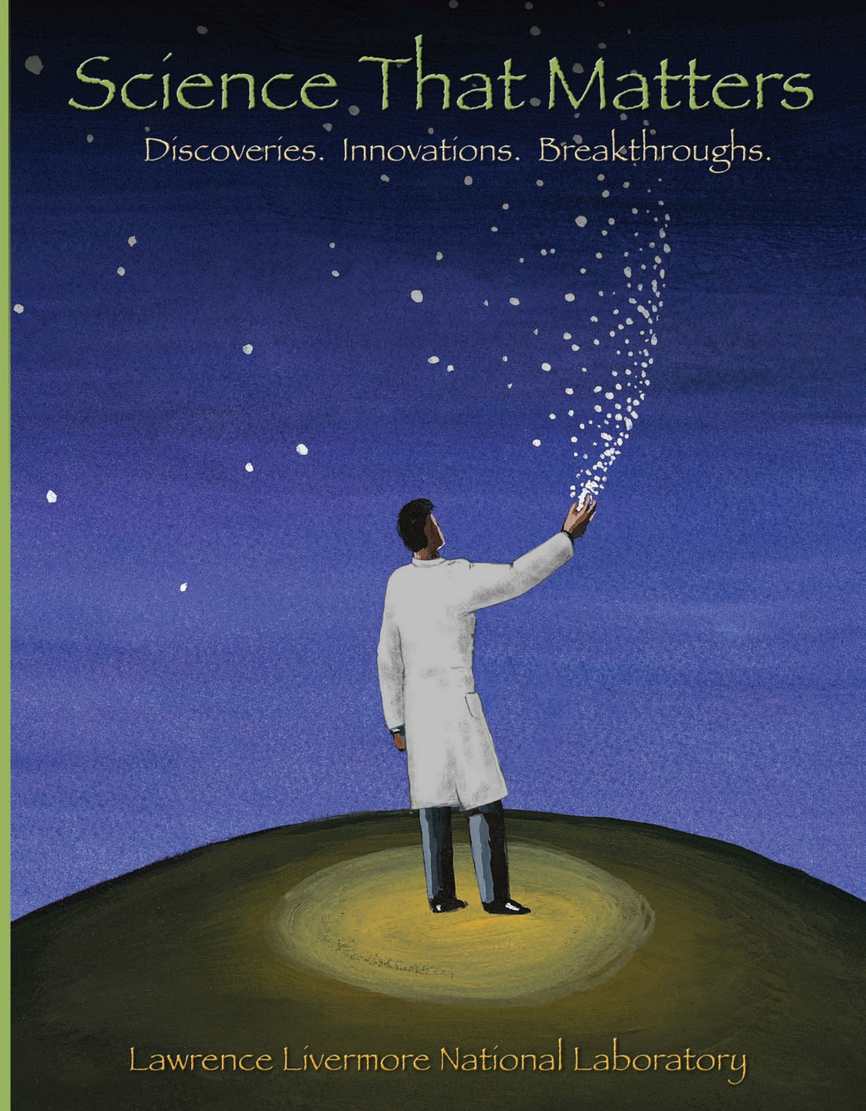
Science That Matters

Discoveries. Innovations. Breakthroughs.



Lawrence Livermore National Laboratory

Fifty scientific wonders, marvels, and minor miracles that make LLNL one incredible place.

We Are Stardust
As part of the Stardust mission that brought back space dust and comet particles, Livermore helped develop the special material that snagged the particles, as well as instruments used to examine the space treasure, which could yield insights into the history of the solar system and the origin of life.

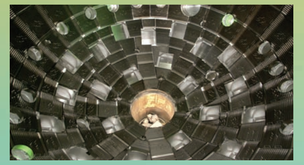
Bio Watch
Technology created by LLNL to warn of biological attack was used to help protect attendees and participants at the 2002 Winter Olympics in Salt Lake City. The Lab has developed several biodetection technologies, including the first truly portable, battery-powered biodetector.

Cancer Detector
Lab researchers are working on a probe that can detect cancer by measuring the optical, electrical and chemical properties of cancerous tissue. The probe would be less invasive than surgical biopsies, but just as accurate, and with results available immediately.

The Little Radar that Could
The Lab's micropower impulse radar – a small, battery-powered radar – has been licensed for everything from home security systems to vehicle collision avoidance systems. It also was used in search and rescue efforts at the World Trade Center after 9/11 and following hurricane Katrina.

Keeping Up With Moore's Law
The next-generation technology for producing computer chips could come from a partnership between LLNL, other labs and industry. Extreme ultraviolet lithography would produce microprocessors 100 times more powerful and memory chips with 1,000 times greater capacity than those of today.

The Long, Long-Term Forecast
Livermore leads the nation in 3-D computer simulations for climate research. Lab researchers work to better understand how and why Earth's climate changes, and to predict effects on climate from human activity.



Clockwise, from top: Polaris missile carrying LLNL-designed warhead; aerogel insulating crayons from flame; 30-ft.-diameter laser target chamber in NIF; LLNL/LANL-developed biosensor deployed in Times Square, New York City.

Guarding the Gates
LLNL is helping Russia and other former Soviet states improve the security of nuclear material left over from the Soviet era. LLNL is assisting with improvements to nuclear facility security to keep the material from falling into the hands of terrorists or rogue states.

Make Mine Rare
Lab research shows that cooking meat at high heat for long periods of time can increase cancer-causing mutagens in the food. Researchers recommend reducing the cooking temperature, and stopping before the meat dries and chars.

Mapping the Moon
The 1994 Clementine space mission used cameras developed at LLNL to map the entire surface of the moon, including its "dark side." Clementine data indicated the surprising presence of frozen water near the surface at the moon's south pole.

Don't Tread on U.S.
The Laboratory developed the first high-yield nuclear warhead for submarine-based missiles. It gave the United States a nuclear deterrent that enemies could not easily counter. LLNL also developed the first high-yield nuclear warheads small enough to allow several to be fit on a single ballistic missile.

Light-Weight Champion
The world's lightest solid – an aerogel – was developed at LLNL. Sometimes called "frozen smoke" due to its cloudy appearance, aerogel is the best thermal and electrical insulator known. It is used in electronics, acoustics, insulation and optical devices, and in physics experiments.

"This is like opening a time capsule from 4.5 billion years ago and seeing what's inside. . ." – Hope Ishii, Lab researcher analyzing comet particles and stardust brought back by the Stardust spacecraft.

Needle In A Big Haystack
The Lab's Center for Accelerator Mass Spectrometry is able to detect one specific atom out of a quadrillion atoms. It is used in research in archaeological dating, biomedicine, global climate change and national security.

Future Fusion Factory?
The Lab leads research in fusing hydrogen atoms together in a technique called inertial confinement fusion. Fusion releases enormous amounts of energy, while creating relatively little hazardous waste. It holds promise as a future energy source.

High-Tech Helping Hand
LLNL's conflict simulation systems are used to help train the U.S. military. They can also be used by local emergency agencies in planning for and responding to terror attacks, natural disasters and large-scale accidents.

Seismic Science
LLNL engineers conducted studies of the San Francisco-Oakland Bay Bridge and other bridges in California to help the state determine how the structures would hold up in an earthquake, and how to retrofit them effectively.

Did You Know?

Lab personnel were part of the UN inspection teams in Iraq after the first Gulf War that uncovered proof that Saddam Hussein's regime had established programs to build nuclear weapons.

Quiz

Fast Gas

The Lab's JASPER gas gun, nearly 100 feet long, is used in national security research. It can fire small projectiles at velocities of up to what speed?

a) 18,000 mph b) 1100 mph c) 1600 mph

Answer: 18,000 mph, or more than 24 times the speed of sound.

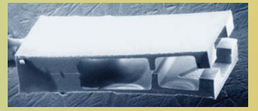
Eye Robot
Livermore scientists are part of a national team of researchers working on an artificial retina that could restore vision to millions.

Safe Storage
Livermore researchers are helping design a storage facility at Yucca Mountain, Nev., where the Department of Energy plans to store more than 70,000 tons of nuclear waste and spent fuel from nuclear power plants.

"Some 20 years ago, this kind of thinking was thought to be science fiction." – physicist Wil van Breugel, on LLNL research showing that black holes can form new stars.

Cal-Cal-Calculating
The Lab is home to the world's fastest supercomputer, BlueGene/L. It is used primarily for national security research, and can perform more than 280 trillion calculations per second – equal to writing the entire Library of Congress book collection in 10 minutes.

Cancer In The Crosshairs
LLNL scientists developed Peregrine to help doctors better target cancer cells during radiation treatment. Peregrine is a computer system that helps physicians reduce the chance of damaging nearby healthy tissue during treatment, thus allowing more radiation to be applied to the cancer itself.



(Left) Laser beam shining out of Keck telescope in Hawaii to produce an artificial guide star. (Above) Microgripper the size of the head of a pin, for use in treating stroke.

Artificial Star Gazing
LLNL pioneered research using an artificial, laser-generated "guide" star to help Earth telescopes sharpen their focus. Special Lab-developed mirrors on the telescopes use the artificial star to remove blurring of the telescope's images caused by atmospheric turbulence.

DYNAmite Design Tool
Used worldwide, a structural analysis computer program developed at LLNL called DYNA3D saves companies hundreds of millions of dollars annually in the design of everything from safer planes, trains and automobiles to better beer cans.

Out Of Sight, But Not Out Of Mind
LLNL conducted the first contained underground nuclear explosive test. The test not only benefited the U.S. nuclear weapon program, it also guided development of technologies to monitor nuclear tests worldwide. This helped in the adoption of an atmospheric nuclear test ban treaty.

Steam Cleaning
Lab environmental scientists developed a technique for cleaning the toughest soil and groundwater contamination. Steam and/or electric current are used to heat the subsurface, break down the contaminants and force them to wells for removal.

Seeing The Light
The National Ignition Facility at LLNL will be the world's largest, most energetic laser experimental system. Its 192 laser beams will be used in nuclear fusion experiments for research in national security, energy production and astrophysics.

Brain Attack
Lab scientists are pioneering research into new treatments for stroke. One technique would use laser light delivered via a catheter to break apart clots in blood vessels and restore blood flow.

Lab Nabs Rad
LLNL has produced various kinds of radiation detection equipment to spot radioactive material being smuggled into the country. The technology – can inspect luggage, containers and even vehicles speeding along roadways.

What Goes Up...Gets Tracked
The National Atmospheric Release Advisory Center at LLNL uses advanced computer simulations to predict the path of hazardous releases in the atmosphere. This can help emergency responders determine safety measures for people in the path of the plume. NARAC tracked fallout from the Three Mile Island and Chernobyl accidents.

Mirror Machine
The Lab has the world's most accurate large machining and measuring tool – precise to tolerances of a millionth of an inch. Originally built to form large mirrors for lasers, it also produced mirrors for Hawaii's Keck telescope.

U.S. Certified
The Lab's major mission is maintaining the safety and reliability of the nation's nuclear weapons without nuclear testing. Each year, the Laboratory, together with the Los Alamos and Sandia national labs and other federal agencies, assesses the U.S. nuclear stockpile to assure that it remains safe and reliable.

Nano Technology, Mega Potential
Lab scientists have created a membrane with pores 50,000 times thinner than a human hair. It may enable cheaper desalination of seawater, reduced greenhouse gas emissions or even development of artificial kidneys.

Rain Research
LLNL researchers are studying the effects of climate change on the supply and demand for fresh water in California. Scientists are predicting changes in precipitation, soil moisture content, surface water runoff and other variables to help water officials prepare for the future.

New Matter
LLNL scientists were part of the international research teams that discovered four new elements: 113, 114, 115 and 116.

American Hero
A Lab researcher was named a "Hero of U.S. Manufacturing" by *Fortune* magazine for, in part, improving a device used for measuring the accuracy of machine tools. The device has been used by industry to test billions of dollars worth of machine tools.

Early Light Saber
The Lab's solid-state heat-capacity laser is the most powerful laser of its kind. A seven-second shot of laser light from this system can bore a 2.5-centimeter hole in a 2.5-centimeter-thick plate of steel. Potential uses include a variety of industrial and military applications.

Charting The Blueprint Of Life
LLNL helped found the Joint Genome Institute, which studies a variety of life forms to advance research in areas such as energy, health, environmental protection and national security. Completing a DNA map of human chromosome 19 that identified 1,461 genes was one of the institute's first achievements.

Energy SSTAR
LLNL is helping develop a small, sealed, tamper-resistant nuclear reactor that easily can be transported to wherever energy is needed. The SSTAR reactor would provide safe, secure nuclear power.

Digital Mammography
LLNL researchers helped develop the technology for digital mammography, which records breast X-ray images electronically rather than onto film. Doctors can thereby use computers to help evaluate mammograms, reducing human error and misinterpretation.

Remember MTBE?
Lab analysis of data on leaking underground fuel tanks in California gave early warning of the threat posed by the gasoline additive MTBE. LLNL developed a system to manage the leaking tanks, as well as innovative techniques for searching for MTBE.

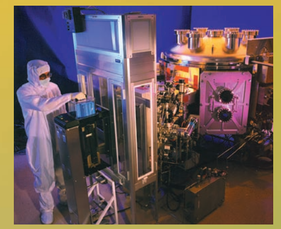
Laser Hammer
Laser peening is a technique developed by LLNL and industry to strengthen metal by bombarding it with laser pulses. Expected to be used in many areas of manufacturing, it is saving the aircraft industry hundreds of millions of dollars in engine maintenance expenses.

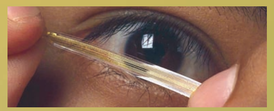
Sugar Sensor
Lab researchers are helping develop a miniature implantable glucose sensor for diabetes patients. The sensor would monitor a patient's glucose levels continuously, and signal a pump to administer insulin when needed.

How Small Are The Brushes?
LLNL scientists invented a way to identify rapidly genetic abnormalities so doctors can more quickly diagnose cancer and other diseases. Called chromosome painting, the technique colors individual chromosomes within cells so medical researchers can more easily spot defects.

Exposing Explosives
ELITE is a card-sized explosives detector that can screen for explosives in minutes. Developed by LLNL for use by military and law enforcement, ELITE received an award for excellence in technology transfer.

Shielding Soldiers
The Laboratory designed an inexpensive and easy-to-install armor system for the Army's use in Iraq. The armor, which has already saved lives, is placed on gun trucks that escort convoys and provide perimeter defense.





(From top) Researcher working on digital mammography system; machine for producing masks used in manufacturing computer chips; (left) microelectrodes for use in an artificial retina.

"Sometimes success in life happens by seizing a moment... Spontaneity is a huge part of life – and in a sense, is a characteristic of the Lab." – Bill Lokke, former LLNL manager.

Super Water
Lab scientists have discovered a state of water that is neither ice nor liquid. In this "superionic" state, water's oxygen atoms remain virtually stationary while its hydrogen atoms are extraordinarily mobile. The discovery may provide clues to conditions at the center of giant planets.

Lasering Land Mines
Lab scientists developed a laser system for destroying land mines and improvised explosive devices. The laser burns through both the soil and explosive from a distance, greatly reducing chance of injury to mine-clearing personnel.

Up, Up And Away
Lab researchers are developing a magnetic system to levitate and power trains. The Inductrack system is safer, cheaper and simpler than previous maglev train systems. It could even be used to help launch rockets into space.

Did You Know?

The Lab's Forensic Science Center is nationally recognized for its expertise in chemical, nuclear, biological and explosives forensic science. The Center has assisted law enforcement in a number of challenging cases, including the hunt for the Unabomber.

Quiz

High Power

When the National Ignition Facility eventually fires its 192 lasers, its peak power of 500 trillion watts will be equal to how many times the electric generating power of the entire United States?

a) 50 b) 1,000 c) 100

Answer: 1,000 times. However, the country's lights won't dim.

Delivering on the Promise of Science & Technology