



Federal R&D Obligations Increase an Estimated 2.7% in FY 2018

by Christopher Pece¹

Federal obligations for research and development increased to an estimated \$121.5 billion in FY 2018, up 2.7% from FY 2017. Obligations for R&D plant increased 22.4% to \$3.2 billion during the same period. Obligations for research increased 2.3% to \$71.3 billion in FY 2018. Life sciences research, which accounts for 47.0% of all federal research obligations, declined 1.9% in FY 2018 to \$33.5 billion (table 1).

Data are from the latest edition of the Survey of Federal Funds for Research and Development, sponsored by the National Center for Science and Engineering Statistics within the National Science Foundation (NSF). Data for FY 2017 are actual amounts, and the FY 2018 data are preliminary.

Federal Funding for Research

In FY 2018, federal obligations for research (including both basic research and applied research) accounted for an estimated 58.6% (\$71.3 billion) of all federal R&D obligations, similar to the FY 2017 share of 58.8% (\$69.6 billion) (table 1). The Department of Health and Human Services (HHS), which includes the National Institutes of Health, accounted for the largest share (46.9%) of federal research obligations, with \$33.5 billion in FY 2018 (table 2).

The Department of Energy (DOE) accounted for 16.0% (\$11.4 billion) of this FY 2018 research total, followed by the Department of Defense (DOD) with 10.8% (\$7.7 billion), the National Aeronautics and Space Administration (NASA) with 8.7% (\$6.2 billion), NSF with 6.9% (\$5.0 billion), and the Department of Agriculture (USDA)

with 3.3% (\$2.3 billion). Together these six agencies accounted for 92.7% (\$66.1 billion) of all federal research obligations in FY 2018, a slight increase from their share of 91.5% (\$63.7 billion) in FY 2017. Individual agency shares of basic research versus applied research vary according to agency mission and objectives.

TABLE 1. Federal outlays and obligations for research, development, and R&D plant, by field of science and engineering for research obligations: FYs 2016–18 (Millions of dollars)

Type of R&D and field	2016	2017	Preliminary	
			2018	% change 2017–18
Outlays for R&D and R&D plant	111,156.0	112,587.3	123,936.0	10.1
R&D	108,927.9	109,380.5	118,733.8	8.6
R&D plant	2,228.1	3,206.8	5,202.2	62.2
Obligations for R&D and R&D plant	117,665.7	121,002.5	124,762.9	3.1
R&D	115,224.7	118,366.4	121,535.3	2.7
Research	66,873.6	69,641.8	71,262.7	2.3
Field of science and engineering				
Computer sciences and mathematics	4,222.8	3,894.2	4,183.5	7.4
Engineering	12,798.8	12,977.9	14,725.6	13.5
Environmental sciences	4,427.9	4,469.6	4,291.2	-4.0
Life sciences	32,045.4	34,089.6	33,458.9	-1.9
Physical sciences	6,669.8	6,581.5	6,931.3	5.3
Psychology	2,021.4	2,081.2	2,092.2	0.5
Social sciences	1,226.7	1,027.2	1,043.7	1.6
Other sciences nec	3,460.8	4,520.6	4,536.3	0.3
Experimental development	48,351.1	48,724.6	50,272.6	3.2
R&D plant	2,441.0	2,636.0	3,227.6	22.4

nec = not elsewhere classified.

NOTES: Because of rounding, detail may not add to total. Percentages are calculated using actual dollars reported.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Federal Funds for Research and Development.

TABLE 2. Federal obligations for research, by agency and type of research: FYs 2017–18
(Millions of dollars)

Agency	Preliminary		
	2017	2018	% change 2017–18
All agencies	69,641.8	71,262.7	2.3
Basic research	33,265.4	33,711.9	1.3
Applied research	36,376.4	37,550.8	3.2
Department of Agriculture	2,216.3	2,341.9	5.7
Basic research	965.2	1,006.8	4.3
Applied research	1,251.1	1,335.1	6.7
Department of Defense	7,178.0	7,690.7	7.1
Basic research	2,110.1	2,261.2	7.2
Applied research	5,068.0	5,429.4	7.1
Department of Energy	9,355.0	11,381.3	21.7
Basic research	4,494.3	4,930.3	9.7
Applied research	4,861.0	6,451.0	32.7
Department of Health and Human Services	33,677.4	33,453.9	-0.7
Basic research	16,700.1	16,733.5	0.2
Applied research	16,977.3	16,720.4	-1.5
National Aeronautics and Space Administration	5,745.3	6,234.4	8.5
Basic research	3,425.8	3,712.5	8.4
Applied research	2,319.5	2,521.9	8.7
National Science Foundation	5,517.6	4,950.3	-10.3
Basic research	4,739.1	4,279.5	-9.7
Applied research	778.6	670.8	-13.8
All other departments and agencies	5,952.2	5,210.4	-12.5
Basic research	831.0	788.1	-5.1
Applied research	5,121.3	4,422.2	-13.6

NOTES: Because of rounding, detail may not add to total. Percentages are calculated using actual dollars reported.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Federal Funds for Research and Development, FYs 2017–18.

Funding for Basic Research

Federal obligations for basic research² increased slightly, from \$33.3 billion in FY 2017 to an estimated \$33.7 billion in FY 2018 (table 2). In FY 2018, six agencies accounted for 97.7% (\$32.9 billion) of all federal obligations for basic research. Although HHS and NSF have traditionally accounted for the largest shares of federal basic research obligations, their respective shares of funding for basic research declined between FY 2017 and FY 2018. Specifically, HHS funded half (49.6% or \$16.7 billion) of all federal obligations for basic research in FY 2018, a slight decrease from its 50.2% share (\$16.7 billion) in FY 2017. DOE's share of basic research in FY

2018 increased to 14.6% (\$4.9 billion), up from 13.5% (\$4.5 billion) in FY 2017. DOE became the second-largest funder of basic research in FY 2018. As a result of both a 9.7% decrease in NSF basic research obligations and a 9.7% increase in basic research funding by DOE, NSF funded 12.7% (\$4.3 billion) of all federal basic research obligations in FY 2018, down from 14.2% (\$4.7 billion) in FY 2017. USDA's share of basic research remained steady at about 3.0% (\$1.0 billion).

Funding for Applied Research

Federal obligations for applied research³ increased 3.2% between FY

2017 and FY 2018, to an estimated \$37.6 billion (table 2). The six agencies obligating the largest amounts of total R&D accounted for 88.2% or \$33.1 billion in obligations for applied research in FY 2018, up from 85.9% or \$31.3 billion in FY 2017. Although HHS remains the largest funder of applied research among all federal agencies, its share declined from 45.9% in FY 2017 to 44.5% in FY 2018. At the same time, DOE's share increased from 13.3% of all federal funding for applied research funding in FY 2017 to 17.2% in FY 2018. Most other agencies remained relatively consistent with previous shares of funding. For example, DOD's share among all agencies increased slightly from 13.9% in FY 2017 to 14.5% in FY 2018, followed by NASA from 6.4% to 6.7%. USDA remained similar at 3.4% and 3.6% of all federal applied research funding. NSF's share decreased from 2.1% in FY 2017 to 1.8% in FY 2018.

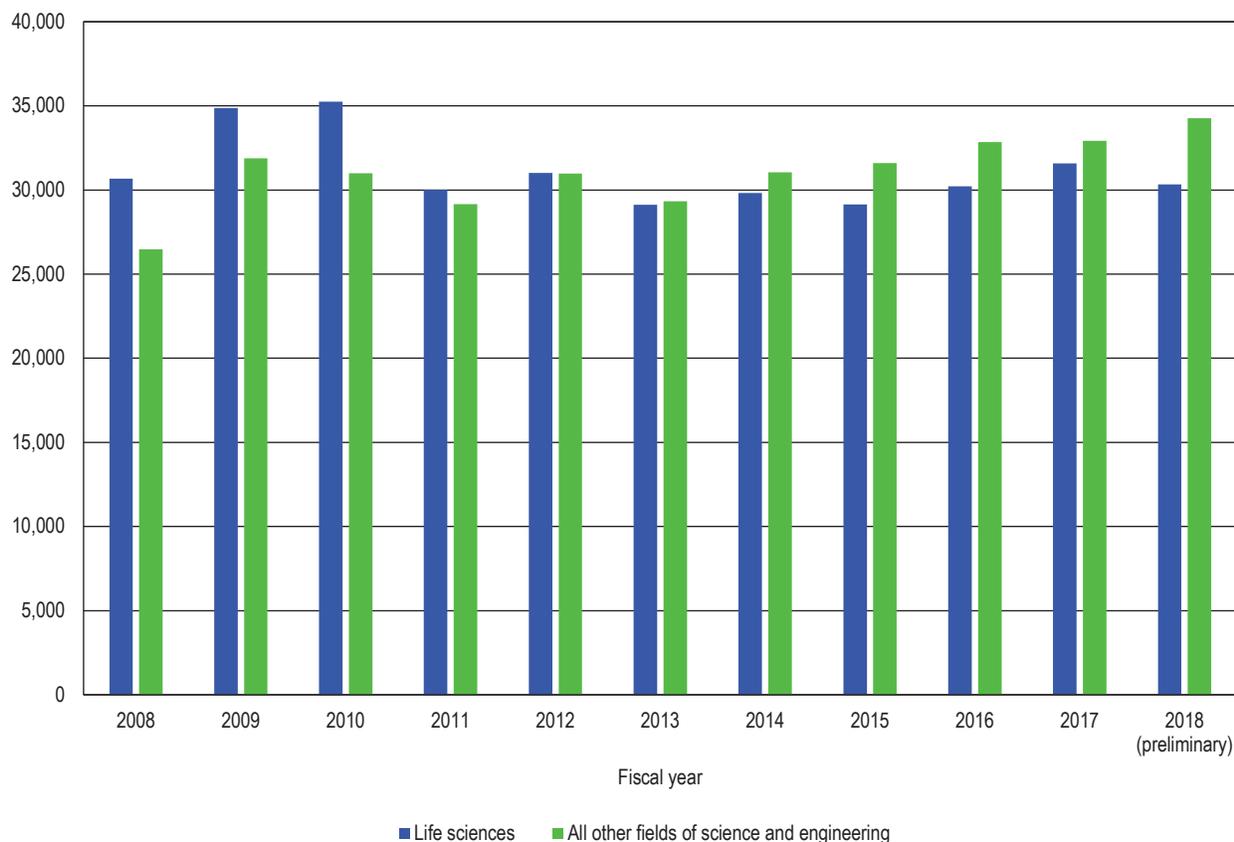
Research Funding by Fields of Science and Engineering

Among all fields of science and engineering, life sciences accounted for the largest share (47.0%) of all research obligations in FY 2018 (figure 1). When adjusted for inflation,⁴ federal obligations for research in life sciences have remained constant at nearly \$30 billion per year, with the exception of FY 2009 and FY 2010, which included additional funding through the American Recovery and Reinvestment Act of 2009. FY 2018 obligations for life sciences are down 1.1% in constant dollars compared to FY 2008. Since FY 2013, obligations for all other fields of science and engineering combined have continued to surpass obligations for life sciences.

When adjusted for inflation, federal obligations for engineering research have increased 40.3% in the past 10 years to \$13.4 billion in FY 2018 (figure 2).

FIGURE 1. Federal obligations for research and development for life sciences and all other fields of science and engineering: FYs 2008–18

Millions of constant 2012 dollars



NOTES: Gross domestic product implicit price deflators were used to convert current to constant dollars. Because of rounding, detail may not add to total. FYs 2009 and 2010 obligations include additional funding provided by the American Recovery and Reinvestment Act of 2009.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Federal Funds for Research and Development.

Computer sciences increased 17.4% since FY 2008, while obligations for physical sciences increased 16.8% during that period. Social sciences, on the other hand, have shown declines of 8.6% since FY 2008. In constant dollars, social sciences totaled \$947 million in FY 2018.

Experimental Development

Although DOD's share of obligations for research constituted 10.3% of total federal research obligations (\$7.2 billion) in FY 2017, their share of obligations for experimental development⁵ were much larger at 77.4% (\$37.7 billion of the \$48.7 billion total) (table 3). DOD's share of experimental devel-

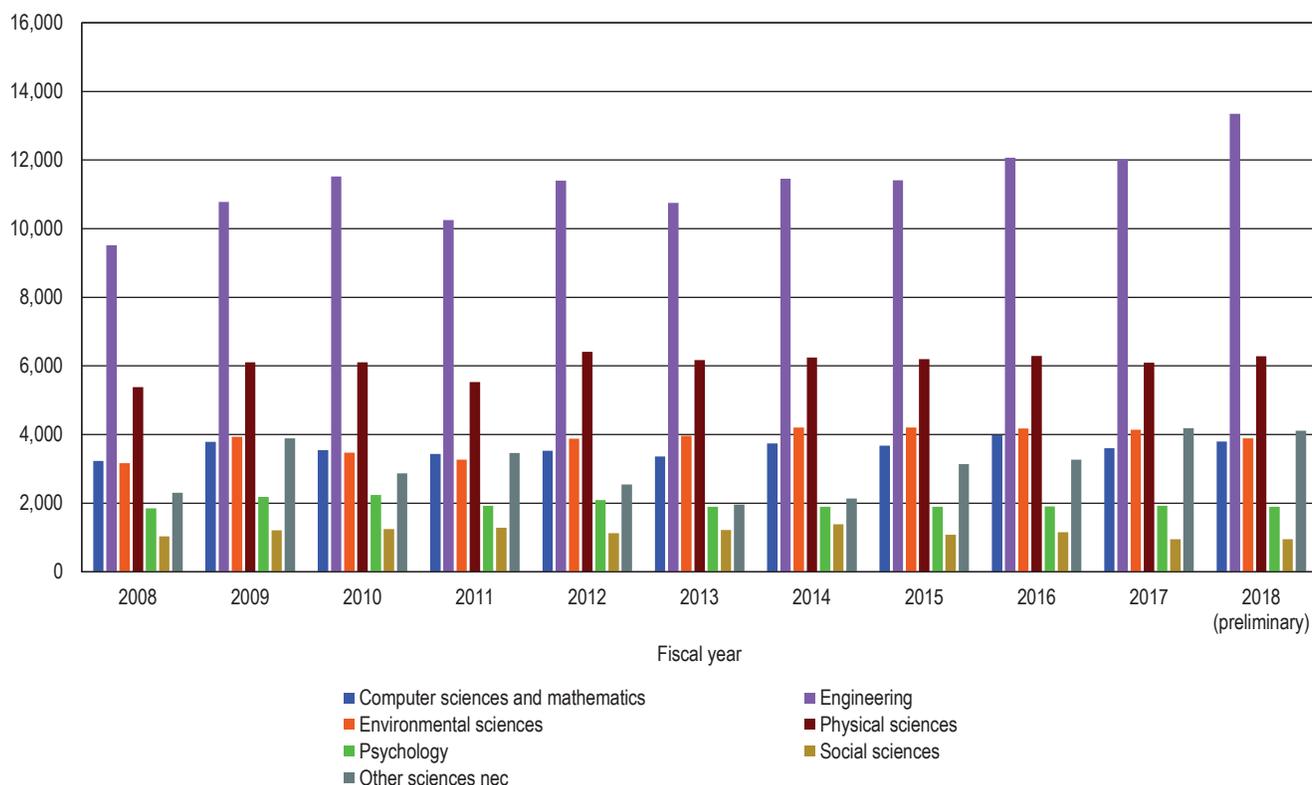
opment obligations increased further to 83.5% of the estimated FY 2018 total (\$42.0 billion of the \$50.3 billion total). NASA's experimental development obligations decreased from \$6.8 billion in FY 2017 to \$4.0 billion in FY 2018, as several programs were moved out of experimental development and into production. NASA accounted for 14.1% and 7.9% of total experimental development in FY 2017 and FY 2018, respectively. DOE had the third-largest amount of federal obligations for experimental development, and its share of total experimental development remained constant from FY 2017 to FY 2018 at 4.8% (approximately \$2.4 billion for both years).

R&D Performers

Of the \$121.5 billion in federal R&D obligations in FY 2018, the majority (72.7%, or \$88.3 billion) of this funding was to extramural performers (table 4). Different sectors rely on different agencies for the bulk of their federal R&D funds. For example, DOD accounts for 73.0% (\$27.3 billion) of all federal R&D obligations to industrial performers (\$37.4 billion). Similarly, DOE accounts for 61.7% (\$8.2 billion) of all R&D obligations to federally funded research and development centers (FFRDCs) (\$13.4 billion); NASA and DOD account for 16.8% (\$2.2 billion) and 12.9% (\$1.7 billion) of all R&D obligations to FFRDCs, respectively.

FIGURE 2. Federal obligations for research and development, by field of science and engineering, excluding life sciences: FYs 2008–18

Millions of constant 2012 dollars



nec = not elsewhere classified.

NOTES: Gross domestic product implicit price deflators were used to convert current to constant dollars. Because of rounding, detail may not add to total. FYs 2009 and 2010 obligations included additional funding through the American Recovery and Reinvestment Act of 2009.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Federal Funds for Research and Development.

TABLE 3. Federal obligations for experimental development, by agency: FYs 2017–18
(Millions of dollars)

Agency	Preliminary		
	2017	2018	% change 2017–18
All agencies	48,724.6	50,272.6	3.2
Department of Agriculture	202.1	195.8	-3.1
Department of Defense	37,694.6	41,980.4	11.4
Advanced technology	5,707.6	6,432.1	12.7
Major systems	31,987.0	35,548.3	11.1
Department of Energy	2,349.5	2,406.2	2.4
Department of Health and Human Services	92.4	69.5	-24.8
National Aeronautics and Space Administration	6,849.4	3,964.0	-42.1
National Science Foundation	0.0	0.0	0.0
All other departments and agencies	1,536.7	1,656.7	7.8

NOTES: Because of rounding, detail may not add to total. Percentages are calculated using actual dollars reported.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Federal Funds for Research and Development, FYs 2017–18.

TABLE 4. Preliminary federal obligations for research and development, by agency and performer: FY 2018

(Millions of dollars)

Agency	Total R&D	Intramural ^a	Extramural							
			United States and U.S. territories							
			Industry	Industry-administered FFRDCs	Universities and colleges	University-administered FFRDCs	Other nonprofits	Nonprofit-administered FFRDCs	State and local governments	Foreign
All agencies	121,535.3	33,217.7	37,442.5	5,077.3	28,899.3	5,041.1	7,474.0	3,231.8	552.1	599.6
Departments										
Department of Agriculture	2,537.7	1,543.3	33.1	0.0	929.0	0.0	21.5	0.0	8.5	2.1
Department of Commerce	1,570.9	1,140.6	58.3	0.0	343.5	3.8	13.0	1.2	9.2	1.2
Department of Defense	49,671.0	16,941.3	27,339.3	459.3	2,519.9	418.4	763.6	838.1	83.5	307.6
Department of Education	275.5	10.3	6.8	0.0	186.1	0.0	72.3	0.0	0.0	0.0
Department of Energy	13,787.5	1,535.9	2,815.3	3,896.3	1,035.2	2,169.4	150.1	2,177.7	7.5	0.0
Department of Health and Human Services	33,523.4	7,030.0	1,729.3	659.5	18,280.8	26.1	5,325.1	23.9	211.7	237.0
Department of Homeland Security	860.7	371.2	325.1	50.1	34.0	3.8	13.4	50.9	11.4	1.0
Department of Housing and Urban Development	74.0	60.8	8.0	0.0	1.8	0.0	3.4	0.0	0.0	0.0
Department of the Interior	853.6	756.9	17.6	0.0	48.2	0.2	3.6	0.0	27.1	0.0
Department of Justice	85.5	11.9	3.2	0.0	40.7	0.0	24.3	0.0	5.4	0.0
Department of Labor	5.0	3.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Department of State	2.1	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Department of Transportation	1,076.1	244.8	406.7	0.7	80.9	0.7	62.1	110.2	169.2	0.9
Department of the Treasury	9.1	8.4	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Department of Veterans Affairs	737.9	737.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other agencies										
Administrative Office of the U.S. Courts	6.8	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0
Agency for International Development	192.2	10.9	0.0	0.0	47.5	0.0	130.3	0.0	0.0	3.4
Appalachian Regional Commission	0.4	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0
Consumer Product Safety Commission	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Environmental Protection Agency	493.3	255.1	186.5	0.0	51.7	0.0	0.0	0.0	0.0	0.0
Federal Communications Commission	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Federal Trade Commission	6.7	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Library of Congress	2.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
National Aeronautics and Space Administration	10,198.4	2,222.9	4,170.3	0.9	1,095.8	2,220.8	432.9	14.7	8.5	31.7
National Archives and Records Administration	0.5	0.4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
National Science Foundation	4,950.3	11.7	196.1	0.2	4,192.8	193.9	332.6	0.2	10.0	12.8
Nuclear Regulatory Commission	61.7	28.4	6.6	10.4	1.9	4.0	0.4	8.1	0.0	1.9
Patient-Centered Outcomes Research Trust Fund	120.2	0.0	0.0	0.0	0.0	0.0	120.2	0.0	0.0	0.0
Smithsonian Institution	209.0	209.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Social Security Administration	136.6	64.0	58.5	0.0	8.8	0.0	5.3	0.0	0.0	0.0
Tennessee Valley Authority	6.1	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
U.S. Postal Service	73.5	0.0	73.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

FFRDC = federally funded research and development center.

^a Intramural activities cover costs associated with the administration of intramural R&D programs and extramural R&D procurements by federal personnel as well as actual intramural performance.

NOTES: Because of rounding, detail may not add to total.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Federal Funds for Research and Development, FYs 2017–18.

HHS R&D obligations to nonprofit institutions accounted for 71.2% (\$5.3 billion) of total obligations (\$7.5 billion). Higher education institutions receive 63.3% (\$18.3 billion) of R&D obligations from HHS, whereas NSF provides 14.5% (\$4.2 billion) of the higher education R&D total. Foreign R&D performance accounted for less than 1% of total extramural federal obligations in FY 2018, nearly \$600 million, mostly funded by DOD (\$308 million) and HHS (\$237 million).

Data Sources and Limitations

The survey is a census of all federal agencies that fund R&D programs, as identified from information in the president's budget submission to Congress. Federal agencies that fund R&D are identified in the budget's Analytical Perspectives section and the detailed budget estimates by agency section of the appendix. Data were obtained from 32 federal agencies (15 federal departments and 17 independent agencies) that had obligations for R&D during FY 2017 or FY 2018. Because multiple subdivisions of some federal departments completed the survey, there were 78 agency-level responses: five federal departments, 56 agencies (within another 10 federal departments), and 17 independent agencies. The survey collects data on outlays for total R&D and R&D plant; obligations for R&D by type of R&D, by type of performer, and by state-area and foreign country; obligations for research by fields of science and engineering; and obligations for R&D plant.

Volume 67 of the Survey of Federal Funds for Research and Development collected final FY 2017 data and preliminary FY 2018 totals. FY 2018 data are subject to revision when collected under next year's volume 68 of the survey.

Beginning with volume 66 of the Survey of Federal Funds for Research and Development (FYs 2016 and 2017), the totals reported for development obligations and outlays represent a refinement to this category by more narrowly defining it to be "experimental development" to align with federal R&D budget formulation as per the Office of Management and Budget's Circular A-11, Section 84. As a result, totals for experimental development do not include the DOD budget activity 7 (Operational Systems Development) obligations and outlays. Those funds, previously included in DOD's development totals, support the development efforts to upgrade systems that have been fielded or have received approval for full-rate production and anticipate production funding in the current or subsequent fiscal year. Therefore, the development data and total R&D data are not directly comparable with totals reported prior to FY 2016.

Obligations represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when the funds were appropriated and when future payments of money are required. This includes funds from direct appropriations, trust funds, special accounts, fees and charges, and other federal sources for the year of the obligation. Obligations include the full cost of R&D, both specific project costs and overhead costs. Interagency transfers for R&D are reported by the transferring agency as R&D or R&D plant, not by the agency receiving the funds.

The full set of detailed statistical tables for volume 67 of the Survey of Federal Funds for Research and Development (FYs 2017 and 2018) will be available online at <https://www.nsf.gov/statistics/srvyfedfunds/#tabs-2>. Individual tables may be available in advance of the full

report. For more information, please contact the author.

Notes

1. Christopher Pece, Research and Development Statistics Program, National Center for Science and Engineering Statistics, National Science Foundation, 2415 Eisenhower Ave., Suite W14200, Alexandria, VA 22314 (cpece@nsf.gov; 703-292-7788).

2. Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts. Basic research may include activities with broad or general applications in mind, such as the study of how plant genomes change, but it should exclude research directed toward a specific application or requirement, such as the optimization of the genome of a specific crop species.

3. Applied research is original investigation undertaken to acquire new knowledge. Applied research is, however, directed primarily toward a specific practical aim or objective.

4. Gross domestic product implicit price deflators were used to convert current to constant dollars. Data on federal fiscal year, historical figures, 1953–2018 can be found in Office of Management and Budget. 2019. Budget of the U.S. Government, Fiscal Year 2020. Historical Tables (Table 10.1). <https://www.govinfo.gov/features/budget-fy2020>. Data on projections, 2019–2021 can be found in Office of Management and Budget. 2019. Economic assumptions and overview. In Analytical Perspectives, Budget of the U.S. Government, Fiscal Year 2020. <https://www.whitehouse.gov/wp-content/uploads/2019/03/spec-fy2020.pdf>.

5. Experimental development is creative and systematic work, drawing on knowledge gained from research and practical experience, which is directed at producing new products or processes or improving existing products or processes. Like research, experimental development will result in gaining additional knowledge. This includes the production of materials, devices, and systems or methods, including the design, construction, and testing of experimental prototypes, as well as technology demonstrations, in

cases where a system or component is being demonstrated at scale for the first time and where it is realistic to expect additional refinements to the design (feedback R&D) following the demonstration. However, not all activities that are identified as “technology demonstrations” are R&D. Activities excluded from experimental development are user demonstrations where the cost and benefits of a system are being validated for a specific use case. This includes low-rate initial production activities and pre-production develop-

ment, which is defined as non-experimental work on a product or system before it goes into full production, including activities such as tooling and development of production facilities. For example, agencies exclude activities and programs that are categorized as “Operational Systems Development” in DOD’s budget activity structure. Activities and programs of this type should generally be reported as investments in other major equipment.