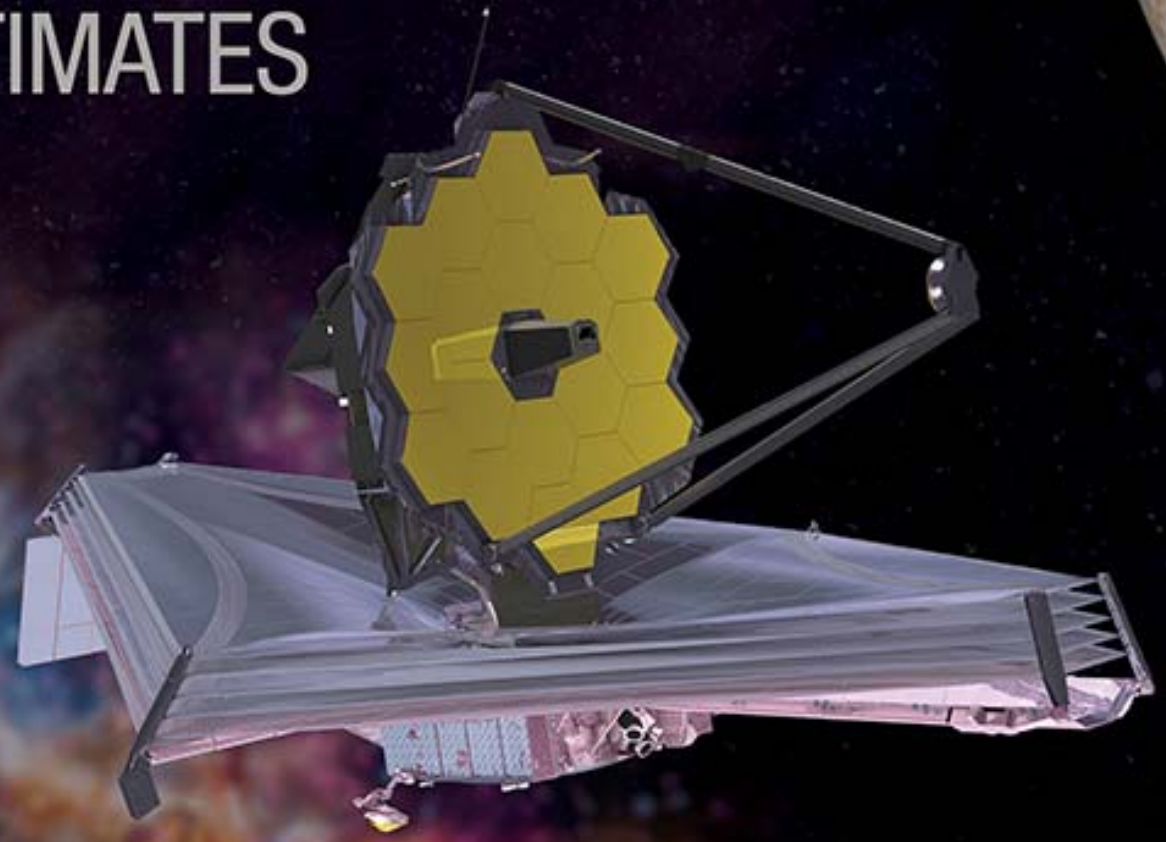
National Aeronautics and Space Administration

SCIENCE MISSION DIRECTORATE
FY 2018 BUDGET ESTIMATES



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FY 2018 Program Highlights

- Supports formulation of the **Europa Clipper** mission
- Includes an SMD-wide initiative to use CubeSats/SmallSats to advance selected high-priority science objectives in a cost-effective way
- Supports formulation of **WFIRST**
  - Entered Phase A formulation in February 2016
  - FY 2018 and notional outyear budget profile supports launch as early as 2025
  - Independent review of science, cost and schedule completed this summer
- Supports launch of **ICON, GRACE-FO, InSight, ICESat-2, TESS**, and **SPP** in FY 2018, and final preparations of **Webb** for launch in October 2018
- Funds all operating missions (except NASA support of **DSCOVR**)
- Supports interagency space weather efforts, as outlined in the Space Weather Action Plan
- Supports all planned activities in the STEM Science Activation project, unchanged by the proposed termination of the Office of Education

Science Budget Request Summary

	Actual	Enacted	Request	Notional			
	FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22
Science	**5,584.1**	**5,764.9**	**5,711.8**	**5,728.7**	**5,728.7**	**5,728.7**	**5,728.7**
Earth Science	**1,926.6**		**1,754.1**	**1,769.1**	**1,769.1**	**1,769.1**	**1,769.1**
Earth Science Research	477.7		406.7	435.1	441.1	459.7	477.8
Earth Systematic Missions	914.6		778.0	787.1	755.0	708.7	680.4
Earth System Science Pathfinder	233.6		264.5	243.8	256.0	271.5	268.3
Earth Science Multi-Mission Operations	192.4		196.5	194.1	200.7	208.6	218.6
Earth Science Technology	60.7		60.4	59.7	63.6	65.9	67.8
Applied Sciences	47.6		47.9	49.3	52.8	54.7	56.3
Planetary Science	**1,628.0**		**1,929.5**	**1,921.4**	**1,916.4**	**1,911.4**	**1,911.4**
Planetary Science Research	274.0		291.5	295.1	298.4	298.9	304.7
Discovery	189.0		306.1	425.4	488.3	376.8	375.2
New Frontiers	194.0		82.1	121.7	169.4	227.8	307.0
Mars Exploration	513.0		584.7	562.5	530.4	356.9	450.7
Outer Planets and Ocean Worlds	261.0		457.9	318.1	229.3	446.2	267.2
Technology	197.0		207.2	198.6	200.6	204.8	206.6
Astrophysics	**762.4**		**816.7**	**1,045.8**	**1,153.2**	**1,200.6**	**1,200.4**
Astrophysics Research	192.8		204.4	220.5	225.4	261.9	288.1
Cosmic Origins	195.6		191.6	190.0	142.0	157.8	156.4
Physics of the Cosmos	125.3		99.9	109.4	111.1	93.6	93.7
Exoplanet Exploration	141.2		176.0	350.8	473.3	475.8	440.2
Astrophysics Explorer	107.6		144.7	175.1	201.3	211.5	222.1
James Webb Space Telescope	**620.0**	**569.4**	**533.7**	**304.6**	**197.2**	**149.8**	**150.0**
Heliophysics	**647.2**		**677.8**	**687.8**	**692.8**	**697.8**	**697.8**
Heliophysics Research	160.0		200.2	217.2	214.8	219.0	219.5
Living with a Star	337.1		381.0	255.9	123.3	118.9	122.1
Solar Terrestrial Probes	49.5		37.8	97.9	171.5	185.1	191.1
Heliophysics Explorer Program	100.6		58.9	116.8	183.1	174.9	165.1

Planetary Science Program Content

	Actual FY 16	Enacted FY 17	Request FY 18	Notional FY 19	Notional FY 20	Notional FY 21	Notional FY 22
Planetary Science	**1,628.0**		**1,929.5**	**1,921.4**	**1,916.4**	**1,911.4**	**1,911.4**
Planetary Science Research	274.0		291.5	295.1	298.4	298.9	304.7
Planetary Science Research and Analysis	163.2		197.9	201.2	201.2	201.2	201.2
Near Earth Object Observations	50.0		50.0	50.0	50.0	50.0	50.0
Other Missions and Data Analysis	60.8		43.6	43.9	47.2	47.7	53.5
Rosetta	12.4		5.4	-	-	-	-
Planetary Data System	15.0		15.4	15.6	16.2	16.3	16.4
Astromaterial Curation	8.5		10.1	10.4	10.6	10.9	10.9
Robotics Alliance	4.3		4.1	4.1	4.1	4.1	4.1
Science Data & Computing	2.3		2.5	2.7	2.7	2.8	2.8
Joint Robotics Program for Exploration	10.0		-	-	-	-	-
Science Innovation Fund	5.0		-	-	-	-	-
Directorate Management	3.3		-	-	-	-	-
Planetary Science Directed R&T	-		6.1	11.1	13.6	13.6	19.3

Astrophysics Program Content

	Actual FY 16	Enacted FY 17	Request FY 18	Notional FY 19	Notional FY 20	Notional FY 21	Notional FY 22
Astrophysics	**762.4**		**816.7**	**1,045.8**	**1,153.2**	**1,200.6**	**1,200.4**
Astrophysics Research	192.8		204.4	220.5	225.4	261.9	288.1
STEM Science Activation	37.0		44.0	44.6	45.9	47.0	48.7
Astrophysics Research and Analysis	69.7		74.1	81.4	82.6	84.2	84.2
Balloon Project	36.2		37.3	40.4	39.9	40.4	37.4
Other Missions and Data Analysis	49.9		49.1	54.1	57.1	90.3	117.8
Astrophysics Data Curation and Archival	18.7		18.8	18.9	18.9	18.9	18.9
Astrophysics Data Program	17.6		17.6	18.1	18.4	18.6	18.6
Astrophysics Senior Review	-		-	-	-	30.6	54.1
Contract Administration, Audit & QA Svcs	12.1		12.7	12.7	12.8	12.8	13.1
Astrophysics Directed R&T	1.5		-	4.5	7.0	9.5	13.2
Cosmic Origins	195.6		191.6	190.0	142.0	157.8	156.4
Hubble Space Telescope	98.3		83.3	83.3	83.3	98.3	98.3
SOFIA	83.6		79.9	79.8	39.8	16.6	-
Other Missions and Data Analysis	13.7		28.4	26.9	18.9	42.9	58.1
Cosmic Origins Future Missions	0.8		0.2	1.5	1.5	28.0	43.1
SIRTF/Spitzer	3.9		11.0	9.5	3.5	-	-
Herschel	2.4		-	-	-	-	-
Cosmic Origins SR&T	3.6		14.3	13.0	11.1	12.1	12.1
Cosmic Origins Program Management	3.0		2.9	2.9	2.9	2.9	2.9

Heliophysics Program Content

	Actual FY 16	Enacted FY 17	Request FY 18	Notional FY 19	Notional FY 20	Notional FY 21	Notional FY 22
Heliophysics	**647.2**		**677.8**	**687.8**	**692.8**	**697.8**	**697.8**
Heliophysics Research	160.0		200.2	217.2	214.8	219.0	219.5
Heliophysics Research and Analysis	36.3		49.9	58.2	58.6	58.6	58.6
Sounding Rockets	49.8		59.0	61.1	63.1	63.1	63.1
Research Range	21.6		24.1	25.5	25.5	25.6	25.6
Other Missions and Data Analysis	52.2		67.1	72.4	67.6	71.7	72.2
CubeSat	5.0		15.0	15.0	10.0	10.0	10.0
Voyager	5.7		5.6	5.6	5.5	5.5	5.5
SOHO	2.2		2.2	2.3	2.3	2.3	2.4
Wind	2.2		2.2	2.2	2.2	2.2	2.2
Geotail	0.4		0.2	0.2	0.2	0.2	0.2
Space Science Mission Ops Services	11.5		11.5	11.6	11.9	11.9	11.9
Data & Modeling Services	2.6		2.7	3.0	3.0	3.0	3.0
Space Physics Data Archive	2.3		2.3	2.3	2.3	2.3	2.3
Community Coordinated Modeling Center	2.2		2.3	2.3	2.4	2.4	2.4
Solar Data Center	1.0		1.2	1.3	1.1	1.2	1.2
Guest Investigator Program	10.5		15.2	20.0	20.0	20.0	20.0
Science Planning and Research Support	6.6		6.7	6.7	6.7	6.7	6.8
Directed Research & Technology	-		-	-	-	3.9	4.2

Earth Science Program Content

	Actual FY 16	Enacted FY 17	Request FY 18	Notional FY 19	Notional FY 20	Notional FY 21	Notional FY 22
Earth Science	**1,926.6**		**1,754.1**	**1,769.1**	**1,769.1**	**1,769.1**	**1,769.1**
Earth Science Research	477.7		406.7	435.1	441.1	459.7	477.8
Earth Science Research and Analysis	347.2		287.8	296.5	299.6	313.7	309.1
Earth Science R&A	158.6		121.3	142.4	149.8	158.0	148.4
Interdisciplinary Science	75.4		62.2	57.0	58.1	62.8	65.4
Airborne Science	49.3		50.0	42.9	36.5	37.1	38.1
Space Geodesy	24.8		24.0	24.0	24.5	24.9	25.5
Global Modeling & Assimilation Office	11.0		10.4	10.4	10.7	10.9	11.1
Fellowships and New Investigators	6.9		8.9	8.9	8.9	8.9	9.1
GLOBE	6.0		6.0	6.0	6.0	6.0	6.2
Carbon Cycle Science Team	2.5		2.5	2.5	2.5	2.6	2.7
Ozone Trends Science	2.5		2.5	2.5	2.5	2.6	2.7
Carbon Monitoring System	10.0		-	-	-	-	-
Computing and Management	130.5		118.9	138.6	141.4	146.0	168.7
High End Computing Capability	43.6		32.5	47.5	48.4	49.1	50.4
Scientific Computing	21.8		21.8	21.5	22.2	22.5	23.2
Directorate Support	53.1		64.6	66.4	64.9	66.5	67.8
Earth Sci Directed Research & Technology	12.0		0.0	3.2	6.0	7.8	27.3

SCIENCE CoF

FY 2018 Budget

Budget Authority (in $ millions)	Actual FY 2016	Enacted FY 2017	Request FY 2018	Notional FY 2019	FY 2020	FY 2021	FY 2022
Total Budget	4.6	--	15.0	0.0	0.0	0.0	0.0

FY 2016 reflects funding amounts specified in Public Law 114-113, Consolidated Appropriations Act, 2016, as executed under the Agency's current FY 2016 Operating Plan.

FY 2017 Enacted reflects the funding amounts specified in Division B of the Consolidated Appropriations Act, 2017, P.L. 115-31. Table does not reflect emergency supplemental funds also appropriated in FY 2017, totaling $184 million.

Artist's rendering of the fully populated modular computing facility, which will house energy efficient supercomputing modules.

Science CoF typically provides construction required to support NASA's programs in Earth Science, Planetary Science, Astrophysics, and Heliophysics. However, it also includes construction for NASA's High End Computing Capability (HECC) Program, which the Science Mission Directorate, as the biggest user, manages for the Agency. Construction for HECC directly supports the Aeronautics, Human Exploration and Operations, Science, and Space Technology Missions. Funds required for the planning and design of out-year programmatic construction remain in the applicable program accounts.

EXPLANATION OF MAJOR CHANGES IN FY 2018

None.

ACHIEVEMENTS IN FY 2016

In FY 2016, NASA completed a proof-of-concept prototype for the MSF at ARC. Rather than meeting computing requirements through the expansion of capability within conventional facilities, this pilot project constructed lower cost modular container-based capability adjacent to the NASA Advanced Supercomputing Facility at ARC. The MSF comprises a well-integrated computing module (including the superstructure of a container and the supporting power distribution and cooling equipment) sitting on top of a concrete pad. The prototype demonstrates the feasibility of new energy-efficient and water-conserving modular computing technology, enabling the increase of NASA's supercomputing capability with minimal impact on limited energy and water resources.

NASA also awarded a contract for procurement and installation of three fuel tanks to improve aircraft operations at the AFRC. In addition to increasing operational efficiency, the new fuel tanks will address significant safety concerns, bringing operations into compliance with local building and fire codes. The

SCIENCE CoF

project directly benefits NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA), as well as Airborne Research activities in Earth Science.

WORK IN PROGRESS IN FY 2017

In October 2016, site preparation began for the AFRC fuel tank installation. The new tanks are scheduled to be operational in summer 2017.

KEY ACHIEVEMENTS PLANNED FOR FY 2018

In FY 2018, NASA will proceed with the Modular Supercomputing Facility at Ames Research Center, providing the infrastructure and utilities required to support the modular container-based capability.

Science Discrete Construction of Facilities Projects

Ames Research Center
Modular Supercomputing Facility
FY 2018 Estimate: $15.0 million; Total Construction Project Cost: $25.0 million (FY 2017 $2.7 million)

This project provides the infrastructure and utilities to support 16 modular containerized data units that will provide supercomputing capability necessary to meet NASA's mission requirements.

The project provides a flexible, cost effective, energy efficient and environmentally friendly solution to expand NASA's supercomputing capability. This agile, high performance solution has a low life cycle cost, and ensures there is the flexibility to adjust for the fast-changing technology with minimal risk. The project will support an additional 200 percent of current high-end computing capacity, enabling groundbreaking discoveries in all Mission Directorates.

This project is essential in allowing NASA's scientists and engineers to utilize supercomputing to meet NASA's mission goals and objectives. The existing facility cannot support future needs due to constraints in power and cooling

Supports all Mission Directorates.

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Supports all Mission Directorates.

Earth Science Program Content (cont'd)

	Actual FY 16	Enacted FY 17	Request FY 18	Notional FY 19	Notional FY 20	Notional FY 21	Notional FY 22
Earth Science Multi-Mission Operations	192.4		196.5	194.1	200.7	208.6	218.6
Multi-Mission Operations	168.0		170.5	166.8	172.1	179.6	186.2
MEaSUREs	-		14.0	14.0	14.0	14.0	14.0
EOSDIS	24.4		12.1	13.3	14.5	15.0	18.4
Earth Science Technology	60.7		60.4	59.7	63.6	65.9	67.8
Instrument Incubator	28.3		28.6	28.6	29.5	29.9	30.7
Advanced Technology Initiatives	18.1		17.7	17.1	19.7	21.3	22.1
Advanced Info Systems technology	14.3		14.1	14.1	14.5	14.7	15.1
Applied Sciences	47.6		47.9	49.3	52.8	54.7	56.3
Applications	22.8		26.4	26.0	28.6	29.7	31.0
Capacity Building	11.9		11.1	12.9	13.7	14.3	14.5
Disaster Support	5.5		5.5	5.5	5.5	5.7	5.7
Mission and Applied Research	7.4		5.0	4.9	5.0	5.0	5.1

SMD Projects Supporting Archives and Computational Capabilities

	FY16	FY17	FY18	FY19	FY20	FY21	FY22
Total	272.8	280.9	279.9	276.6	284.0	292.8	301.3
Planetay Science	17.3	16.9	17.9	18.3	18.9	19.1	19.2
Planetary Data System	15.0	14.5	15.4	15.6	16.2	16.3	16.4
Science Data and Computing	2.3	2.4	2.5	2.7	2.7	2.8	2.8
Astrophysics Data Curation and Archival	18.7	16.9	18.8	18.9	18.9	18.9	18.9
Heliophysics	3.3	3.4	3.5	3.6	3.4	3.5	3.5
Space Physics Data Archive	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Solar Data Center	1.0	1.1	1.2	1.3	1.1	1.2	1.2
Earth Science	233.4	243.7	224.7	235.9	242.7	251.3	259.8
High-End Computing Capability	43.6	44.7	32.5	47.5	48.4	49.1	50.4
Scientific Computing	21.8	21.3	21.8	21.5	22.2	22.5	23.2
Multi-Mission Operations	168.0	177.7	170.5	166.8	172.1	179.6	186.2
Modular Supercomputing Facility			15.0				