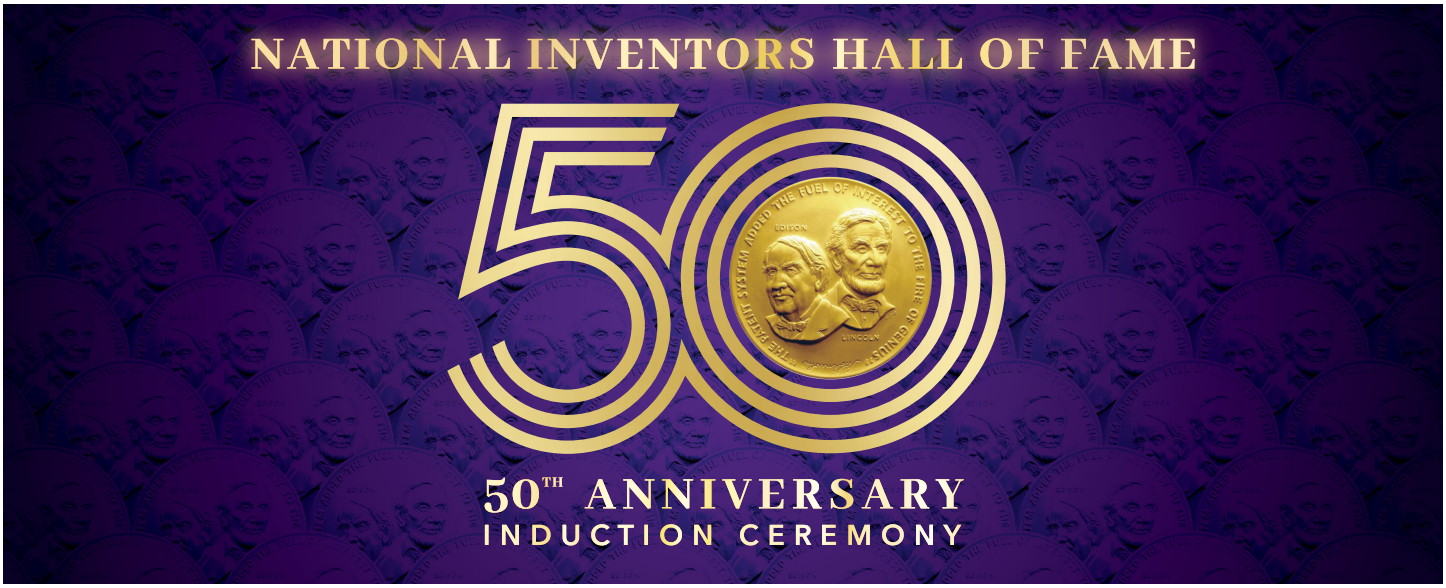

2023 Inductees

Rodolphe Barrangou

CRISPR-enhanced Food Products

U.S. Patent Nos. 9,951,342 & 9,879,269

Cultures with improved phage resistance; Method for modulating resistance

Inducted in 2023

Photo courtesy of Bill Baverstock, North Carolina State University

Inductee Bio:

Molecular biologists Rodolphe Barrangou and Philippe Horvath discovered that CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) sequences and associated proteins comprise an acquired immune system in bacteria. Applying their research to create better starter cultures for the dairy industry, they improved the world's food supply while laying the foundation for the field of gene editing.

Born in Paris, Barrangou earned his bachelor's degree in life sciences from the René Descartes University in 1996, his doctorate in functional genomics from North Carolina State University in 2004 and his MBA from the University of Wisconsin-Madison in 2011.

At Danisco, which was later acquired by DuPont, Barrangou and Horvath studied how bacteria survive to viruses called bacteriophages. They wanted to breed bacteria with natural resistance to these viruses, because viral outbreaks can destroy bacterial starter cultures for products like yogurt and cheese. Starter cultures are part of a company's intellectual property, and are vital to production and profitability.

In 2005, Barrangou and Horvath identified similarities between viral DNA sequences and spacer sequences in bacterial CRISPR regions. They discovered that bacterial genomes evolved over time, picking up sequences from bacteriophages to which they'd been exposed and using those spacers to recognize viruses, and that bacterial CRISPR spacers created a permanent record of viruses against which the bacteria has mounted defenses.

This discovery of CRISPR-based bacterial immunity to phages was first applied to develop resistance to viral invaders in bacterial cultures. In 2011, DuPont began commercializing improved starter cultures, selecting those with CRISPR sequences for increased virus resistance. Worldwide, hundreds of millions have since consumed cheese and yogurt with CRISPR enhancement.

In 2013, Barrangou joined North Carolina State University, where he researches CRISPR systems and potential applications. He is building the CRISPR scientific community through co-organizing the first five international conferences, serving as the founding editor-in-chief of The CRISPR Journal and co-founding Ancilia Biosciences, Intellia Therapeutics, Locus Biosciences, CRISPR Biotechnologies and TreeCo.

Barrangou holds 24 U.S. patents. His honors include the Canada Gairdner International Award in 2016, the Warren Alpert Foundation Prize in 2016, and the National Academy of Sciences Award in Molecular Biology in 2017 and Prize in Food and Agriculture in 2018.

Short Description:

Molecular biologists Rodolphe Barrangou and Philippe Horvath discovered that CRISPR sequences and associated proteins comprise an acquired immune system in bacteria. Applying their research to enhance starter cultures in the dairy industry, they improved the world's food supply and laid the foundation for the field of gene editing.

Philippe Horvath

CRISPR-enhanced Food Products
U.S. Patent Nos. 9,951,342 & 9,879,269
Cultures with improved phage resistance; Method for modulating resistance

Inducted in 2023

Photo courtesy of Mikael Pianfetti

Inductee Bio:

Molecular biologists Philippe Horvath and Rodolphe Barrangou discovered that CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) and associated proteins comprise an acquired immune system in bacteria. Their work led to improved dairy starter cultures and food production, and was key to establishing the CRISPR field.

Born in Colmar, France, Horvath studied cellular and molecular biology and earned his master's degree in 1996 and his doctorate in 2000 from the Université Louis Pasteur, now the University of Strasbourg.

In the early 2000s, Horvath and Barrangou began researching the genetic underpinnings of beneficial bacteria, or starters, used in dairy foods. At Danisco, an industrial biotechnology company acquired by DuPont and then by International Flavors & Fragrances (IFF), they studied how bacteria survive to viruses called bacteriophages. In 2005, while working to breed bacteria with natural resistance to these viruses, they identified similarities between viral DNA sequences and spacer sequences in bacterial CRISPR regions.

Horvath and Barrangou discovered that bacterial genomes evolve over time, picking up sequences from bacteriophages to which they were exposed, then using these spacers to recognize viruses that later invade their cells. Further research showed that bacterial CRISPR spacers created a permanent record of viruses against which the bacteria has mounted defenses, passing it to subsequent generations. They also showed that by altering CRISPR sequences, scientists can provide, withdraw or switch resistance against phages.

Their work catalyzed the exploration of CRISPR systems, leading ultimately to the development of the CRISPR-Cas toolkit for targeted DNA edits and laying the foundation for technology applied in areas including genome editing, plant breeding, and antibacterial and antimicrobial production.

In 2011, DuPont began commercializing improved starter cultures, selecting those with CRISPR sequences for increased virus resistance. Since then, hundreds of millions across the globe have consumed cheese and yogurt with CRISPR enhancement.

Today, Horvath is senior scientist and technical fellow at IFF in France. His honors include the Massry Prize in 2015, the Warren Alpert Foundation Prize in 2016, the Canada Gairdner International Award in 2016, and the Franklin Institute Bower Award and Prize for Achievement in Science in 2018. He holds 19 U.S. patents.

Short Description:

Molecular biologists Philippe Horvath and Rodolphe Barrangou discovered that CRISPR sequences and associated proteins comprise an acquired immune system in bacteria. They improved the world's food supply by creating better starter cultures for the dairy industry and laid the foundation for the field of gene editing.

Robert G. Bryant

LaRC-SI (Langley Research Center-Soluble Imide)

U.S. Patent Nos. 5,639,850, 5,741,883 & 6,048,959
Process for preparing a tough, soluble, aromatic, thermoplastic copolyimide (5,639,850); Tough soluble aromatic thermoplastic copolyimides (5,741,883 & 6,048,959)

Inducted in 2023

Photo courtesy of Robert Bryant

Inductee Bio:

NASA chemist Robert Bryant developed a polymer called LaRC-SI (Langley Research Center-Soluble Imide), taking it from laboratory discovery to application as an insulation material for leads in implantable cardiac resynchronization therapy (CRT) devices.

Bryant was born in Chicago. He earned his bachelor's degree in chemistry from Valparaiso University in 1985. He then joined the Polymer Institute at the University of Akron as a graduate student, earning his master's and doctorate degrees under the NASA Graduate Student Research Fellowship in Polymer Science in 1990.

That same year, Bryant joined a team at NASA Langley Research Center investigating composite materials suitable for high-speed civil transport aircraft and lightweight rocket bodies. Bryant noticed one of his polymer formulations, LaRC-SI, unexpectedly remained soluble during polymerization. He continued developing LaRC-SI while several NASA research groups explored potential applications and published articles to make scientific and technical communities aware of the formulation.

Because LaRC-SI is biologically inert and solvent resistant, it can be used in implantable medical devices. Medtronic, a leading medical device company, licensed LaRC-SI in 2004. Investing nearly $50 million over the next decade, with Bryant as consultant, Medtronic adapted the polymer for its needs as a coating and electric insulator for left ventricle leads. A lead is a thin wire attached to the implanted heart device that helps to resynchronize contractions and improve pumping efficiency. LaRC-SI enhances lead design, making them easier to implant and benefiting patient outcomes.

LaRC-SI enables leads that are small, flexible and reliable for threading through an often-convoluted vein via a tiny space to the coronary sinus. Before LaRC-SI, Medtronic's CRT left ventricle leads were about 3 mm in diameter. Using LaRC-SI, they are rarely more than 1 mm in diameter with the latest generation containing several electrode pairs. Since obtaining Food and Drug Administration approval in 2010, over 700,000 Medtronic Attain™ family of left ventricular leads have been sold.

In addition to his induction into NIHF, Bryant was inducted into the Space Foundation's Space Technology Hall of Fame and the NASA Inventors Hall of Fame. His numerous awards include NASA's Exceptional Achievement Medal, NASA Langley's Lifetime Achievement Award and Valparaiso University's Distinguished Alumni Award and Doctor of Science Honoris Causa, and three R&D 100 Awards including an Editor's Choice. During his NASA tenure, he holds 33 U.S. patents, over a dozen foreign patents and over 20 NASA commercial licenses.

Short Description:

NASA chemist Robert Bryant developed LaRC-SI (Langley Research Center-Soluble Imide), a polymer used as an insulation material for leads in implantable cardiac resynchronization therapy devices. LaRC-SI enables small, flexible, reliable leads that are easier to implant, benefiting patient outcomes.

Emmanuelle Charpentier

CRISPR-Cas9 Gene Editing

U.S. Patent No. 10,266,850
Methods and compositions for RNA-directed target DNA modification and for RNA-directed modulation of transcription

Inducted in 2023

Photo courtesy of Hallbauer & Fioretti

Inductee Bio:

Microbiologist Emmanuelle Charpentier and biochemist Jennifer Doudna co-invented the gene-editing system CRISPR-Cas9, a versatile technology providing the means to edit DNA on an unprecedented scale with high precision.

Born in Juvisy-sur-Orge, France, Charpentier studied biochemistry, microbiology and genetics at the University Pierre and Marie Curie (now Sorbonne University) in Paris, and obtained her doctorate in microbiology for her research performed at the Pasteur Institute in Paris.

When Charpentier and Doudna met in 2011 at a scientific conference, both had been researching different aspects of CRISPR — Charpentier at Umeå University in Sweden, and Doudna at the University of California, Berkeley.

Doudna was focused on RNA and wondered how a repeating sequence of DNA in the bacterial genome enabled bacteria to fight viral infections. Charpentier had published findings about an unusual RNA called tracrRNA, and how its work with the Cas (CRISPR-associated) 9 protein contributed to the identification and elimination of invading viruses. Their collaboration yielded a leap in innovation.

Charpentier and Doudna discovered how Cas9 is guided by both the tracrRNA and an RNA matching a viral sequence, using it to seek out and destroy matching viral DNA. They engineered the two-piece RNA into a single guide RNA and showed that it could be designed to pinpoint any gene, allowing the Cas9 protein to cut at that spot. Charpentier and Doudna then proposed that CRISPR-Cas9 can be re-engineered as a programmable gene editing tool to delete or add specific strands of DNA.

CRISPR-Cas9 gene editing technology has applications across fields including human and veterinary medicine, agriculture and biotechnology. It has been rapidly adopted by the scientific community due to its broad applicability, versatility and ease of use.

In 2015, Charpentier joined the Max Planck Institute for Infection Biology in Berlin, where she is director of the Unit for the Science of Pathogens. She is also the co-founder of CRISPR Therapeutics and ERS Genomics and holds 50 U.S. patents.

Short Description:

Microbiologist Emmanuelle Charpentier and biochemist Jennifer Doudna co-invented the gene-editing system CRISPR-Cas9, creating a versatile technology that provided the means to edit genes on an unprecedented scale with extremely high precision. For this work, they won the Nobel Prize in Chemistry in 2020.

Jennifer Doudna

CRISPR-Cas9 Gene Editing

U.S. Patent No. 10,266,850
Methods and compositions for RNA-directed target DNA modification and for RNA-directed modulation of transcription

Inducted in 2023

Photo courtesy of Keegan Houser, University of California, Berkeley

Inductee Bio:

Biochemist Jennifer Doudna and microbiologist Emmanuelle Charpentier co-invented the gene-editing system CRISPR-Cas9, a technology for editing DNA with unprecedented precision and efficiency. CRISPR-Cas9 opens up novel, wide-ranging possibilities across medicine, biology and agriculture.

Doudna grew up in Hawaii. She received her bachelor's degree in biochemistry in 1985 from Pomona College and her doctorate in biological chemistry and molecular pharmacology in 1989 from Harvard Medical School.

Doudna and Charpentier began collaborating in 2011 after researching different aspects of RNA and CRISPR (an immune system used by bacteria to fend off viruses) independently — Doudna at the University of California, Berkeley, and Charpentier at Umeå University in Sweden. Their partnership led to the 2012 discovery that Cas (CRISPR-associated) 9, a gene-cutting protein used by bacteria to kill viruses, can be re-engineered as a programmable gene editing tool.

They described how an RNA molecule guides the CRISPR-Cas9 system, binding it to a specific region in the DNA, and showed how the Cas9 protein then cuts the DNA, allowing it to be edited in a precise manner. The CRISPR-Cas9 system is faster, more accurate and more efficient than previous genome editing methods, and laboratories worldwide have incorporated CRISPR-Cas9 into their research programs.

CRISPR has the potential to be transformative in medicine. It is being tested for treatment for genetic diseases, and scientists are using it to develop new diagnostic tests. The technology also is being explored to create crops that resist disease and are resilient to a changing climate.

Doudna holds the Li Ka Shing Chancellor's Chair in Biomedical and Health Sciences, and is a professor in the departments of chemistry and of molecular and cell biology at UC Berkeley. She founded the Innovative Genomics Institute in 2014. To commercialize her CRISPR technologies, she has founded companies including Caribou Biosciences, Intellia Therapeutics, Mammoth Biosciences and Scribe Therapeutics. She holds more than 100 U.S. patents.

Doudna and Charpentier were awarded the Nobel Prize in Chemistry in 2020. They also have won the Harvey Prize and the Wolf Prize in Medicine among their many additional honors.

Short Description:

Biochemist Jennifer Doudna and microbiologist Emmanuelle Charpentier co-invented the gene-editing system CRISPR-Cas9, a technology for editing DNA with unprecedented precision and efficiency. They won the Nobel Prize in Chemistry in 2020 for their work, which opens wide-ranging possibilities across medicine, biology and agriculture.

Lynn Conway

Very Large-Scale Integration (VLSI)
U.S. Patent No. 5,046,022
Tele-autonomous system and method employing time/position synchrony/desynchrony

Inducted in 2023

Photo courtesy of Joseph Xu

Inductee Bio:

Lynn Conway and NIHF Inductee Carver Mead invented VLSI, or Very Large-Scale Integration, which transformed the global microelectronics industry. This technology triggered what is now known as the Mead-Conway Revolution by allowing small teams of individuals to design powerful chips.

Born in Mount Vernon, New York, Conway earned bachelor's and master's degrees in electrical engineering from Columbia University in 1962 and 1963. She then joined IBM Research, where she made foundational contributions to computer architecture, including multiple-out-of-order dynamic instruction scheduling — an innovation key to architecture designs for ultra-high-performance computers.

Into the 1970s, a cumbersome, segmented system hampered digital design engineers keen to create higher-performance devices. Semiconductor firms, circuit designers and system architects largely worked apart from one another, and computer processor manufacturers applied individual design and fabrication methods. It was against this backdrop that Caltech professor Mead, recognized for simplifying custom circuit designs for VLSI processors, and Conway, then a Xerox PARC computer system architect and creator of scalable VLSI design rules, worked to streamline VLSI prototyping techniques and design methodology.

Conway and Mead's groundbreaking textbook, "Introduction to VLSI Systems," became the chip designer's handbook, freeing chip design from the confines of commercial chip fabricators.

In 1978, Conway taught the first VLSI course at the Massachusetts Institute of Technology. By 1983, nearly 120 schools taught the approach. At the time, the idea that design could be handled using a high-level system architecture approach — where designers understood basic concepts but didn't have to become experts in circuitry fabrication — was radical. Today, it is fundamental. As of 2021, silicon foundries were a $105 billion strategic global industry.

Conway joined the University of Michigan in 1985, where she is professor of electrical engineering and computer science, emerita. She is active in supporting transgender rights and seeking recognition for women's technological achievements.

Short Description:

Lynn Conway and NIHF Inductee Carver Mead transformed the global microelectronics industry with their invention of VLSI, or Very Large-Scale Integration. This revolutionary technology, detailed in their groundbreaking textbook "Introduction to VLSI Systems," allowed small teams of individuals to design powerful chips.

Rory Cooper

Wheelchair Technology

U.S. Patent Nos. 6,276,705 & 8,264,458
Wheelchair hand rim; Variable compliance joystick with compensation algorithms

Inducted in 2023

Photo courtesy of U.S. Department of Veterans Affairs

Inductee Bio:

Biomedical engineer Rory Cooper developed innovations that have improved manual and electric wheelchairs, advancing the health, mobility and social inclusion of people with disabilities and older adults.

Born in Los Angeles, Cooper is a U.S. Army veteran. While stationed in Germany in 1980, a bicycle accident left him paralyzed from the waist down. He attended California Polytechnic State University, and when he became frustrated that his 80-pound wheelchair was difficult to maneuver on campus, he built his own ultralight wheelchair.

He earned bachelor's and master's degrees in electrical engineering in 1985 and 1986, followed by a doctorate in electrical and computer engineering from the University of California, Santa Barbara in 1989. By 1994, he was founder and director of the Human Engineering Research Laboratories (HERL), a collaboration between the U.S. Department of Veterans Affairs and the University of Pittsburgh, and was determined to reduce the repetitive stress injuries plaguing many users of manual wheelchairs.

His research showed the correlation between wheelchair propulsion and injury. The Ergonomic Dual Surface Wheelchair Pushrim — marketed as the Natural-Fit Handrim and the Surge Handrim — evolved from these findings and enabled less-forceful gripping with improved propulsion and braking. Users reported less hand and wrist pain, and significantly fewer wrist and shoulder injuries.

Cooper and his colleagues then created the Variable Compliance Joystick with Compensation Algorithms, providing safe, powered independent mobility for older adults and those with severe and complex disabilities. The digital joystick, calibrated to individual hand strength, controls the speed and direction of an electric-powered wheelchair through pressure sensing while software compensates for hand tremors.

Cooper holds more than 20 U.S. patents and continues to direct HERL, the nation's leading assistive technology research laboratory. A fellow of the National Academy of Inventors, American Association for the Advancement of Science, the American Institute for Medical and Biological Engineering, and IEEE, his honors include the Samuel E. Heyman Service to America Medal. Cooper won a bronze medal at the 1988 Seoul Paralympics in the 4×400-meter wheelchair relay and more than 200 medals in the National Veterans Wheelchair Games.

Short Description:

Biomedical engineer Rory Cooper's innovations have improved manual and electric wheelchairs, and advanced the health, mobility and social inclusion of people with disabilities and older adults. His research has been informed by his own experience as a disabled U.S. Army veteran.

Katalin Karikó

Modified mRNA Technology Used in COVID-19 Vaccines
U.S. Patent No. 8,278,036
RNA containing modified nucleosides and methods of use thereof

Inducted in 2023

Photo Peggy Peterson courtesy of Vilcek Foundation/MHamiltonVisuals

Inductee Bio:

Biochemist Katalin Karikó and immunologist Drew Weissman discovered how to enable messenger ribonucleic acid (mRNA) to enter cells without triggering the body's immune system. Their research laid the foundation for the mRNA vaccines developed by Pfizer-BioNTech and Moderna to address the COVID-19 pandemic.

Born in Szolnok, Hungary, Karikó earned her bachelor's degree in biology in 1978 and her doctorate in biochemistry in 1982 from the University of Szeged. She worked at the Biological Research Center of the Hungarian Academy of Sciences before immigrating to the United States in 1985.

Karikó joined the Perelman School of Medicine at the University of Pennsylvania in 1989. In 1997, she started working with Weissman in researching RNA and mRNA — the genetic material in the human body that instructs cells to make proteins. At the heart of the COVID-19 vaccines is modified, synthetic mRNA that instructs cells to make copies of the virus' spike protein. Later, the body's immune system will recognize the real virus upon exposure and a rapid immune response will occur to protect against severe disease.

Unmodified mRNA molecules are unable to slip past the body's immune system, but Karikó and Weissman modified mRNA so it could avoid immediate immune detection, remain active longer and efficiently instruct cells to create antigens to protect against severe disease. Karikó and Weissman's discovery in the early 2000s that exchanging one of the four building blocks of mRNA molecules, uridine, with pseudouridine created a modified mRNA with favorable qualities, including reduced adverse reactions. This fundamental discovery paved the way for modified mRNA to be potentially used in a wide array of future vaccines and treatments.

Since December 2020, several billion mRNA vaccine doses have been administered worldwide to combat the COVID-19 respiratory disease caused by SARS-CoV 2, a novel coronavirus discovered in 2019.

Karikó, who holds 14 U.S. patents, is a professor at the University of Szeged in Hungary and an adjunct professor of neurosurgery at the University of Pennsylvania. She is a founding member of the International mRNA Health Conference, an event held annually since 2013.

Short Description:

Fundamental research by biochemist Katalin Karikó and immunologist Drew Weissman laid a critical piece of the foundation for the mRNA COVID-19 vaccines developed by Pfizer-BioNTech and Moderna. Crucial in the fight against the coronavirus pandemic, several billion mRNA vaccine doses have been administered worldwide since December 2020.

Drew Weissman

Modified mRNA Technology Used in COVID-19 Vaccines

U.S. Patent No. 8,278,036
RNA containing modified nucleosides and methods of use thereof

Inducted in 2023

Photo Peggy Peterson courtesy of Penn Medicine

Inductee Bio:

The work of immunologist Drew Weissman and biochemist Katalin Karikó enabled messenger ribonucleic acid (mRNA) to enter cells without triggering the body's immune system. Their research and discoveries paved the way for the mRNA vaccines developed by Pfizer-BioNTech and Moderna to fight against the COVID-19 pandemic.

Weissman grew up in Lexington, Massachusetts. He earned his bachelor's and master's degrees from Brandeis University in 1981 and his doctorate and M.D. from Boston University in 1987. He completed his residency in internal medicine at Beth Israel Hospital in Boston in 1990.

After completing a fellowship at the National Institute of Allergy and Infectious Diseases of the National Institutes of Health, he came to the University of Pennsylvania in 1997 and began collaborating with Karikó.

In the early 2000s, Weissman and Karikó discovered that by replacing one of the four building blocks of mRNA molecules, uridine, with pseudouridine, they could create a modified mRNA with favorable qualities and reduced adverse reactions. While unmodified mRNA molecules are unable to slip past the body's immune system, Weissman and Karikó's changes allowed the resulting modified mRNA to avoid immediate detection, remain active longer and enter cells to efficiently instruct them to create antigens or other proteins that fight or treat disease. This discovery was vital in making it possible for modified mRNA to be applied to an array of potential uses in future vaccines and treatments. The Weissman laboratory was the first to publish the use of lipid nanoparticles to deliver mRNA in animals, which was followed by their demonstration of the modified mRNA-LNP vaccine platform that produced protection from Zika virus infection in mice and monkeys. His lab has recently developed the ability to deliver mRNA-LNPs to specific cells, tissues and organs allowing in vivo gene therapy and protein mediated treatments for a variety of diseases.

The modified, synthetic mRNA in the COVID-19 vaccines is delivered into the human body and instructs cells to make copies of the spike protein of the virus. If a vaccinated individual is later exposed to the real virus, their immune system will recognize it and will rapidly trigger an immune response to protect against severe disease.

To fight the COVID-19 respiratory disease, several billion doses of mRNA vaccines have been administered worldwide since December 2020.

Weissman holds 16 U.S. patents and serves as the Roberts Family Professor in Vaccine Research at the Perelman School of Medicine at the University of Pennsylvania.

Short Description:

Immunologist Drew Weissman and biochemist Katalin Karikó laid a critical piece of the foundation for the mRNA COVID-19 vaccines with their fundamental research. Developed by Pfizer-BioNTech and Moderna, these vaccines have been vital in fighting the coronavirus pandemic, and since December 2020, several billion doses have been administered worldwide.

Luis von Ahn

reCAPTCHA
U.S. Patent No. 8,555,353
Methods and apparatuses for controlling access to computer systems and for annotating media files

Inducted in 2023

Photo courtesy of Duolingo

Inductee Bio:

Computer scientist Luis von Ahn co-invented the website security program CAPTCHA, or Completely Automated Public Turing test for telling Computers and Humans Apart. He then created reCAPTCHA, furthering the work of CAPTCHA while assisting in digitizing books and other archives. He also co-founded Duolingo, whose online platform is the world's most popular way to learn languages.

Born in Guatemala City, Guatemala, von Ahn earned his bachelor's degree in mathematics from Duke University in 2000, and his master's and doctorate degrees in computer science from Carnegie Mellon University in 2003 and 2005.

In response to a request in 2000 from the web portal Yahoo!, a team from Carnegie Mellon that included von Ahn created CAPTCHA. This test was designed to help companies thwart "bots" — autonomous software programs that interact with computer systems or users to generate fake email accounts, corrupt search results or bypass online queues to reserve thousands of event tickets. A CAPTCHA program generated tests that humans could pass, but computers could not, by employing distorted text that users had to type correctly to confirm they were human before gaining access to a website or program.

In 2001, Yahoo! was the first company to introduce CAPTCHA and its use rapidly spread. Then von Ahn developed reCAPTCHA, which continued to protect against bot attacks while harnessing the efforts of billions of internet users to transcribe scans of archived newspapers and books. The reCAPTCHA program displayed scanned words for human users to decipher. Each time someone solved a reCAPTCHA puzzle, they translated that image into text. In 2007, the New York Times partnered with von Ahn to digitize over a century's worth of its archives. By 2018, over 1 billion people had helped digitize books through reCAPTCHA.

In 2009, von Ahn sold reCAPTCHA to Google and then dedicated himself to enabling people of all social classes to access better life opportunities through learning. In 2011, he co-founded Duolingo, whose online language-learning platform is the largest in the world. He continues to serve as Duolingo's CEO.

He holds 13 U.S. patents and his awards include a MacArthur Fellowship and the Lemelson-MIT Prize. The Luis von Ahn Foundation was established in 2021 to improve life in Guatemala.

Short Description:

Computer scientist Luis von Ahn co-invented the website security program CAPTCHA, or Completely Automated Public Turing test for telling Computers and Humans Apart. He then created reCAPTCHA, furthering this work while assisting in digitizing books and other archives. He also co-founded Duolingo, whose online platform is the world's most popular way to learn languages.

Angela Hartley Brodie

Aromatase Inhibitors

U.S. Patent No. 4,235,893
Ester derivatives of 4-hydroxy-4-androstene-3,17-dione and a method for inhibiting estrogen biosynthesis

Inducted in 2023

Photo courtesy of University of Maryland School of Medicine

Inductee Bio:

Angela Hartley Brodie discovered and developed a class of drugs called aromatase inhibitors, which are among the leading therapies against breast cancer.

Brodie was born in Oldham, Lancashire, England. She earned her bachelor's and master's degrees in biochemistry from the University of Sheffield in 1956 and 1959, and her doctorate in chemical pathology from the University of Manchester in 1961.

In 1962, she joined the steroid biochemistry training program sponsored by the National Institutes of Health at the Worcester Foundation for Experimental Biology in Massachusetts. There, she met her future husband, Harry Brodie. Each researched the biochemistry of aromatase for different purposes. Harry Brodie was interested in its application to contraception, while Angela Brodie strove to identify a link between estrogen biosynthesis and breast cancer patients.

In the 1970s, the Brodies optimized the first selective aromatase inhibitors and tested synthetic compounds to block estrogen synthesis. One compound, 4-hydroxyandrostenedione (4-OHA), was particularly effective.

In 1979, Angela Brodie moved to the University of Maryland School of Medicine in Baltimore and began manufacturing clinical-grade material in her own laboratory. For 37 years, she was a professor of pharmacology at the School of Medicine and a researcher in the Hormone Responsive Cancers Program at the University of Maryland Marlene and Stewart Greenebaum Comprehensive Cancer Center. She passed away a year after her retirement in 2017.

Clinical trials of 4-OHA began in 1981 and subsequent studies showed the compound reduced blood estrogen levels. In 1993, Ciba-Geigy brought 4-OHA, known as formestane, to market to treat advanced breast cancer in postmenopausal women. It was the first new agent in a decade explicitly developed to treat breast cancer.

Many breast cancers are hormone dependent, requiring estrogen to reproduce and grow. Aromatase inhibitors work by interfering with aromatase, the enzyme that catalyzes the key step in the body's synthesis of estrogens, thereby starving hormone-dependent cancers of their estrogen fuel supply. Currently, three aromatase inhibitors are FDA-approved: anastrozole, letrozole and exemestane. It is estimated that 500,000 women worldwide now receive aromatase inhibitor therapy every year.

Named on 13 U.S. patents, Brodie was a Fellow of the American Academy for Cancer Research (AACR), a recipient of the Dorothy P. Landon-AACR Prize for Translational Cancer Research and the Brinker Award for Scientific Distinction from the Susan G. Komen Breast Cancer Foundation, and the only woman to receive the Charles F. Kettering Prize from the General Motors Cancer Research Foundation.

Short Description:

Angela Hartley Brodie discovered and developed a class of drugs called aromatase inhibitors, which can stop the production of hormones that fuel the growth of cancer cells. Aromatase inhibitors are among the leading therapies against breast cancer.

Marjorie Stewart Joyner

Permanent Wave Machine
U.S. Patent No. 1,693,515
Permanent-waving machine

Inducted in 2023

Photo courtesy of Marjorie Stewart Joyner Papers (Photo 051), Chicago Public Library, Vivian G. Harsh Research Collection

Inductee Bio:

Marjorie Stewart Joyner invented a permanent wave machine and was a leader in the beauty industry as a beautician, salon owner, instructor and executive for the Madam C. J. Walker Manufacturing Co.

Joyner was born in Monterey, Virginia. At the age of 20, she became the first Black student to graduate from the A.B. Moler Beauty and Culture School in Chicago in 1916, and she soon opened her own beauty shop.

Realizing her training had not prepared her to work with the specific textures of Black hair, she enrolled in Mme. C. J. Walker's beauty school. There, she honed her expertise and began working with Walker. With a business built on her line of hair care products, Walker taught students and opened beauty schools and shops across the country, and Joyner played an important role in this work. She became the company vice president and national supervisor for 200 Walker Co. beauty schools and remained affiliated with the company for more than 50 years.

In 1928, Joyner patented a machine to create permanent hair waves. The traditional method was a laborious, curl-by-curl procedure, but Joyner imagined a more efficient way. While cooking a pot roast, she observed the long thin rods holding the roast together, heating it from the inside, and realized these rods might be adapted for use as rollers. Fastening 16 rods to a hair dryer hood, Joyner created a device that did the job of multiple curling irons used simultaneously. It became an instant hit with her beauty shop clientele.

Joyner, who held two U.S. patents, was a powerful advocate for civil rights, education and Black beauty culture. In 1924, she helped write Illinois' first cosmetology laws. In 1935, she became a founding member of Mary McLeod Bethune's National Council of Negro Women, and she worked with Bethune to support Bethune-Cookman College (now University) in Daytona Beach, Florida.

To advance Black beauty culture professionals, in 1945 Joyner founded the Alpha Chi Pi Omega Sorority and Fraternity, and a year later, the United Beauty School Owners and Teachers Association.

Short Description:

Marjorie Stewart Joyner invented a permanent wave machine in the 1920s. A beautician, salon owner, instructor and executive for the Madam C. J. Walker Co., she established beauty industry standards and powerfully advocated for civil rights.

Cyril Keller

Bobcat® Skid-Steer Loader
U.S. Patent No. 3,151,503
Transmission system

Inducted in 2023

Photo courtesy of Doosan Bobcat North America

Inductee Bio:

Brothers Cyril and Louis Keller played a key role in launching the compact equipment industry in the late 1950s and early 1960s with their invention of the world's first compact loader, which became the Bobcat® skid-steer loader.

Cyril Keller was born in Tintah, Minnesota, and served in the U.S. Navy in World War II. Despite having no formal schooling beyond the eighth grade, he held six U.S. patents and made a lasting, worldwide impact with his resourcefulness and drive to invent.

Operating early motorized loaders in small spaces was all but impossible because they required a wide area for turning around, so in late 1956 and early 1957, the Keller brothers designed a solution. In just six weeks, they created the first small, lightweight, three-wheel front-end loader in their machine shop in Rothsay, Minnesota, using mechanical parts from local junkyards and bars from the old Rothsay jail for the manure fork teeth. The Keller Self-Propelled Loader had a bucket in front, which was operated using hydraulic foot pedals, and a motor in the back. It had two front tires, and the rear wheel was a pivoting caster that enabled sharp turns. The Kellers' patented clutch system, operated with two hand levers, made it possible to put one side of the loader into forward and the other into reverse, without the use of a transmission gearshift or a steering wheel. The loader could turn around in a circle the size of its own length.

In 1958, Melroe Manufacturing Company was awarded exclusive manufacturing rights on a royalty basis and hired the Kellers, who continued to develop their invention. The first four-wheel skid-steer loader was introduced in 1960 as the M400. It was the first machine that required the wheels to skid for directional control, or skid steer. The M440, the first model with the Bobcat name, entered the market in 1962.

Over the next several years, Cyril Keller set up dealerships throughout the United States and in Europe. He later ran a school training new dealers in operating the Bobcat skid-steer loader.

More than 1 million Bobcat skid-steer loaders have been sold worldwide. In 2004, the American Society of Agricultural and Biological Engineers recognized the Kellers' skid-steer loader as a Historic Landmark. Cyril and Louis Keller were inducted into the Association of Equipment Manufacturers Hall of Fame in 1999 and the Minnesota Inventors Hall of Fame in 2004.

Short Description:

Brothers Cyril and Louis Keller played a key role in launching the compact equipment industry in the late 1950s and early 1960s with their invention of the world's first compact loader, which became the Bobcat® skid-steer loader.

Louis Keller

Bobcat® Skid-Steer Loader
U.S. Patent No. 3,151,503
Transmission system

Inducted in 2023

Photo courtesy of Doosan Bobcat North America

Inductee Bio:

Louis Keller and his brother Cyril Keller invented the world's first compact loader and helped launch the compact equipment industry in the late 1950s and early 1960s.

Born in Tenney, Minnesota, Louis Keller served in the U.S. Army in World War II. Though he had no formal education beyond the eighth grade, his exceptional ingenuity led him to earn six U.S. patents and make a lasting, global impact.

In 1947, Louis Keller started Keller Welding in Rothsay, Minnesota, and in 1953, his brother Cyril joined the growing business. When a local farmer needed a light and easily maneuverable machine to clear manure from his turkey barn, the Kellers created a solution in just six weeks. Using mechanical parts from local junkyards and bars from the old Rothsay jail for manure fork teeth, they built the first small, lightweight, three-wheel front-end loader in 1957.

The Melroe Manufacturing Company was awarded exclusive manufacturing rights to the loader on a royalty basis and hired the Kellers, who sold their business and continued to develop their invention for Melroe.

The original loader featured a front bucket, hydraulic foot pedals, a rear motor, two front wheels, a pivoting rear caster wheel that enabled sharp turns, and a belt-and-chain drive system. The Kellers later replaced the belts with their patented clutch system, added a counterweight in the back for stability, and designed attachments including a snow blower, sweeper, bucket and fork. Louis Keller later replaced the single rear caster wheel with two rear-drive wheels, helping the loader turn on soft ground.

In 1960, a four-wheel, skid-steer design was introduced as the M400, and in 1962, the M440 was introduced and dubbed the "Bobcat." Today, compact loaders are ubiquitous at construction sites and on farms, railyards and seaports. More than 1 million Bobcat® skid-steer loaders have been built and sold worldwide.

In addition to the skid-steer loader, Louis Keller also patented steel over-the-tire tracks for wheeled vehicles. The American Society of Agricultural and Biological Engineers recognized the Kellers' skid-steer loader as a Historic Landmark in 2004. Louis and Cyril Keller were inducted into the Association of Equipment Manufacturers Hall of Fame in 1999 and the Minnesota Inventors Hall of Fame in 2004.

Short Description:

With their invention of the world's first compact loader, which became the Bobcat® skid-steer loader, brothers Louis and Cyril Keller helped launched the compact equipment industry in the late 1950s and early 1960s.

James A. Parsons Jr.

Durimet 20 Stainless Steel Alloy
U.S. Patent No. 2,185,987
Corrosion resistant ferrous alloy

Inducted in 2023

Photo courtesy of the National Afro-American Museum and Cultural Center

Inductee Bio:

Metallurgist James A. Parsons Jr. invented Durimet 20 stainless steel alloy. Developed in the 1930s, this corrosion-resistant alloy is used today in a wide range of industrial processes.

Born in Dayton, Ohio, Parsons earned his bachelor's degree in electrical engineering from Rensselaer Polytechnic Institute in Troy, New York, in 1922.

As an analytical chemist at Dayton's Duriron Co., a manufacturer of pumps and valves for chemical processes, Parsons worked on alloy compositions and metal processing methods, initially focusing on aluminum, bronze and high-silicon castings. He then turned to the research and development of corrosion-resistant, stainless steel alloys and high-silicon alloys.

In 1929, Parsons received the first of eight patents involving the development and application of noncorrosive metals. He then began developing Durimet 20, a high-alloy austenitic stainless steel containing nickel and chromium with lesser percentages of molybdenum, copper, silicon, manganese, carbon and other elements. Its balanced composition provides increased sulfuric acid resistance over conventional 18-8 (18% chromium and 8% nickel content) stainless steels while maintaining equal or superior resistance to many other corrosives.

In 1935, Duriron produced the first commercial castings from Durimet 20, which became the basis for a family of stainless steel alloys used extensively in industries involving the handling of corrosives.

Parsons rose to become the chief metallurgist and laboratory manager at Duriron — likely the only company of its kind with a laboratory fully staffed by Black employees at the time.

After retiring in 1953, Parsons organized the metallurgy program at Tennessee A&I State University (now Tennessee State University), believed to be the first of its kind at any historically Black college or university, and served as professor, department head and dean of the engineering school during his tenure from 1953-66. He also taught at the Ohio State University and at an occupational training center in Dayton.

In 1997, Duriron, then known as Durco International, merged with BW/IP to form Flowserve Corp. Flowserve manufactures and sells Durimet 20, which is used today in applications including the production of detergents, soaps, fertilizers, pharmaceuticals, plastics, and synthetic rubber and fibers.

Short Description:

Metallurgist James A. Parsons Jr. created corrosion-resistant, stainless steel alloy Durimet 20. Invented in the 1930s, the alloy is still widely used today in industrial processes that involve corrosive chemicals.

Roger Tsien

Green Fluorescent Protein (GFP) Variants
U.S. Patent No. 5,625,048
Modified green fluorescent proteins

Inducted in 2023

Photo courtesy of University of California-San Diego

Inductee Bio:

Biochemist Roger Tsien invented green fluorescent protein (GFP) variants. Having discovered how to make GFP, a substance found in the jellyfish Aequorea victoria, glow more brightly and consistently, he created a full palette of fluorescent proteins that enable scientists to track multiple cellular processes simultaneously.

Born in New York City, Tsien received his bachelor's degree in chemistry and physics from Harvard University in 1972 and his doctorate in physiology from the University of Cambridge in 1977. He joined the faculty of the University of California, Berkeley, in 1982 and moved to UC San Diego in 1989.

At the time, techniques for monitoring cellular proteins disrupted molecular dynamics, leading to ambiguous results, and didn't allow proteins to be tracked in a living cell. By contrast, GFP tags can be used in vivo without disturbing the function of the protein. Tsien hoped to label subunits of proteins with different colored tags, so in the early 1990s, he set about mutating GFP to improve its stability and to develop a second color.

The GFP chromophore is tolerant of chemical modifications that change its spectral properties, and Tsien explored the limits of this tolerance. Through slight variations in the structure of the chromophore and its interactions with the protein environment, he produced an enhanced GFP and a GFP version that glowed blue. This led to his creation of a range of brighter, artificially derived GFP variants for use as fluorescent markers in living cells.

Tsien transformed GFP into a ubiquitous tool found in biology, chemistry, genetics and medical labs worldwide, allowing researchers to investigate the inner workings of cells or whole animals and to watch molecules interact in real time. GFPs have made it possible to track nearly every biochemical event in living systems, and Tsien's optimization of GFP remains the gold standard.

Named on over 130 U.S. patents, Tsien was an investigator for the Howard Hughes Medical Institute and co-founded several companies based on his research. For his contributions, he shared the 2008 Nobel Prize in Chemistry.

Short Description:

Biochemist Roger Tsien invented green fluorescent protein (GFP) variants. For his contributions to creating a full palette of fluorescent proteins that enable scientists to track multiple cellular processes simultaneously, he shared the 2008 Nobel Prize in Chemistry.