

## 10 Life-Changing Technologies

Where would we be without organ transplants, space flight, cell phones and PCs?

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So many new technologies have appeared in the past half century that it's impossible to list them all. But these 10 high-tech breakthroughs stand out over the last 50 years because they've revolutionized the way Americans live. We look back at their beginnings, as well as where they've taken us today.

**10. Organ transplants.** In 1954, Dr Joseph Murray removed the kidney from one human patient and implanted it in another. The recipient accepted the kidney as its own rather than rejecting it as a foreign body. It was more than skillful surgery: Murray had chosen a pair of identical twins, Ronald Herrick and his terminally ill brother Richard, in hopes their similar genetic makeup would reduce the likelihood of Richard's body rejecting Ronald's liver. Soon afterward, though, other researchers developed drugs that could squelch a transplant recipient's immune system long enough for the new organ to become incorporated into its new body. Today, some 25,000 Americans a year receive a new heart, kidney, liver, lung, pancreas or intestine — and a new lease on life.

**9. Robots and artificial intelligence.** The term "robot" was coined by Czechoslovakian playwright Karel Capek in 1920 — "robota" being a Czech word for tedious labor — but the first real industrial robot was built in 1954 by George Devol. Five years later, the Massachusetts Institute of Technology founded its Artificial Intelligence Laboratory in a quest to mechanically mimic human minds as well as hands. Today, robots assemble products better, faster and often cheaper than manual laborers, while more than 8 million U.S. airline flights a year are scheduled, guided and flown with the superhuman assistance of advanced software. Still, some Americans eye such systems with the cynical view of novelist Kurt Vonnegut, whose 1952 story "Player Piano" warned that the machines might leave people without a purpose — or a job.

**8. Electronic funds transfer.** The Federal Reserve Bank of San Francisco set up a paperless transfer system with the Los Angeles branch in 1972. By the end of the decade, instantaneous transfers of millions of dollars in value between banks, insurance companies and other financial institutions had become common. The real appeal of EFT today is its trickle down to the individual: You get grab cash from your bank account anywhere in the world, and use PayPal to buy and sell stuff on eBay without sending money or checks through the mail.

**7. Nuclear power.** When the Queen herself threw the switch on the world's first atomic power plant at Calder Hall outside London in 1956, nuclear reactors were seen as a source of cheap, pollution-free energy. But a partial meltdown in 1979 at the Three Mile Island reactor in Pennsylvania soured Americans on nukes as safe power. Nonetheless, the United States today has about 100 active plants that generate 20 percent of the country's electricity — second only to coal as a source of power — and have been steadily increasing their capacity. Will the next 50 years bring a better alternative?

**6. Mobile phones.** The idea for cellular phone service dates back at least to 1947, but the first call was made from the sidewalk outside the Manhattan Hilton in 1973 by Martin Cooper, a Motorola researcher who rang up his rival at AT&T Bell Labs to test the new phone. Thirty years later, more than half of all Americans own one and cellular networks are beginning to serve Internet access at broadband speeds through thin air.

**5. Space flight.** Americans from 50 years ago would be disappointed to learn we never went further than the Moon — no Mars colony, no 2001 odyssey to Jupiter, no speed-of-light spaceships. Even the Shuttle is in trouble. But the space race against the Russians that dominated the national psyche (and a good chunk of the budget) in the '60s and '70s pushed the development of hundreds of enabling technologies, including synthetic fibers and integrated computer circuits, necessary to fly men to the Moon and back. And the astronauts brought back a lesson from space: "We saw the earth the size of a quarter, and we realized then that there is only one earth. We are all brothers."

**4. Personal computers.** Before IBM recast the desktop computer from hobbyist's gadget to office automation tool in 1983 — followed by Apple's people-friendly Macintosh a year later — a "minicomputer" was the size of a washing machine and required a special air-conditioned room. But the trained technicians who operated the old mainframes already knew computers were cool: They could use them to play games, keep diaries, and trade messages with friends across the country, while still looking busy. Today, thanks to the PC, we all look busy.

**3. Digital media.** "The camera doesn't lie" went a saying not heard much since the release of Photoshop 1.0 in 1990. Digitized audio, pictures, movies, and text let even an amateur edit reality — or conjure it from scratch — with a keyboard and a mouse. A singer's bad notes, a model's blemishes, or an overcast sky in a movie scene can be fixed as easily as a spelling error. Just as important, digital media can be copied over and over nearly for free, stored permanently without fading, and sent around the world in seconds. It rightly worries the movie and music industries, but how do you put the genie back in the bottle if there's no bottle anymore?

**2. Genetic engineering.** Everyone knows Watson and Crick, who unraveled the secret of DNA in 1953. But have you heard of Boyer and Cohen, who

constructed the first organism with combined DNA from different species in 1973? They inserted toad genes into a bacterium that then replicated itself over and over, passing the toad's genetic code down through generations of bacteria. Thirty years later, an estimated 70 percent of processed foods contain genetically modified ingredients, such as soybeans or corn engineered for higher crop yields. Of course, the much bigger potential — good and bad — is in engineering humans. It might prevent birth defects, and diseases later in life. But the side effects could be disastrous and unknown. Is there an ethical way to beta-test human beings?

**1. The Internet.** This one seems like a no-brainer, but the Net's unique strength is that no two people will agree on why it's so important. The world's largest and most unruly library, it's also a global news channel, social club, research archive, shopping service, town hall, and multimedia kiosk. Add to that the most affordable mass medium ever, and a curse to anyone with a secret to keep. Three-fifths of Americans now use the Net, but it remains to be seen whether the connections to one another will transform us, or prove that we'll never change.