



THE 46TH ANNUAL
NATIONAL INVENTORS
HALL OF FAME
Induction Ceremony

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2018 NATIONAL INVENTORS
HALL OF FAME INDUCTEE

Marvin Caruthers

BORN FEBRUARY 11, 1940

Marvin Caruthers helped jump-start the biotechnology industry. With his team at the University of Colorado-Boulder, Caruthers developed the methods for chemically synthesizing DNA —transforming protein and DNA synthesis from highly specialized basic research into a widely used research, diagnostic and forensic tool.

The ability to synthesize DNA — rapidly and in the laboratory — enables researchers to learn how certain genetic sequences are formed, and to locate and isolate genes for selected proteins. Early clinical studies on drugs stemming from Caruthers' techniques showed remarkable benefits for patients with severe kidney disease and cancer.

His procedures have been incorporated into "gene machines" automating synthetic DNA production used by biochemists, biologists, molecular biologists and biophysical chemists. More recently, his procedures have been adapted for use with modified inkjet printers to synthesize DNA on glass chips.

Caruthers' innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Marvin Caruthers

Inventor of Chemical Synthesis of DNA

U.S. PATENT NOS. 4,415,732 & 4,458,066

1. Caruthers' invention is widely considered to be one of the cornerstone technologies behind the biotechnology revolution.
2. Since 1973, he has been a distinguished professor of chemistry and biochemistry at the University of Colorado-Boulder.
3. Notable results from his work include the development and commercialization of pharmaceutical drugs Epogen and Neupogen.
4. He was the co-founder of several successful biotech companies including Amgen, Applied Biosystems, Array BioPharma and miRagen Therapeutics.
5. He considers himself to be equally a researcher, inventor and entrepreneur.
6. In 2007, Caruthers donated \$20 million to the University of Colorado-Boulder to construct a new biotechnology center on campus. The center is named for his late wife, Jennie Smoly Caruthers.
7. He says his "comfortable but intense" childhood working on a farm shaped his work ethic.
8. He believes the biotechnology revolution would not have been possible without intellectual property protection.
9. He was awarded the 2006 U.S. National Medal of Science.
10. He holds 43 U.S. patents.

To learn more about the 2018 Class of Inductees, visit www.invent.org/honor/inductees/.



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2018 NATIONAL INVENTORS
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Stan Honey

BORN APRIL 8, 1955

A pioneer in the field of sports television graphics, Stan Honey has transformed how we all watch sports. Innovations developed by Honey and his team at Sportvision include the Virtual Yellow 1st & Ten® line, introduced on Sept. 27, 1998, during an ESPN-televised game between the Baltimore Ravens and the Cincinnati Bengals. Now ubiquitous in football, the superimposed yellow line has been hailed as one of the most important developments in sports broadcast history.

Other televised sports advances led by Honey include K-Zone™, a baseball pitch tracking and highlighting system; RACEf/x®, which tracks NASCAR racers using GPS; and LiveLine™, a helicopter-mounted, GPS-tracked camera system first implemented during the 2013 America's Cup in conjunction with GPS tracking on the race boats and marks.

A professional yachtsman and navigator, Honey was the 2010 Yachtsman of the Year, and is a 2012 inductee of the National Sailing Hall of Fame. As navigator, Honey has set records for transatlantic, transpacific, circumnavigation, and 24-hour passages under sail.

Honey's innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Stan Honey

Inventor of Football's Yellow 'First-and-Ten Line'

U.S. PATENT NO. 6,141,060

1. Stan Honey is a native of San Marino, Calif.
2. Honey earned his B.S. in engineering and applied science at Yale University, and his MSEE at Stanford University.
3. His television technology inventions combine two lifelong interests: electronics and navigation.
4. He has received numerous awards, including three Emmys for technical and engineering innovations in sports television broadcasts.
5. He co-founded Etak Inc., a company that pioneered automobile navigation systems and digital mapping.
6. He co-founded Sportvision in 1998.
7. Honey is a 2017 inductee of the Sports Broadcasting Hall of Fame.
8. He was the sailing and navigation coach for the 2008 movie "Morning Light."
9. His approach to engineering is "figure it out."
10. He holds 31 U.S. patents in television graphics and in navigation technology and tracking.

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2018 NATIONAL INVENTORS
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Sumita Mitra

BORN FEBRUARY 27, 1949

Sumita Mitra's dental innovations capture the importance of strength and the elegance of beauty, allowing her to solve ongoing issues plaguing both dental patients and professionals.

By revolutionizing the field of dentistry with her invention of the first nanocomposite dental materials, she made the development and commercialization of many dental products possible.

Mitra's invention of Filtek™ Supreme Universal Restorative improved upon previous dental composites by providing superior optical properties both initially and long-term, while exhibiting excellent mechanical strength and wear resistance. The Filtek™ Supreme product line has been used in more than 600 million dental restorations worldwide since the product launched in 2002.

Mitra's innovation will be celebrated this May as she is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Sumita Mitra

Inventor of Nanocomposite Dental Materials

U.S. PATENT NOS. 6,387,981, 6,572,693 & 6,730,156

1. She retired after more than 30 years with 3M, and now runs Mitra Chemical Consulting LLC with her husband.
2. Mitra earned her B.S. in chemistry from India's Presidency College, her M.S. in organic chemistry from India's University of Calcutta, and her Ph.D. in organic/polymer chemistry from the University of Michigan.
3. Mitra was born in India, going to school in Kolkata until she moved to the United States.
4. She was corporate scientist of the new materials/products research and development efforts at 3M's Dental Products Division from 1998-2010.
5. Mitra is a former science coach for the American Chemical Society, where she volunteered to share her chemistry knowledge in Minnesota communities.
6. Mitra also served as the industrial director of the Minnesota Dental Research Center for Biomaterials and Biomechanics at the University of Minnesota's School of Dentistry.
7. She is the winner of many honors and awards, including the International Association for Dental Research Peyton-Skinner Award for Innovation in Dental Materials (2012); American Chemical Society (ACS) Hero of Chemistry (2009); and the ACS Regional Industrial Innovation Award (2004).
8. She is an experienced lecturer, giving more than 100 presentations and teaching courses at various universities in 45 countries.
9. Mitra has more than 90 publications in the areas of polymer science and dental materials.
10. She holds 98 U.S. patents and their international equivalents.

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2018 NATIONAL INVENTORS
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Arogyaswami Paulraj

BORN APRIL 14, 1944

If it wasn't for Arogyaswami Paulraj, you would be living in a much slower world. Paulraj pioneered MIMO — Multiple Input, Multiple Output — a wireless technology that has revolutionized broadband wireless Internet access for billions of people worldwide. MIMO improves both transmission data rates and expands network coverage. It is the essential foundation for all current (WiFi and 4G mobile) and future broadband wireless communications.

Paulraj's MIMO concept requires multiple antennas at both the transmission and reception stations, unlike prior radio technologies. These multiple antennas, along with appropriate transmitter coding and receiver decoding, enable multiple parallel data streams to be delivered over a single radio channel to boost speed. Beamforming, using the multiple antennas at both ends, improves coverage.

After three decades of service in the Indian Navy, Paulraj moved to the United States to join the faculty at Stanford University. Shortly after joining Stanford, while working on wireless experiments, he noticed surprising results in signal separability that became the genesis of MIMO.

Paulraj's innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Arogyaswami Paulraj

Inventor of MIMO Wireless Technology

U.S. PATENT NO. 5,345,599

1. Paulraj is a native of India.
2. His MIMO wireless technology is currently used in all 4G and WiFi services.
3. He served for three decades in the Indian Navy.
4. While a researcher in the Indian Navy, he headed one of the country's most successful military research and development projects — APSOH sonar.
5. He founded three national laboratories in India.
6. He is a fellow of eight national engineering/science academies in the United States, India, China and Sweden.
7. He founded Rasa Networks and Iospan Wireless, and co-founded Beceem Communications. He jokes that "Every time I learn something new, I start a company."
8. He currently is professor emeritus at Stanford University.
9. Paulraj has received numerous awards including the 2014 Marconi Prize, and the Institute of Electrical and Electronics Engineers (IEEE) Alexander Graham Bell Medal.
10. He holds 79 patents.

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2018 NATIONAL INVENTORS
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Jacqueline Quinn

BORN JULY 19, 1967

Jacqueline Quinn got into the sciences as a career to nurture the environment. And as an environmental engineer at NASA, she did just that.

An environmentally safe clean-up technology called emulsified zero-valent iron (EZVI) was co-invented by Quinn and a team of researchers from the University of Central Florida in the late 1990s. The team developed EZVI to combat contaminants left over from space exploration's early years, when NASA used chlorinated solvents as degreasers for rocket engine parts. Heavier than water, these solvents sink into the ground and can pollute fresh water sources if left untreated.

EZVI works by placing nanoscale zero-valent iron particles into a biodegradable water-in-oil emulsion. This emulsion is injected into contaminated groundwater where the system acts like a sponge, pulling the contaminant into the emulsion. Then, reacting with the zero-valent iron, the contaminant breaks down into harmless byproducts.

The EZVI system eliminates the need to dig up contaminated water and soil, requires less treatment time, produces less toxic and more biodegradable byproducts, and is cost-competitive. Now licensed for commercial use, EZVI has decontaminated groundwater supplies on government sites; near plants that manufacture dyes, chemicals, pharmaceuticals, adhesives, aerosols and paint; and in dry cleaning, leather tanning, and metal cleaning and degreasing facilities.

Quinn's innovation will be celebrated this May as she is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Jacqueline Quinn

Inventor of Emulsified Zero-Valent Iron (EZVI)

U.S. PATENT NO. 6,664,298

1. Quinn calls her EZVI emulsion a "salad dressing" due to its water-in-oil composition.
2. The EZVI technology was inducted into the Space Technology Hall of Fame in 2007.
3. Quinn is currently working on NASA's Resource Prospector mission, which will search for water under the surface of the Moon.
4. She previously worked in NASA's Space Shuttle Program, working on environmental controls on the shuttles Columbia and Atlantis.
5. In today's society, Quinn sees a "gender influence" where girls aren't nurtured or encouraged to get into science.
6. One of her favorite phrases is "I wonder," because of all the good that comes from checking out ideas based on that statement.
7. She likes to have brainstorming sessions with her teams outside of the office environment, which she calls "ideas on a napkin."
8. Quinn is a great lover of the outdoors. She enjoys hiking, camping, skiing and scuba diving.
9. She loves Venn Diagrams, where "different parts come together to find the right answer."
10. She holds 11 U.S. patents.

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2018 NATIONAL INVENTORS
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Ronald Rivest

BORN MAY 6, 1947

Imagine a world without secure e-commerce. If you can't, you have Ronald Rivest to thank! Without the work of Rivest and his colleagues on RSA Cryptography, our personal and financial information would be at much greater risk.

RSA Cryptography is the world's most widely used public-key cryptography method for securing communication on the Internet. Instrumental in the growth of e-commerce, RSA is used in almost all Internet-based transactions to safeguard sensitive data such as credit card numbers.

Introduced in 1977 by MIT colleagues Ron Rivest, Adi Shamir and Leonard Adleman, RSA — its name derived from the initials of their surnames — is a specific type of public-key cryptography that enables secure message encoding and decoding between communicating parties.

Unlike previous methods requiring securely exchanged keys to encrypt and decrypt messages, RSA provided a method for encryption and decryption without both parties needing a shared secret key. RSA could also mark messages with a digital signature.

Rivest's innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Ronald Rivest

Inventor of RSA Cryptography

U.S. PATENT NO. 4,405,829

1. Rivest grew up in Niskayuna, N.Y., a suburb of Schenectady.
2. He was a co-founder of RSA Data Security and VeriSign.
3. Following graduate school he accepted a postdoctoral position at INRIA (the French Institute for Research in Computer Science and Automation).
4. He has been a computer science and electrical engineering professor at the Massachusetts Institute of Technology since 1974.
5. Rivest's most famous work is his contribution to the RSA algorithm.
6. His research interests include cryptography, computer and network security, electronic voting and algorithms.
7. His co-written textbook *Introduction to Algorithms* has become a classroom standard.
8. He is a Fellow of the Association for Computing Machinery and the American Academy of Arts and Sciences.
9. He created a voting mechanism called the ThreeBallot — a paper system that allows voters to verify that their votes are properly recorded and produces an end-to-end audit trail.
10. He has received numerous professional honors, including the 2002 A.M. Turing Award from the Association for Computing Machinery.

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2018 NATIONAL INVENTORS
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Adi Shamir

BORN JULY 6, 1952

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10 Things You Need to Know About

Adi Shamir

Inventor of RSA Cryptography

U.S. PATENT NO. 4,405,829

1. Shamir is a native of Tel Aviv, Israel.
2. Shamir's most famous work is his contribution to the RSA algorithm.
3. He was a co-founder of RSA Data Security.
4. He is an expert in cryptographic schemes and protocols, and has a specialization in cryptanalysis.
5. Shamir is a frequent panelist and speaker at international cryptography conferences.
6. He has advanced the field of identity-based cryptography.
7. Since 1980, he has been a professor of computer science and applied mathematics at Israel's Weizmann Institute of Science.
8. Shamir thinks artificial intelligence can be used to better understand interactions and behaviors.
9. He was awarded the 2002 A.M. Turing Award from the Association for Computing Machinery.
10. He was among three winners of the 2017 Japan Prize, an award honoring achievement in science and technology.

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2018 NATIONAL INVENTORS
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Leonard Adleman

BORN DECEMBER 31, 1945

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Adleman's innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Leonard Adleman

Inventor of RSA Cryptography

U.S. PATENT NO. 4,405,829

1. Adleman's research interests include algorithms, computational complexity, computer viruses, cryptography, DNA computing, immunology, molecular biology, number theory and quantum computing.
2. He is considered the "Father of DNA Computing," or computing that uses biochemistry and molecular biology.
3. He is a Distinguished Professor of Computer Science and holder of the Henry Salvatori Chair in Computer Science.
4. As a child, he was inspired by the children's television program "Mr. Wizard."
5. Adleman is an avid boxer who has trained alongside several professional world champions.
6. He was the "mathematical consultant" for the 1992 movie "Sneakers."
7. Adleman is quoted as saying, "Becoming a mathematician is like falling in love."
8. He is a dynamic speaker.
9. He has received numerous professional honors, including the 2002 A.M. Turing Award from the Association for Computing Machinery.
10. He currently dedicates himself to research in complex analysis, a branch of mathematical analysis that investigates functions of complex numbers.

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2018 NATIONAL INVENTORS
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Ching Wan Tang

BORN JULY 23, 1947

The reach of OLED — organic light-emitting diode — is found in your hand, on your wall and on shelves in consumer electronics stores worldwide.

Chemists Ching Wan Tang and Steven Van Slyke pioneered OLED — an advance in flat-panel displays found in computers, cell phones and televisions that provides increased power efficiency, longer battery life and improved display quality.

OLEDs can be used wherever LCDs are used. They are thinner, lighter, provide superior brightness and color, and offer ultra-fast response time for functions such as refreshing and on-off switching. Unlike LCDs that rely on a backlight that passes through color filters to produce light, OLED screens utilize luminescent organic materials to make their own light.

The first OLED product was a display for a car stereo, commercialized by Pioneer in 1997. Kodak's EasyShare LS633 digital camera, introduced in 2003, was the first consumer electronic product incorporating a full-color OLED display. Today, Samsung uses OLEDs in all its smartphones, and LG manufactures large OLED screens for premium TVs. Other companies incorporating OLED technology include Apple, Google, Facebook, Motorola, Sony, Hewlett-Packard, Panasonic, Konica, Lenovo, Huawei, BOE, Philips and Osram. The OLED display market is expected to grow to \$57 billion by 2026.

Tang's innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Ching Wan Tang

Inventor of Organic Light-Emitting Diode (OLED)

U.S. PATENT NO. 4,356,429

1. Tang is a native of Hong Kong.
2. His research interests include chemical and condensed matter physics and organic electronics.
3. He invented the first heterojunction organic solar cell.
4. He is currently on the faculty at the Hong Kong University of Science and Technology, and he is professor emeritus at the University of Rochester.
5. Tang was a distinguished research fellow at Eastman Kodak from 1975-2006.
6. He received his B.S. in chemistry from the University of British Columbia, and his Ph.D. in physical chemistry from Cornell University.
7. Tang is a founding member of the Academy of Sciences of Hong Kong.
8. He is a 2013 Inductee of the Consumer Technology Association's Consumer Technology Hall of Fame.
9. Tang has received numerous awards for his work on organic materials and electronics, including the 2011 Wolf Prize in Chemistry and the 2004 American Chemical Society Award for Team Innovation shared with Steven Van Slyke.
10. He has been named on 84 patents.

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2018 NATIONAL INVENTORS
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Steven Van Slyke

BORN JULY 19, 1956

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Van Slyke's innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Steven Van Slyke

Inventor of Organic Light-Emitting Diode (OLED)

U.S. PATENT NO. 4,539,507

1. He worked at Eastman Kodak from 1979-2010, serving as research fellow and director of OLED Solid State Lighting.
2. Van Slyke is chief technology officer at Kateeva, which is pioneering inkjet printing technology enabling high-volume manufacturing of flexible and large-size OLED displays.
3. Van Slyke played lacrosse in high school.
4. He earned a B.S. in chemistry from Ithaca College, and an M.S. in materials science from the Rochester Institute of Technology.
5. In college, Van Slyke gained an interest in electrical engineering, which would figure prominently in his later OLED work.
6. He is an avid bicycle rider.
7. He is a 2013 Inductee of the Consumer Technology Association's Consumer Technology Hall of Fame.
8. He has received numerous awards, including the 2004 American Chemical Society Award for Team Innovation shared with Ching Wan Tang.
9. Van Slyke has published more than 40 papers on OLED.
10. He holds 40 U.S. patents.

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2018 NATIONAL INVENTORS
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Warren S. Johnson

NOV. 6, 1847 - DEC. 5, 1911

Wisconsin's harsh winter temperatures spurred Warren Johnson's invention of the electric room thermostat. And the company he co-founded, Johnson Controls, led the growth of the now multi-billion-dollar building controls industry.

In 1876, Johnson began teaching at Whitewater Normal School, where classrooms were heated by basement hot-air furnaces. The system yielded fluctuating classroom temperatures; hand-operated dampers located at the basement furnaces were the sole, inefficient means of adjustment. Each hour, a custodian entered classrooms to assess temperature, then opened or closed dampers as needed. The ongoing disruption spurred Johnson to develop a practical solution, leading to his 1883 patent for the bi-metallic thermostat. This eliminated hourly interruptions, but still required manual intervention. Johnson improved the electric room thermostat by incorporating compressed air with electricity, which automated operation of the valves and dampers. In 1885, Johnson left teaching to concentrate fully on advancing his technology.

In 1895, Johnson introduced the first multi-zone automatic temperature control system commercially feasible for widespread application. In 2008, it was designated an American Society of Mechanical Engineers Historic Mechanical Engineering Landmark.

Johnson's innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Warren S. Johnson

Inventor of Temperature Control

U.S. PATENT NOS. 281,884 & 542,733

1. Warren Johnson was born in 1847 in Leicester, Vt., to homesteading farmers.
2. As a boy, he kept a book of sketches of mechanical, chemical and electrical inventions.
3. Despite his lack of formal education, he became a surveyor, teacher, superintendent of schools and college professor.
4. Teaching colleagues at the State Normal School in Whitewater, Wis. now the University of Wisconsin-Whitewater, considered Johnson "one of the most strikingly original teachers."
5. In his private laboratory, he conducted experiments in areas including electro-chemistry — a glamour science of the day.
6. He co-founded the Johnson Electric Service Company (now Johnson Controls) in Milwaukee, Wis.
7. The Johnson System of Temperature Regulation was used in commercial buildings, offices and schools, and it also was installed in the U.S. Capitol, the Smithsonian Institution, the New York Stock Exchange, and the home of industrialist Andrew Carnegie.
8. Johnson also created and commercialized early steam-powered motor vehicles, experimented with wireless communications and designed large pneumatic clock towers.
9. Johnson was recognized by the American Society of Mechanical Engineers with a Historic Mechanical Engineering Landmark in 2008.
10. He held more than 30 U.S. patents.

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2018 NATIONAL INVENTORS
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Howard S. Jones Jr.

AUG. 18, 1921 - FEB. 26, 2005

Howard S. Jones was an innovator of radar antenna systems because his breakthrough in design reduced — or eliminated — drag during flight. Vital for the guidance of military, air, space and weapon fuzing systems, most antennas before Jones' invention were thought of as devices that needed to be separate from the structures to which they attached. By creating something that conformed to the aerodynamic shape of the projectile, he resolved challenges related to size, weight, volume and electrical properties.

His first patent on conformal antennas launched the development of a class of antennas that achieved his vision and reduced the problem of drag. His innovations in antenna technology dramatically expanded the capabilities of U.S. defense and space systems, and continues to impact the systems to this day.

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10 Things You Need to Know About

Howard S. Jones Jr.

Inventor of Conformal Antennas

U.S. PATENT NO. 4,010,470

1. Jones loved to work with and mentor young students, and he encouraged them to study math and science to pursue careers in engineering. He was particularly interested in helping young minority students.
2. Conformal antennas are still used in nearly all modern U.S. missiles.
3. Jones published more than 40 technical papers in scientific and technical literature.
4. He was born in Richmond, Va.
5. Jones received his B.S. in mathematics and physics from Virginia Union University, his Certificate of Engineering from Howard University and his M.S. in electrical engineering from Bucknell University.
6. He carried out much of his work for the U.S. Army's Harry Diamond Laboratories, which evolved into the U.S. Army Research Laboratory (ARL).
7. His conformal antennas benefited spacecrafts such as the Voyager, and military systems such as the U.S. Army's Patriot missile.
8. Jones was elected to the National Academy of Engineering in 1999.
9. In his more than 60-year career as a scientist, Jones worked in military, academic, government and corporate settings.
10. He held 31 patents and was awarded a variety of industry awards including the IEEE Harry Diamond Award, the U.S. Army's Meritorious Civilian Service Award and Harry Diamond Laboratories Inventor of the Year.

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Mary Engle Pennington

OCT. 8, 1872 - DEC. 27, 1952

Mary Engle Pennington was more than a pioneer for food preservation and storage techniques — she was a leader for women's rights.

In 1905, Pennington joined the U.S. Department of Agriculture's Bureau of Chemistry, which later evolved to become the U.S. Food and Drug Administration (FDA). After the passage of 1906's Pure Food and Drug Act, she became chief of the Food Research Laboratory, making her the FDA's first female lab chief. There, she developed the standards for the safe processing of chicken and the safety procedures to help avoid bacterial contamination of milk.

A noted authority on refrigeration and its application to food, Pennington also researched and devised spoilage-free methods of storing and shipping poultry, eggs and other perishable foods. She also developed processes for scaling, skinning, quick-freezing and dry-packing fish fillets immediately after the catch. She set the national standards for ice-cooled refrigerator cars and solved the problem of humidity control in cold storage.

Pennington's innovation will be celebrated this May as she is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Mary Engle Pennington

Inventor of Food Preservation and Storage

U.S. PATENT NO. 1,996,171

1. Pennington's love of science was spurred at the age of 12 when she became fascinated with a book on medical chemistry.
2. In 1892 at the University of Pennsylvania, she could only receive a certificate of proficiency in chemistry, botany and zoology because at the time the university denied degrees to women.
3. She received her doctorate from the University of Pennsylvania in 1895 at the age of 22.
4. When she was unable to find a job post-graduation, she formed the Philadelphia Clinical Laboratory, where she improved the standards of ice cream delivered to school children.
5. Pennington achieved the highest score possible on the Civil Service Exam, which was required to work in the federal service.
6. When Pennington began working with Harvey Wiley at the U.S. Food and Drug Administration, he disguised the fact that she was a woman in her hiring request — referring to her as M.E. Pennington.
7. She helped implement the Pure Food and Drug Act by discovering that food could be preserved for much longer by keeping the temperature of perishables at a constant low temperature.
8. Pennington was the FDA's first female laboratory chief.
9. She steadfastly refused to appear in hearings, keeping her sole focus on research.
10. She was recognized for her efforts with industry awards including the American Chemical Society's Garvan Medal, and she was inducted posthumously into the ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Hall of Fame, the National Women's Hall of Fame and the American Poultry Historical Society Hall of Fame.

To learn more about the 2018 Class of Inductees, visit www.invent.org/honor/inductees/.



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2018 NATIONAL INVENTORS
HALL OF FAME INDUCTEE

Joseph C. Shivers Jr.

NOV. 29, 1920 - SEPT. 1, 2014

From sportswear to bathing suits, the work of chemist Joseph Shivers makes us look good.

Shivers invented one of the top clothing innovations of the 20th century at DuPont in the 1950s. While working as a researcher developing polymers, Shivers created LYCRA®, the stretchy synthetic fiber known generically as spandex. Today, this fiber exists throughout the garment industry — from sportswear and undergarments to high fashion — and it has found applications in other areas including healthcare, home furnishings and the automotive industry.

In 1946, Shivers joined DuPont, where his work included perfecting Orlon and then Dacron polyester, before looking for a synthetic elastomer to replace the heavy rubber threads then necessary for foundation garments. After using an intermediate substance to modify Dacron, Shivers achieved a stretchy fiber that thickened, bounced, withstood high temperatures and could be spun into filaments. Unlike rubber, Shivers' fiber could stretch five times its original length while retaining its elasticity and recovering near to its original dimensions. It was also lightweight, smooth and soft; stronger and more durable; and could withstand exposure to perspiration, lotions and detergents.

In 2004, DuPont sold its Invista synthetic fibers business, which included LYCRA, to Koch Industries for \$4.4 billion. The global Spandex market is estimated to exceed \$5 billion by 2020. LYCRA is known as elastane in Europe and throughout most of the world.

Shivers' innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Joseph C. Shivers Jr.

Inventor of LYCRA® Fiber (Spandex)

U.S. PATENT NO. 3,023,192

1. Shivers worked at DuPont from 1946-80, and he retired as technical director of its fibers department.
2. He was an instructor at Canisius College.
3. He received three degrees in organic chemistry — a B.S. with honors, M.A., and Ph.D. — from Duke University.
4. He is credited with developing the basic structural concepts that led to LYCRA's discovery.
5. The LYCRA brand is now owned by Koch Industries.
6. Shivers' honors included DuPont's Lavoisier Medal, awarded to scientists whose extraordinary achievements result in significant business impact and enduring scientific value.
7. In 1998, he was awarded the American Association of Textile Chemists and Colorists Olney Medal for achievement in textile chemistry.
8. He was a member of the American Chemical Society and Phi Beta Kappa.
9. Shivers was the author or co-author of many scientific papers.
10. He held several U.S. and international patents.

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2018 NATIONAL INVENTORS
HALL OF FAME INDUCTEE

Paul Terasaki

SEPT. 10, 1929 - JAN. 25, 2016

Every 10 minutes, someone is added to the national organ transplant waiting list. Although the wait can be harrowing, the process of undergoing a transplant has been aided greatly by Paul Terasaki.

A tissue-typing test invented by Terasaki in the 1960s became the international standard for matching potential organ donors with recipients.

The procedure — used for kidney, heart, liver, pancreas, lung and bone marrow donors and recipients — remained for decades the most common method of HLA antibody screening.

Terasaki also founded the first kidney transplant registry, and his contributions to developing a cold-storage solution for kidney preservation during shipping helped define the field of transplantation science.

Seeking a better way to detect antibodies, he developed the microcytotoxicity test, a procedure enabling quick determination of the HLA types of both recipient and donor. Terasaki's microscale test permitted 1,000 tests to be performed with only 1 mL of serum.

The test also led to advances in several peripheral fields, proved an important tool in anthropology and contributed to the field of bone marrow transplantation.

Terasaki's innovation will be celebrated this May as he is Inducted into the 2018 Class of the National Inventors Hall of Fame.

10 Things You Need to Know About

Paul Terasaki

Inventor of Tissue Typing for Organ Transplants;
Terasaki Tray

U.S. PATENT NO. 4,599,315

1. In 1942, when he was 12, Terasaki and his parents, two brothers and an aunt were interned at the Gila River Relocation Camp in Arizona.
2. He earned a B.A. in preventive medicine and public health, and M.S. and Ph.D. degrees in zoology, from the University of California-Los Angeles. It was at UCLA that Terasaki began investigating the cellular and molecular basis of tissue rejection.
3. Terasaki did his postdoctoral work at University College in London, England.
4. He was a professor in UCLA's Department of Surgery from 1969-99.
5. In 1984, Terasaki co-founded One Lambda to market the assay plate — The Terasaki Tray — used as the micro test apparatus. Thermo Fisher Scientific acquired One Lambda in 2012.
6. Following his retirement in 1999, he established the Terasaki Research Institute, a center dedicated to solving problems limiting the success of organ transplantation.
7. During his lifetime, Terasaki donated \$58 million to UCLA.
8. A building at UCLA bearing his name, the Terasaki Life Sciences Building, was endowed by his foundation.
9. He received Lifetime Achievement Awards from the American Society of Transplantation and the University Kidney Research Organization.
10. In 2014, for his commitment to preserving the history of Japanese-Americans, Terasaki received the U.S.-Japan Council Lifetime Achievement Award.

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