President Obama's FY 2016 R&D budget would surpass spending caps

The Department of Energy and NSF would get healthy increases while basic research programs at the Department of Defense and NASA would see reductions.

For his penultimate year in office, President Obama proposes to shrug off the austerity that has dominated federal spending politics for the past few years and instead attend to what he believes to be urgent needs in national infrastructure, R&D, advanced manufacturing, and other areas.

The White House 2016 budget request would provide $146 billion government-wide for R&D, an $8 billion, or 6%, increase from 2015 enacted levels. Of that funding, $67 billion is for basic and applied research, a $2 billion, or 3%, increase from 2015 enacted levels. The basic research request is $33 billion, also a 3% increase from current-year funding. The request includes $69 billion for nondefense R&D and $77 billion for defense R&D.

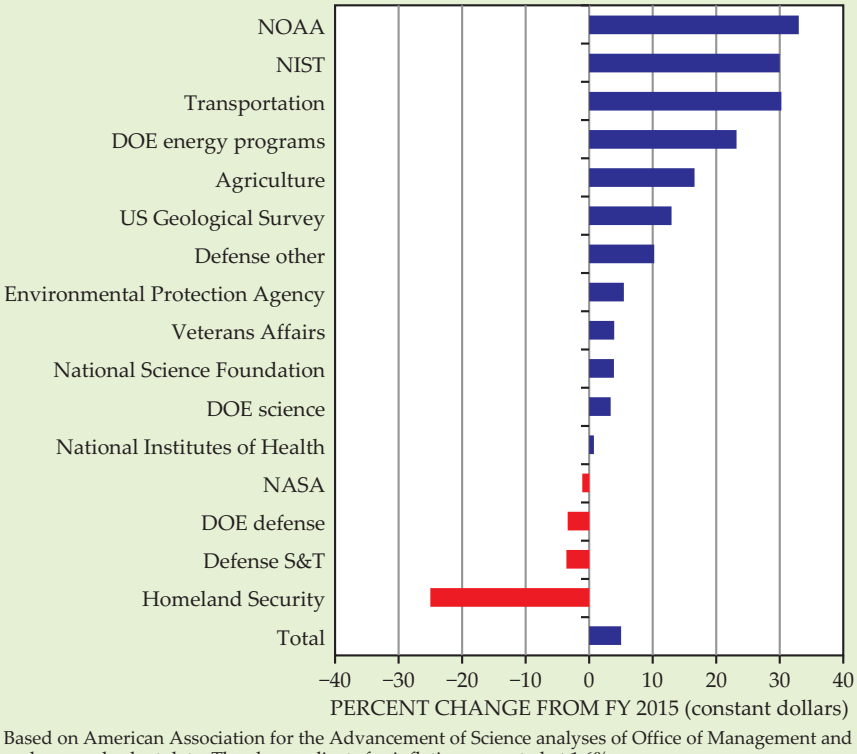
But to make his proposal happen, or for any increases at all to become law, the president will need to convince the Republican-controlled Congress to scrap the mandatory, across-the-board cuts on discretionary spending that lawmakers enacted four years ago. For fiscal year 2014, and again in the current year, the White House and Congress agreed to add billions to the spending caps established in the Budget Control Act of 2011. Without similar action, the caps, known as sequestration, will return with a vengeance.

The caps due to resume in FY 2016 "do not provide sufficient resources for national security, domestic investments, and core Government functions that are required to ensure the Nation is achieving its full potential in a growing economy," cautioned a report issued on 2 February by the White House Office of Management and Budget (OMB) to the president and Congress. It also said, however, that the president's budget would restore funding to required levels.

In the report, whose delivery coincided with the release of Obama's budget proposal, OMB director Shaun Donovan warned Congress that if lawmakers don't act, federal agencies will be forced to cut their FY 2016 budgets by $90 billion from this year's level—$36.6 billion, or 4.1%, from nondefense programs and $54 billion, or 10.7%, from defense. If past experience is any guide, the fiscal drama between the executive and legislative branches is likely to play out up to, or beyond, the 1 October deadline.

In announcing Obama's R&D budget proposal, his science adviser, John Holdren, said the president was investing in America's future, which, "among other

Current percentage-change estimates for R&D in the FY 2016 budget



Federal funding for R&D would increase by 6% under President Obama's fiscal year 2016 budget request. The request would devote $67 billion to basic and applied research, a 3% increase from the FY 2015 level. Defense-related R&D would total $77 billion, while the nondefense request is $69 billion. By agency, year-to-year changes would vary sharply, from the 33% increase for the National Oceanic and Atmospheric Administration to a 25.8% decrease at the Department of Homeland Security. The request includes $7.4 billion for clean-energy-related research, mainly at the Department of Energy. DOE's basic research budget would rise 5.4%.

Based on American Association for the Advancement of Science analyses of Office of Management and Budget, Office of Science and Technology Policy, and agency budget data. The above adjusts for inflation, expected at 1.6%.

things, includes investing in innovation, in the infrastructure, and transforming information into wide benefit." But he cautioned that in the current budget climate, "not everything that is desirable is affordable."

The proposed R&D increases are unevenly distributed among agencies. The National Institutes of Health, for example, which accounts for roughly half of nondefense R&D spending, would grow by just 3.2% from its FY 2015 level, despite biomedical research advocates' persistent complaints that, with the exception of a two-year respite afforded by the American Recovery and Reinvestment Act, the NIH budget has been declining in real terms ever since a vaunted five-year budget doubling was completed 12 years ago.

The Department of Energy's R&D, on the other hand, would increase 19%, while the much smaller R&D programs at the National Oceanic and Atmospheric Administration would surge 33%. Department of Homeland Security programs would plummet 25.8% compared with the administration's FY 2015 request.

Among the administration's R&D priorities is manufacturing, for which it requests a total of $2.4 billion, mostly at the Department of Defense, DOE, NSF, NIST, and NASA. That includes $350 million to create seven new manufacturing innovation institutes to join the nine previously established. (See Politics and Policy, 13 October 2014, on PHYSICS TODAY's website.) Ultimately, the administration wants to fund 45 such institutes, but the remaining ones would be financed through a proposed new mandatory spending account, a budgetary mechanism that Congress has consistently rejected. Obama's manufacturing programs also include R&D on robotics and a materials genome program that aims to speed the development of new materials designed for specific applications.

The administration continues to draw attention to the three main sources of federal support for the physical sciences: DOE's Office of Science, NSF, and NIST's laboratory programs. Obama initially committed to doubling the budgets of those programs over 10 years, as did the George W. Bush administration, but neither president provided the annual increases needed to accomplish that goal. That pledge quietly disappeared with the FY 2015 budget request. Collectively, the budgets of those three programs would increase by $700 million, or 5.3%, to $13.9 billion in FY 2016.

Department of Energy R&D programs

	FY 2015 actual	FY 2016 request	FY 2015–16 percent change
	(millions of dollars)*		
Total DOE	27 403	29 924	9.2
DOE R&D	11 068	13 196	19.2
Office of Science	5 068	5 340	5.4
Total high-energy physics (HEP)	766	788	2.9
Energy frontier experimental physics	148	155	4.7
Research	79	79	0.1
Facilities	54	57	5.4
Projects	15	19	26.7
Intensity frontier experimental physics	264	247	–6.4
Research	55	56	1.3
Facility operations and experimental support	165	158	–4.5
Projects	44	34	–23.3
Cosmic frontier experimental physics	107	119	11.6
Research	49	50	1.5
Facility operations and experimental support	12	10	–10.9
Projects	46	59	28.4
Theoretical and computational physics	59	60	1.7
Research	58	58	0.1
Theory	50	50	–0.1
Computational HEP	8	8	1.0
Projects	1	2	100.0
Advanced technology R&D (accelerators and detectors)	120	115	–4.1
Research	90	83	–7.3
HEP general accelerator R&D	45	40	–12.2
HEP directed accelerator R&D	23	21	–4.7
Detector R&D	22	22	—
Facility operations and experimental support	30	32	5.6
Accelerator stewardship	10	14	40.0
Construction	37	56	51.6
Long-Baseline Neutrino Facility	12	16	33.3
Muon to Electron Conversion Experiment	25	40	60.0
SBIR/STTR	21	21	1.6
Total nuclear physics	595	625	4.9
Medium-energy nuclear physics	151	158	4.7
Research	36	38	7.7
Operations	97	100	3.1
SBIR/STTR and other	18	19	7.1
Heavy-ion nuclear physics	200	211	5.7
Research	34	36	7.5
Operations (primarily RHIC)	166	175	5.3
Low-energy nuclear physics	75	80	6.1
Research	48	52	7.7
Operations	27	28	3.1
Nuclear theory	43	46	7.2
Isotope development and production	20	22	9.1
Construction	106	107	0.9
CEBAF upgrade	16	7	–54.5
Facility for Rare Isotope Beams	90	100	11.1
Total fusion energy sciences	467	420	–10.2
Burning plasma science: Foundations	216	192	–11.2
Burning plasma science: Long pulse	39	31	–20.6
Discovery plasma science	62	47	–24.2
ITER	150	150	—
Total basic energy sciences	1 733	1 849	6.7
Materials sciences	352	362	3.0
Chemical sciences, geosciences, and energy biosciences	304	311	2.3
Energy frontier research centers	100	110	10.0
Energy innovation hubs	39	39	—
Total scientific user facility operations	877	922	5.1
Advanced Light Source, LBNL	60	63	4.5
Advanced Photon Source, ANL	125	130	4.5
National Synchrotron Light Source, BNL	5	0	–100.0
National Synchrotron Light Source II, BNL	90	110	21.7
Center for Nanophase Materials Sciences, ORNL	23	24	4.5
Center for Integrated Nanotechnologies, SNL/LANL	21	22	4.5
Molecular Foundry, LBNL	26	28	4.5
Center for Nanoscale Materials, ANL	23	24	4.5
Center for Functional Nanomaterials, BNL	20	21	4.5
Stanford Synchrotron Radiation Laboratory, SLAC	39	41	4.5
High Flux Isotope Reactor, ORNL	61	63	4.5
Manuel Lujan Jr Neutron Scattering Center, LANL	2	2	—
Spallation Neutron Source, ORNL	181	190	4.5
Linac Coherent Light Source, SLAC	127	133	4.5
Major equipment, research	74	71	–15.7

Department of Energy R&D programs (continued)

	FY 2015 actual	FY 2016 request	FY 2015–16 percent change
	(millions of dollars)*		
Construction	148	200	35.3
Linac Coherent Light Source II, SLAC	148	200	35.3
SBIR/STTR	50	55	8.7
Advanced scientific computing research	541	621	14.8
Biological and environmental research	592	612	3.4
Science laboratories and infrastructure	80	114	42.7
Program direction	184	187	2.0
Workforce development for teachers and scientists	19	20	5.1
Safeguards and security	93	103	10.7
Advanced Research Projects Agency–Energy	280	325	16.1
Fossil energy R&D	561	560	–0.1
Nuclear energy R&D	833	908	8.9
Energy efficiency and renewable energy R&D	1 914	2 723	42.3
Electricity delivery and energy reliability	147	270	83.8
Total National Nuclear Security Administration R&D	2 912	3 053	4.8
Total weapons science, technology, and engineering	1 952	2 003	2.6
Science campaigns	412	390	–5.5
Engineering campaigns	136	131	–3.4
Advanced simulation and computing	598	623	4.2
Inertial confinement fusion	513	502	–2.1
Directed stockpile work R&D†	185	226	22.2
Advanced manufacturing development	107	130	21.3
Nonproliferation and verification R&D	393	419	6.6
Naval reactors R&D	567	631	11.3
Environmental management R&D	14	17	23.5

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.
†Includes the R&D support and R&D certification and safety items of the directed stockpile work program.

ANL, Argonne National Laboratory. BNL, Brookhaven National Laboratory. CEBAF, Continuous Electron Beam Accelerator Facility. LANL, Los Alamos National Laboratory. LBNL, Lawrence Berkeley National Laboratory. ORNL, Oak Ridge National Laboratory. RHIC, Relativistic Heavy Ion Collider. SBIR, Small Business Innovation Research. SNL, Sandia National Laboratories. STTR, Small Business Technology Transfer.

NSF R&D programs

	FY 2015 actual	FY 2016 request	FY 2015–16 percent change
	(millions of dollars)*		
Total NSF	7 344	7 724	5.2
Research and related activities (R&RA)			
Mathematical and physical sciences (MPS)			
Mathematical sciences	232	235	1.6
Astronomical sciences	244	247	1.0
Physics	275	277	0.9
Chemistry	244	251	3.0
Materials research	307	316	2.9
Multidisciplinary activities	35	40	13.8
Total MPS	1 337	1 366	2.2
Geosciences (GEO)			
Atmospheric and geospace sciences	251	263	4.7
Earth sciences	177	188	6.2
Ocean sciences	356	370	3.8
Integrative and collaborative education and research	84	95	13.7
Polar programs	436	450	3.0
Total GEO	1 304	1 365	4.7
Engineering	892	949	6.4
Biological sciences	731	748	2.3
Computer & Information Science & Engineering (CISE)			
Advanced cyberinfrastructure	219	227	3.9
Computer and network systems	228	236	3.8
Computing and communication foundations	191	199	3.8
Information and intelligent systems	192	199	3.8
Information technology research	92	93	1.1
Total CISE	922	954	3.5
Arctic research commission	1	1	5.0
Social, behavioral, and economic sciences	272	291	7.1
Integrative activities	425	459	7.9
International activities	49	51	5.2
Total R&RA	5 934	6 184	4.3
Major research equipment and facilities construction	201	200	–0.2
Education and human resources	866	963	11.2
Agency operations and award management	325	355	9.2
National Science Board	4	4	—
Inspector general	14	15	5.1

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.

The National Nanotechnology Initiative, which involves 20 federal agencies, would total $1.5 billion, unchanged from its FY 2015 level. The $3 billion requested government-wide for science, technology, engineering, and mathematics (STEM) education represents a 3.6% increase from the current year.

Other government-wide administration spending priorities include the 13-agency US Global Change Research Program, for which $2.7 billion is requested. That is $200 million above this year's spending. Some $7.4 billion is requested for clean energy R&D, three-quarters of which would go to DOE.

Following are some highlights of the request for agencies that fund the bulk of R&D in the physical sciences.

Department of Energy

As the largest federal funder of physical sciences, DOE would see its R&D funding increase 19.2%, according to PHYSICS TODAY's analysis. By far the biggest increase in the department is for the energy efficiency and renewable energy (EERE) programs, which would rise 42.3%, to $2.7 billion. Within EERE, the budget increases funding by 32% above 2015 levels for alternative vehicle and fuel technologies, by 60% for energy efficiency and advanced manufacturing activities, and by 41% for innovative renewable-power projects. Congress has routinely slashed the administration's requests for EERE programs.

Funding for the national security R&D programs of DOE's National Nuclear Security Administration would move up 4.8%, to roughly $3.1 billion. But the inertial-fusion program would decline by 2.1%. The Mixed Oxide Fuel Fabrication Facility at the Savannah River Site in South Carolina would receive $345 million, the same as the current year. Energy secretary Ernest Moniz told reporters that DOE is following a congressional directive to continue the construction of the facility while the department awaits the results of an external analysis of potentially lower-cost alternatives to disposing of DOE's surplus weapons plutonium. The administration last year proposed to mothball the well-over-budget plant.

The department has identified six research focus areas that are relevant to multiple program offices. Those crosscutting programs are subsurface science and engineering, grid modernization, energy–water nexus, exascale computing, cybersecurity, and supercritical carbon dioxide technology.

Collectively, they account for $1.2 billion in R&D, and each is coordinated by the programs and the national laboratories that perform the research.

The Office of Science, which funds basic, nonweapons research, would move up 5.4%, to more than $5.3 billion. Each of its individual programs would get an increase except fusion energy sciences, which would drop 10.2%. Patricia Dehmer, acting director of the Office of Science, told reporters that Congress had increased the FY 2015 request and that the FY 2016 figure is a little higher than what the administration asked for in 2015. The $150 million requested for ITER, the international project to build a fusion reactor, is the same as last year, as the administration awaits a new project cost and schedule baseline due for completion this summer, she said. (See PHYSICS TODAY, February 2014, page 20.)

Included in the nuclear-physics budget is $100 million for constructing the Facility for Rare Isotope Beams at Michigan State University. That is a $10 million increase from the current year. The 12-GeV upgrade of the Continuous Electron Beam Accelerator Facility at Jefferson Lab would get $7 million, as the project nears its scheduled completion. Construction funding for the Linac Coherent Light Source II at SLAC would increase 35.3%, to $200 million.

The high-energy physics request includes $20 million for the Long-Baseline Neutrino Facility, which will evaluate transformations in muon neutrinos in a beam originating at Fermilab and traveling to a detector in South Dakota 1300 km away. In addition to $16 million in construction funds—up $4 million from the current year—another $4 million is requested for modifying the preliminary design to accommodate international participation in the project. The goal is to "achieve enhanced scientific capability through non-DOE contributions," according to budget documents. (See the story on page 22.)

The high-energy request also includes $40 million for construction of the Muon to Electron Conversion Experiment at Fermilab, a $15 million increase from the current year. Civil construction of the experiment, which will utilize a proton beam to produce muons and determine whether those muons can change into electrons, is scheduled to begin this year.

A 15% increase in the budget for advanced scientific computing research would support new research and partnerships working toward exascale computing. The leadership computing facilities at Argonne and Oak Ridge National Laboratories are scheduled for upgrades to the 75–200 petaflops range beginning in 2017.

More than $900 million of the Office of Science request is for basic research on clean-energy projects.

The administration proposes a new carbon capture and storage demonstration plant that will address natural-gas-fired electricity generation. At the same time, FutureGen, a long-stalled, cost-shared, coal-fired demonstration plant meant to capture and sequester CO_2 underground, was abandoned. Federal funding from the American Recovery and Reinvestment Act was set to expire in October, and litigation and other problems with the project will prevent use of the money before that deadline.

In another bid to accelerate commercial deployment of carbon capture and storage and spur development of new carbon-reducing technologies, the administration proposes two new tax credits. One would authorize $2 billion in refundable investment tax credits for electricity-generating plants that install carbon capture technology to permanently store CO_2. The second proposal would provide for qualifying facilities a 20-year, refundable sequestration tax

NASA R&D programs

	FY 2014 actual	FY 2015 enacted*	FY 2016 request	FY 2015–16 percent change
	(millions of dollars)†			
Total NASA	17 646	18 010	18 529	2.9
NASA R&D				
Total science	5 148	5 245	5 289	0.8
Planetary science				
Planetary science research	222	—	276	—
Discovery	297	—	156	—
Lunar quest	11	—	—	—
New frontiers	232	—	259	—
Mars exploration	288	—	412	—
Outer planets	152	—	116	—
Technology	143	—	142	—
Total planetary science	1 346	1 438	1 361	–5.3
Astrophysics				
Astrophysics research	145	—	188	—
Cosmic origins	224	—	199	—
Physics of the cosmos	113	—	108	—
Exoplanet exploration	107	—	64	—
Astrophysics explorer	90	—	150	—
Total astrophysics	678	684	709	3.5
James Webb Space Telescope	658	645	620	–4.0
Heliophysics				
Heliophysics research	185	—	158	—
Living with a star	212	—	343	—
Solar terrestrial probes	143	—	50	—
Heliophysics explorer	100	—	99	—
Total heliophysics	641	669	651	–1.7
Earth science				
Earth science research	457	—	485	—
Earth systematic missions	837	—	895	—
Earth system science pathfinder	257	—	268	—
Multimission operations	179	—	191	—
Technology	60	—	61	—
Applied sciences	35	—	48	—
Total Earth science	1 825	1772	1 947	9.9
Exploration				
Exploration systems development	3 115	3 245	2 863	–11.7
Exploration R&D	302	306	399	30.4
Commercial spaceflight	696	805	1 244	54.5
Total exploration	4 113	4 357	4 506	3.4
Aeronautics research	566	651	571	–12.3
Space technology	576	596	725	21.6
Space operations				
International Space Station	2 964	—	3 106	—
Space and flight support	810	—	898	—
Total space operations	3 774	3 828	4 004	4.6
Cross-agency support	2 793	2 759	2 843	3.0

*NASA's budget tables provide FY 2015 amounts only where figures were specified by Congress in the 2015 Omnibus Appropriations Act. Therefore, FY 2015–16 comparisons are not available for many programs.
†Figures are rounded to the nearest million. Changes are calculated from unrounded figures.

Department of Defense R&D programs

	FY 2015 actual	FY 2016 request	FY 2015–16 percent change
	(millions of dollars)*		
Research, development, test, and evaluation (RDT&E)			
Total basic research (6.1)	2 278	2 089	−8.3
US Army			
In-house independent research	13	13	−3.0
Defense research sciences	248	239	−3.7
University research initiatives	90	73	−19.1
University and industry research centers	109	100	−7.8
Total US Army	460	425	−7.6
US Navy			
University research initiatives	134	116	−12.7
In-house independent research	19	19	−0.1
Defense research sciences	497	452	−9.1
Total US Navy	650	587	−9.7
US Air Force			
Defense research sciences	390	330	−15.4
University research initiatives	147	142	−3.7
High-energy laser research	14	14	−1.2
Total US Air Force	551	485	−11.9
Defense-wide basic research programs†			
DTRA basic research initiative	38	38	1.7
Defense research sciences‡	332	333	0.3
Basic operational medical research science‡	61	57	−6.9
National defense education program	58	49	−15.3
Chemical and biological defense research	48	46	−4.1
Basic research initiatives	44	42	−5.6
Historically black colleges & universities/minority institutions	34	26	−24.9
Total defense-wide basic research programs	616	592	−4.0
Applied research (6.2)	4 648	4 713	1.4
Advanced technology development (6.3)	5 326	5 464	2.6
Total science and technology (6.1–6.3)	12 252	12 266	0.1
Other RDT&E§	51 755	57 710	11.5
Total RDT&E‖	64 007	69 976	9.3

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.
†Includes the basic research budgets of DOD agencies such as DARPA, the Defense Advanced Research Projects Agency; DTRA, the Defense Threat Reduction Agency; the Missile Defense Agency; and the Office of the Secretary of Defense.
‡The two categories that make up DARPA's basic research budget. The bulk of DARPA's budget is provided from the applied research (6.2) and advanced technology development (6.3) categories. DARPA's overall FY 2016 request is just under $3 billion, up 1.9% from the FY 2015 appropriation of $2.9 billion.
§Includes RDT&E categories 6.4 through 6.7.
‖Excludes $980 million requested in FY 2016 for medical research and $570 million requested for R&D in support of chemical and munitions destruction.

credit of $10 per metric ton if they use the captured CO_2 beneficially (such as in enhanced oil recovery), or $50 per ton if they permanently store the CO_2.

The Advanced Research Projects Agency–Energy, which supports research on high-risk, potentially high-payoff clean-energy technologies, would receive $325 million, 16.1% more than in the current year.

The $270 million requested for the electricity delivery and energy reliability program is $123 million, or 83.8%, above the FY 2015 level. The increase would step up grid modernization efforts and add $52 million for R&D on increasing grid cybersecurity.

The budget request includes $248 million to resume operations at the Waste Isolation Pilot Plant in New Mexico following last year's shutdown of the underground transuranic waste repository after a fire and a radiation leak. Full-scale operations at the plant won't occur until 2017, Moniz said.

NSF

A proposed 5.2% increase for NSF would take its budget to $7.7 billion. The education and human resources division would receive the biggest relative increase—11.2%—to $963 million. Funding for research and related activities, the source of NSF's peer-reviewed, investigator-initiated research grants, would rise 4.3%, to $6.2 billion. Mathematical and physical sciences would see an increase of 2.2%, to $1.4 billion. A new $75 million, cross-foundation focus on innovations at the nexus of food, energy, and water systems would be established, with participation from NSF's science, engineering, and social sciences programs.

Among other NSF-wide priorities, the budget proposes $377 million in research and education for renewable energy (solar, wind, wave, and geothermal) and alternative fuels, a 2% increase from FY 2015. Cyber-enabled materials, manufacturing, and smart systems would receive $257 million, an 11% increase over the previous year. But science, engineering, and education for sustainability and understanding humans' impact on the natural world would plunge 42%, to $80.5 million, in preparation for the program's termination in 2017.

Funding for the 8-meter, wide-field Large Synoptic Survey Telescope would increase to $100 million, from $80 million, for the third year of its scheduled nine-year construction phase. The NSF request also includes $81 million for the National Ecological Observatory Network, a reduction from the $96 million in the current year. The national network consists of 106 environmental monitoring stations that measure and predict the impacts of changing climate and land use and the effects of invasive species.

A 9.2% increase, to $355 million, is requested for agency operations and award management. The bulk of that increase is for the relocation of NSF headquarters from Arlington, Virginia, to Alexandria, Virginia, and for a cost-of-living adjustment for employees.

The two-year-old NSF-wide initiative on improving undergraduate STEM education would receive a 27.7% increase, to $135 million. The program goals are to increase the number, broaden the diversity, and improve the undergraduate preparation of STEM professionals.

NASA

Although the space agency would receive a 2.9% overall increase, its science programs would inch up less than 1%. At the time the budget was released, NASA was awaiting congressional approval for an annual operating plan first mandated in FY 2014. Pending that approval, the only firm numbers for comparison are the appropriation levels explicitly spelled out in the FY 2015 Omnibus Appropriations Act.

Earth science, with a 9.9% increase from this year's appropriation, is the winner among the astronomy fields. Funding is included for development of the *Landsat 9* and *Landsat 10* satellites, which are components of the multidecadal Sustainable Land Imaging program. Faring worse is planetary science, which would decline 5.3%, or $77 million. The reduction comes mainly from the program to formulate a mission to the Jovian moon Europa, for which Congress appropriated $100 million this year.

Despite a proposed 4% decline in year-to-year funding for the *James Webb*

Space Telescope, the $6.2 billion project remains on track for launch in 2018, NASA documents say.

Facing congressional opposition, the administration abandoned its proposal last year to ground the Stratospheric Observatory for Infrared Astronomy, a flying telescope mounted on a Boeing 747 and jointly operated with the German Aerospace Center. (See Politics and Policy, 12 June 2014, on PHYSICS TODAY's website.) The $85.2 million requested for the observatory is a 22% hike over the $70 million appropriated in FY 2015.

Aeronautics research would fall 12.3%, to $571 million, from the current-year appropriation. Congress had added substantially to the administration's FY 2015 request for those programs.

Human exploration would rise 3.8%, or $325 million, to $8.5 billion. Funding for development of the *Orion* deep-space crew vehicle would decline 8.2%, or $98 million, to $1.1 billion, and development of the heavy-lift rocket to propel *Orion* would be funded at $1.8 billion, a decrease of 20.2%, or $343 million below the current year. Both reductions were planned, however, and the two programs remain on track, according to NASA budget documents.

Funding for commercial crew development soars to $1.2 billion, a 54.5% increase from the FY 2015 amount. Boeing and SpaceX continue to develop their respective crew vehicles and launch systems to transport astronauts into orbit and to the International Space Station. The first manned flights are expected by the end of 2017.

The $3.1 billion requested for the space station is 1.8% more than the current year's request.

Department of Defense

Although the Pentagon's science and technology programs—basic, applied, and advanced technology development—would collectively increase by a mere 0.1%, to $12.3 billion, the basic research portion would drop 8.3%, to $2.1 billion. The basic research performed by universities for the Navy, Army, and Air Force totals $331 million. DOD's development programs, which mostly address specific weapons systems, would jump 11.5%, to $57.7 billion. Funding for the Defense Advanced Research Projects Agency would rise $57 million, to roughly $3 billion.

Department of Commerce

The largest component of a proposed 33% increase to the National Oceanic and Atmospheric Administration's R&D programs is the $147 million requested for the construction of a new ocean research vessel. Oceanic and atmospheric research programs, which include NOAA's climate change research efforts, would rise 12%, to $507 million, while coastal science and assessment programs would increase 7.5%, to $86 million.

Overall NIST funding would leap 30%, or $256 million, to $1.1 billion. The core laboratory research programs at NIST would rise 11.7%. The largest component of that increase is a $26.5 million addition to advanced manufacturing technology development. The agency's industrial technology programs (not shown in the table) would surge 122%, to $306 million, as part of the president's advanced manufacturing initiative. Much of that increase would finance the competitive selection of two new manufacturing institutes on technology subjects that are proposed by industry.

Department of Commerce (NOAA and NIST) R&D programs

	FY 2015 actual	FY 2016 request	FY 2015–16 percent change
	(millions of dollars)*		
National Oceanic and Atmospheric Administration R&D			
Total	657	874	33.0
NIST R&D			
Total	726	814	12.1
Scientific and Technical Research Services (STRS)†	675	755	11.7
Construction of research facilities	50	59	17.3

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.
†STRS includes NIST's laboratories.

Department of Homeland Security R&D programs

	FY 2015 actual	FY 2016 request	FY 2015–16 percent change
	(millions of dollars)*		
Total DHS R&D	1 320	993	–25.8
Domestic Nuclear Detection Office R&D	198	196	–1.0
Science and technology†			
Acquisition and operations support	—	47	—
Research, development, and innovation	—	435	—
APEX R&D‡	—	78	—
Border security	—	42	—
Chemical, biological, and explosive defense R&D	—	98	—
Counterterrorism R&D	—	57	—
Cybersecurity/information analytics R&D	—	67	—
First responder/disaster resilience R&D	—	93	—
University programs	—	31	—
Laboratory facilities	—	134	—
Management and administration	130	132	1.5
Total science and technology	1 104	779	–28.5
Coast Guard	18	18	1.0

*Figures are rounded to the nearest million. Changes are calculated from unrounded figures.
†Fiscal year 2015 appropriations for individual S&T categories were not available at press time.
‡APEX R&D projects are described as crosscutting, multidisciplinary projects that have been requested by DHS's numerous operating units.

Department of Homeland Security

The science and technology programs at the Department of Homeland Security address the needs of the DHS operational units and those of first responders at the state and local levels. A 28.5% drop in that request was mostly due to the full funding received in FY 2015 for construction of the National Bio and Agro-Defense Facility, a foreign animal and zoonotic disease R&D and testing center to support DHS and Department of Agriculture missions. The DHS appropriations bill was signed into law 4 March, and figures for the science and technology component programs were not available at press time.

R&D at the Domestic Nuclear Detection Office would decline by 1% from the previous year. The agency is developing alternative radiation-detecting backpack and handheld systems that do not use scarce helium-3. DNDO also is evaluating technologies to replace the fixed and mobile radiation portal monitors currently deployed at the nation's ports of entry. **David Kramer** ■