INNOVATION

Caltech scientists have been at the forefront of inquiry and innovation since the Institute was founded in 1891. Researchers and engineers on campus and at the Jet Propulsion Laboratory (JPL), which Caltech manages on behalf of NASA, have launched new fields of study and invented world-changing tools and technologies while seeking answers to the scientific questions that define the times.

Over the years, Caltech has...

Put the Volts in High-Voltage Lines
A high-voltage laboratory built on campus in 1923 was the first in the country to have a million-volt power source. The laboratory helped Southern California Edison develop high-voltage transmission lines, which would furnish lightning protection to oil storage tanks and address other power needs of a rapidly industrializing Southern California.

Put Cameras in Space—and Cell Phones
Tasked with miniaturizing cameras for future spacecraft, engineers at JPL invented a new kind of image sensor that functions as a camera on a chip. That technology, the complementary metal-oxide semiconductor (CMOS), is ultimately responsible for putting cameras in cell phones.

Lifted the Fog on Smog
In the 1940s, Caltech chemist Arie Haagen-Smit became the first scientist to directly link smog to automobile exhaust, ultimately prompting the formation of the California Air Resources Board. Since then, Caltech researchers have continued to influence air-pollution management with new insights into urban smog formation and discoveries about the origin, chemistry, and evolution of particles in the atmosphere.

Made Computing Personal
As director of research and development at Fairchild Semiconductor and, later, co-founder of Intel, Gordon Moore (PhD ’54) developed memory chips and microprocessors that paved the way for personal computers. His 1965 prediction, popularly known as Moore’s Law, correctly surmised that the number of transistors on a single chip would double approximately every two years.

Fought Lead Contamination
Attempting to calculate the age of the earth (4.55 billion years), Caltech geochemist Clair Patterson unexpectedly discovered that toxic lead contaminated everything from his lab instruments to canned fish, ocean water, fossils, etc. and most plastic containers. Throughout the 1960s, Patterson’s research drove efforts to reduce lead in gasoline and to implement environmental protections including the Clean Air Act of 1970.

Directed Evolution
In the 1990s, Caltech chemical engineer Frances Arnold pioneered the technique of directed evolution, which mimics the process of natural selection to create new enzymes that can be used in medicine, neurobiology, and alternative energy. For example, Arnold has used directed evolution to engineer enzymes that can convert plant waste into fuel.

Pioneered Chip Design
Caltech engineer Carver Mead (BS ’56, MS ’57, PhD ’60) validated the science behind Moore’s Law in 1972. Through a process known as very-large-scale integration (VLSI), Mead made it possible for tens of thousands of transistors to be packaged on a single silicon chip. VLSI revolutionized electronics, enabling the building of processors that today drive devices such as laptops, tablets, smartphones, and DVD players.

Caltech has an outsized impact on science, technology, and society. With a community of 300 faculty, 2,200 undergraduate and graduate students, and 600 postdoctoral scholars, the Institute is recognized as a leader in innovation. In the 2017 fiscal year, Caltech was associated with:

190 U.S. patents issued
1,928 active U.S. patents
16 new start-up companies
77 licenses (including options)
305 material transfer agreements

Made Computing Personal
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Contact the World
Fiber optic communications systems rely on distributed feedback semiconductor lasers, developed in the 1970s by Caltech’s Amnon Yariv, an engineer and applied physicist. Today, such lasers are the main information carriers of internet traffic.

IMPACT by the numbers

Caltech led its peers, with more than
660 U.S. patents issued between 2012 and 2015. www.caltech.edu

Cover: At Caltech’s new Center for Autonomous Systems and Technologies, researchers are imagining, creating, and testing the next generation of drones, robots, and other autonomous systems.
Captured Reactions in Action
Caltech chemical engineer David Evans developed a barcode-amplified microfluidic device that enabled investigators to perform single-cell analysis of RNA within days. The device amplified RNA from just a few cells to an optimal concentration for analysis. But these words, as in so many sciences, are not enough. They tell mere novices, each one-eighth of an omni-vision of a second.

Produced a Wonder Material
Caltech physicists Min-Chae Yung and David Boyd created a universality boundary material at zero.

Redefined Surgical Precision
A year at JPL develops the robotic arm and associated software for use in surgical incisions allowing surgeons to perform operations using robots with 20 times more accuracy than can be done by surgeons.

Connected Bacteria to the Brain
Caltech neurobiologist Taro Tsuchiya and colleagues created a wireless cockpit for the brain. They built a circuit that can send a signal to the brain.

Championed the Treatment of HIV/AIDS
Caltech virologist David Baltimore invented the widely used retroviral drug that has dramatically increased the lifespan of HIV-positive patients.

Identified the Prostodon
Caltech paleontologist Neil Shubin has identified fossil remains of a new species of animal, a mix between a mammal and a bird.

Written the Book on Physics
Caltech physicist Robert P. Feynman wrote a book on physics, which tells how to interpret the fields of quantum theory and quantum mechanics.

Detected Hippos on Skies
Caltech astronomers have detected a new planet, which is the most habitable planet outside the solar system.

Launched the Lab that Launched Rogues
In 1930, Caltech's JPL was the first laboratory to launch rockets, which are now used to launch satellites and spacecraft.

Identified the Most All All Atoms on Earth Were Created in Stars
Scientists at Caltech have identified that most of the elements on Earth were created in stars.

Trapped Eyes on the Skies
Caltech astronomers have identified that the stars are the most important sources of light and energy in the universe.

Built the Tools that Measure Earthquakes
In the 1930s, Caltech developed the seismograph, which is used to measure earthquakes.

Detected Phases Promoted a New Planet Nine
A Caltech geologist has detected a new planet, which is the most massive planet known to exist.

Captured Reactions in Action
Caltech chemical engineer Sandeep Kumar has captured reactions in action, showing how they occur.

Made Sense of the Brain's Split Functions
Sperry's split-brain experiments revealed the separate functions of the brain's two hemispheres: the left hemisphere is analytic and sequenced, while the right hemisphere is creative and sequential.

Put the Wind Beneath, Well … Everything
In 1994, Caltech geophysicist Peter Gisser and Charles Richter (PhD '28) developed the Richter scale, a numerical scale for measuring earthquake magnitude.

Turned Thoughts into Action
Andersen demonstrated that a neuroprosthetic device could be used to control robotic limbs. For example, patients have used their minds to move robotic limbs.