



The Department of Energy's Advanced Photon Source in Lemont, Illinois, will get an upgrade under the new spending bill.

IN DEPTH

U.S. SCIENCE FUNDING

Congress gives science a record funding boost

Lawmakers largely reject deep cuts proposed by President Donald Trump for 2018

By Jeffrey Mervis

Researchers are ecstatic over the \$4.8 billion increase that the U.S. Congress showered on nine leading civilian science agencies last week. But their joy may be short-lived.

The hikes, including \$3 billion more for the National Institutes of Health (NIH), are part of a \$1.3 trillion spending package for 2018 that includes a record \$176.8 billion for federal spending on R&D—a 12.8%, or \$20.1 billion, increase over 2017. The spending bill, which President Donald Trump signed last Friday, has put the scientific community “over the moon,” Rush Holt, CEO of AAAS (publisher of *Science*) in Washington, D.C., said in a statement. “We applaud congressional leaders ... for recognizing that funding science and technology continues to be a sound investment.”

The good news stems largely from a government-wide budget deal that allowed lawmakers to lift mandatory spending caps on discretionary accounts by a cumulative \$300 billion over 2 years. But there's a string attached: Most of the additional civilian spending occurs in the first year, 2018, meaning that researchers shouldn't expect a repeat of this year's windfall in fiscal 2019, which starts on 1 October 2018.

Another concern is the lopsided allocation, with NIH getting about two-thirds of the raise given to the top civilian science agencies (see graphic, p. 1448). That could reignite a long-simmering debate over

whether federal investments have tipped too far toward the biomedical sciences.

Still, passage of the legislation marked a happy ending to a year of fiscal angst and political wrangling. Many scientists had seen Trump's 2018 budget request as a slap in the face. Released last May, it called for massive cuts to research—22% less for NIH, an 11% reduction at the National Science Foundation (NSF), 17% less for the Office of Science at the Department of Energy (DOE), and a 24% cut at the National Institute of Standards and Technology (NIST). The White House also wanted to ax the Advanced Research Projects Agency-Energy (ARPA-E) and numerous climate and environmental science programs. A modest 1% dip in NASA science was a rare exception to the proposed bloodletting.

Congressional appropriators largely ignored the cuts Trump requested as they began writing their spending bills. Still, they were constrained by annual spending caps set by a 2011 law aimed at reducing the federal deficit over the next decade. In practice, the caps meant that any boost for one program required offsetting cuts elsewhere.

Those trade-offs reflected ideological and personal preferences. At NASA, for instance, Representative John Culberson (R-TX), a science fan who leads the House of Representatives spending committee that oversees NASA, NSF, and other science agencies, proposed cutting the space agency's climate research—which he thinks falls outside NASA's charter. At the same time, he wanted to expedite a proposed mission to Jupiter's wa-

tery moon Europa, which he and some scientists see as a promising place to find alien life.

Culberson and other appropriators also noted that many science agencies might benefit if Congress and the White House could agree on raising the caps. That is exactly what happened. A February budget deal, which also prevented a government shutdown, provided \$63 billion more for civilian discretionary spending in 2018, with an additional \$18 billion available in 2019. (The military got \$80 billion and \$18 billion, respectively.)

With the new money in hand, Congress went to work. NASA science got an 8% boost, to \$6.22 billion, and the Europa mission—including a lander—got an even bigger hike than initially planned. The agency's \$1.92 billion earth sciences budget avoided the ax, as did several climate missions. NSF's budget grew by 4%, to \$7.767 billion, and NIST's research account gained 5%, to \$724 million.

At DOE, the final bill not only rejected the proposed Trump cuts but also raised the Office of Science budget by \$868 million—or 16%—to \$6.26 billion. The total will enable the agency to continue U.S. support for ITER, the international fusion reactor under construction in France, and accelerate work on several shovel-ready projects at DOE's national laboratories, including upgrading the Spallation Neutron Source at the Oak Ridge National Laboratory (ORNL) in Tennessee. In addition, ARPA-E survived and received a \$47 million bump, to \$353 million. Overall, DOE's raise should allow the agency to fund “a lot of timely, well-vetted ideas that are

champing at the bit,” says Thom Mason, a former ORNL director who is vice president for laboratory operations at Battelle in Columbus, which runs six DOE labs.

NIH, the biggest winner, cashed in on its traditional popularity among legislators and the potent pleas of disease advocacy organizations. No one expected Congress to go along with Trump’s proposed deep cut. Instead, the question was how much more NIH, which received \$2 billion increases in both 2016 and 2017, would get this time around.

Last summer, before the budget caps were lifted, the House came in at the low end, with a \$1 billion raise for 2018. The Senate countered with \$2 billion. In the end, the two bodies “compromised” at \$3 billion, an 8.7% boost. That’s the largest annual increase for NIH since a massive 2009 economic recovery bill gave it \$10 billion.

the agency received in the late 1990s and early 2000s, when its budget doubled in just 5 years. The doubling triggered concern that federal spending had tilted too far toward biomedicine and was neglecting the physical sciences. In response, in 2006, then-President George W. Bush and his science adviser, John Marburger, hatched an initiative to double the budgets of NSF, NIST, and DOE science over a similarly short time span. Congress liked the idea but never delivered the money.

At the same time, the NIH doubling left a mixed legacy. NIH’s budget stagnated for the next decade as legislators felt they had taken care of the agency for years to come. Meanwhile, the boom created an expanded cohort of young, well-trained scientists, leading to increasingly stiff competition for funding. Community leaders lamented this “hard landing,” and some said that smaller, steadier

REGENERATIVE MEDICINE

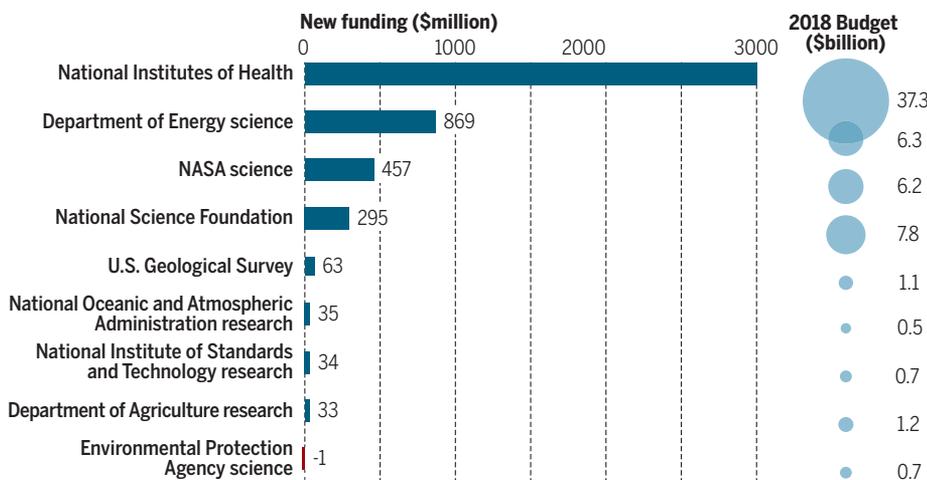
U.K. trials of airway transplants are in limbo

Studies are based on flawed evidence and could harm patients, scientists say

By **Matt Warren**, in Liverpool, U.K.

The National Institutes of Health leads the way

Biomedical research won about two-thirds of the \$4.8 billion increase given to nine civilian science agencies.



The total includes a 30%, \$414 million increase for Alzheimer’s disease research. The Brain Research through Advancing Innovative Neurotechnologies Initiative gets a \$140 million boost, to \$400 million. The All of Us precision medicine study receives a \$60 million increase, to \$290 million. At least \$500 million in new funds will go to research on opioid addiction. The bill also orders NIH to delay implementing a new, broader definition of clinical trials that basic behavioral and brain researchers had warned could stifle their research.

Even NIH advocates were stunned by the outcome. “Beyond words, folks,” tweeted Benjamin Corb, director of public affairs at the American Society for Biochemistry and Molecular Biology in Rockville, Maryland.

But outside the biomedical community the news stirred some quiet grumbling. NIH’s success recalls the large spending increases

increases would have been better for NIH.

Congress may not have the fiscal wherewithal for another big boost in civilian research in 2019, however. And there’s also reason to question its overall commitment to continued growth. In touting the omnibus bill, for instance, many top appropriators didn’t even mention research. Those that did mentioned just medical research.

The White House has also ignored the research boost, emphasizing the big increases for the military and denigrating civilian science programs. Trump responded to the news of a final deal by tweeting that he “had to waste money on Dem giveaways” to get the \$700 billion he wanted for national security. Of course, those “giveaways” include every dollar spent on civilian science. ■

With reporting by Jeffrey Brainard, Adrian Cho, Jocelyn Kaiser, and Kelly Servick.

Replacing a failing windpipe, or trachea, with one partially made from a patient’s own stem cells once looked like the cutting edge of regenerative medicine. But the concept took a severe blow in 2016 with the dramatic fall of Paolo Macchiarini, a surgeon at the Karolinska Institute (KI) in Stockholm. Macchiarini was fired by KI for scientific negligence and has been found guilty of misconduct in more than half a dozen papers. Most of his patients have died, and Swedish prosecutors are considering whether to reopen a criminal case against him that was closed last October.

But is the idea underlying Macchiarini’s work—“seeding” a scaffold with a patient’s own stem cells, in hopes of regenerating a healthy, functional organ—still worth testing in patients? That’s the question facing scientists in the United Kingdom, where two trials of stem cell-based larynx (voice box) and trachea transplants are planned but on hold in the wake of the scandal.

Both studies, led by former Macchiarini collaborator and University College London (UCL) laryngologist Martin Birchall, received approval from the Medicine and Healthcare Products Regulatory Agency more than 2 years ago and have obtained close to £5 million from U.K. funding agencies. An independent inquiry last year concluded there was no reason to cancel the trials, and UCL says they can proceed.

But some scientists say the studies, like Macchiarini’s operations, are based on flimsy evidence and could harm patients. In November 2017, cellular and molecular biologist Patricia Murray and biochemist Raphaël Lévy of the University of Liverpool filed a detailed complaint with the U.K. Parliament’s Science and Technology Committee, which is holding an inquiry into research integrity, in an effort to stop the studies. (They followed

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