

NASA Rebounds in 2008 With \$1.1 Billion Increase

AAAS R&D Funding Update on R&D in the FY 2008 NASA Budget

(This analysis is a preview of the NASA chapter in the forthcoming *AAAS Report XXXII: Research and Development FY 2008*, a comprehensive look at the President's budget for R&D in FY 2008. This analysis contains revised AAAS estimates of NASA R&D, different from figures originally presented in the President's budget. More tables and continually updated supplemental materials on R&D in the FY 2008 budget can be found on the AAAS R&D Web site at <http://www.aaas.org/spp/rd>.)

Highlights

- The National Aeronautics and Space Administration (NASA) suffers a budget setback in 2007 but looks to rebound with a \$1.1 billion requested increase in 2008 over the final 2007 appropriation. The \$17.3 billion 2008 request would be a 6.5 percent increase, of which \$12.6 billion would go for R&D activities (up 6.7 percent; see Table II-12).
- The Constellation Systems program to develop the new Crew Exploration Vehicle and Crew Launch Vehicle would increase 10 percent from 2007 to \$3.1 billion in 2008. Funding shortfalls in 2007 and project delays recently led NASA to push back the launch date from 2014 to 2015 at the earliest. Construction of the International Space Station, now in full gear with the return of the Space Shuttle to flight, would require \$2.2 billion next year, up \$503 million from this year.
- Increases for these two big-ticket programs would leave NASA's research-oriented programs in decline. Although NASA would protect the Science program of earth science, earth observations, astronomy, planetary science, and robotic missions from cuts (up 2.4 percent to \$5.5 billion), aeronautics research would plummet 20 percent to \$554 million and the remnants of the life and physical sciences effort would be \$183 million, less than half last year's funding level. Even within the Science portfolio, a downscaling of funding from previous plans has led to cancellations or delays of many missions and projects.

NASA R&D in the FY 2008 Budget

The National Aeronautics and Space Administration (NASA) continues to forge ahead with its full program of flying the Space Shuttle, building the Space Station, funding research across a broad range of disciplines, and developing the next generation of space vehicles as part of the Vision for Space Exploration, but tight budget constraints in the overall federal budget and NASA Administrator Michael Griffin's promise to do everything within a budget rising no faster than the rate of inflation are forcing tough choices in the agency's priorities. NASA's total budget of \$17.3 billion in FY 2008 would be \$1.1 billion or 6.5 percent more than the current year because of a recently finalized 2007 appropriation that fell well below what NASA requested (see Table II-12), but the new budget would only bring funding roughly even or down slightly in real terms compared with past budgets (see Figure 1).

NASA's R&D funding would climb \$788 million or 6.7 percent to \$12.6 billion (see Table II-12 and Figure 1), continuing a rebound from a dismal 2005 when Shuttle cost overruns forced the agency to siphon money from R&D programs to the non-R&D Shuttle. **But efforts to develop next-generation human space vehicles to replace the Shuttle and ramped-up construction of the International Space Station (ISS) would take up the entire R&D increase and more, leaving all other NASA R&D programs combined with declining funding.** NASA's Constellation Systems program aims to develop a new Orion Crew Exploration Vehicle (CEV) and Ares 1 Crew Launch Vehicle (CLV) to replace the Space

Shuttle as the primary means of getting humans into space. This large program to fund development of the CEV, CLV, and related technologies is part of the President's Vision for Space Exploration, announced in 2004, to get humans back to the moon and onward to Mars. Funding quadrupled from just \$422 million in 2005 to \$1.7 billion last year, and increased again to \$2.8 billion in 2007. The 2008 budget would further boost funding 10.2 percent or \$285 million to \$3.1 billion. Although the goal is to have the new vehicles ready by 2014, a nearly half-billion dollar shortfall in the final 2007 appropriation from the 2007 request and project delays have caused NASA to recently push back the projected launch date to 2015 or later. The Vision for Space Exploration calls for the new vehicles to launch in 2014, and the NASA Authorization Act of 2005 calls on them to launch as close to 2010 as possible.

The International Space Station (ISS) budget would climb 29 percent or \$503 million to \$2.2 billion in 2008, partly because of a transfer of support costs from Constellation Systems to the ISS account and partly for a ramped-up construction schedule aiming for final assembly of the Station in 2010, followed by full operations through 2016.

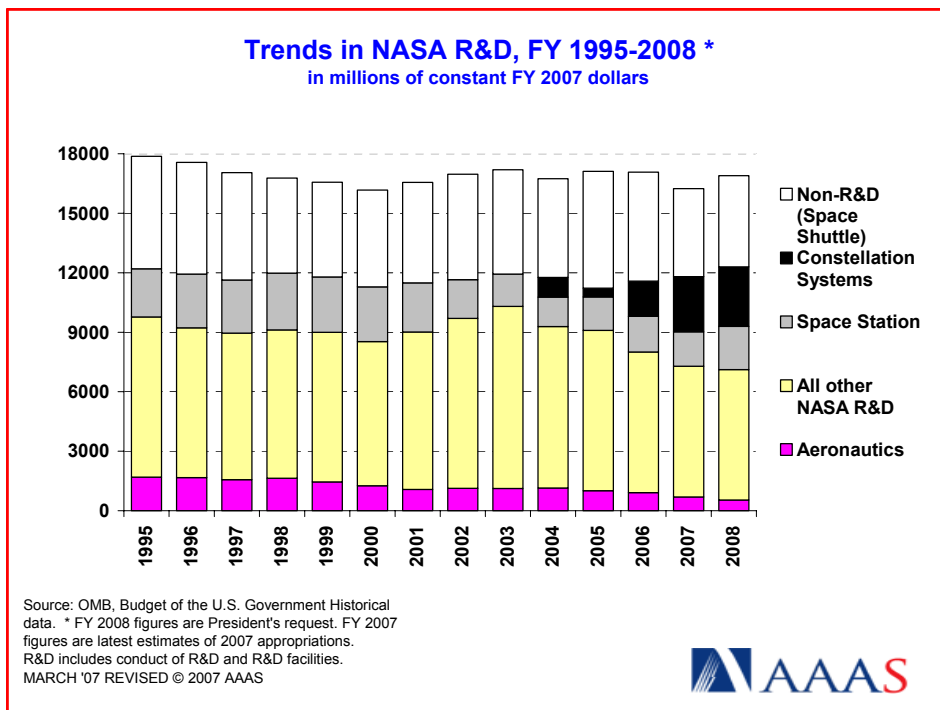


Figure 1. (click on image for PDF)

Together, the Constellation Systems and ISS increases would take up the entire increase for NASA R&D, leaving all other NASA R&D programs combined with cuts, following similar cuts in each of the last four years (see Figure 1). Ironically, NASA is a large supporter of physical sciences research but was left out of the President's American Competitiveness Initiative (ACI) to boost basic physical sciences research, and its support for physical sciences research and other research would fall in the 2008 budget. **NASA's basic and applied research support would fall 2.0 percent down to \$3.4 billion, less of a cut than in previous years but still a continuation of a downward trend.** Aeronautics research funding would tumble 20 percent down to \$554 million in 2008 following similar cuts in previous years; in real terms, the aeronautics research portfolio would be half its size of just four years ago (see Figure 2). The Human Systems Research program would have an increase to \$183 million, but only after a 60 percent cut in 2007 and cuts in previous years to leave it a shadow of its former self, when it was the Biological and Physical Research portfolio and funded a broad range of life and physical sciences (see Figure 2). Astrobiology research (funded in Science) to study the possible existence of life in the universe has declined by half over the last few years.

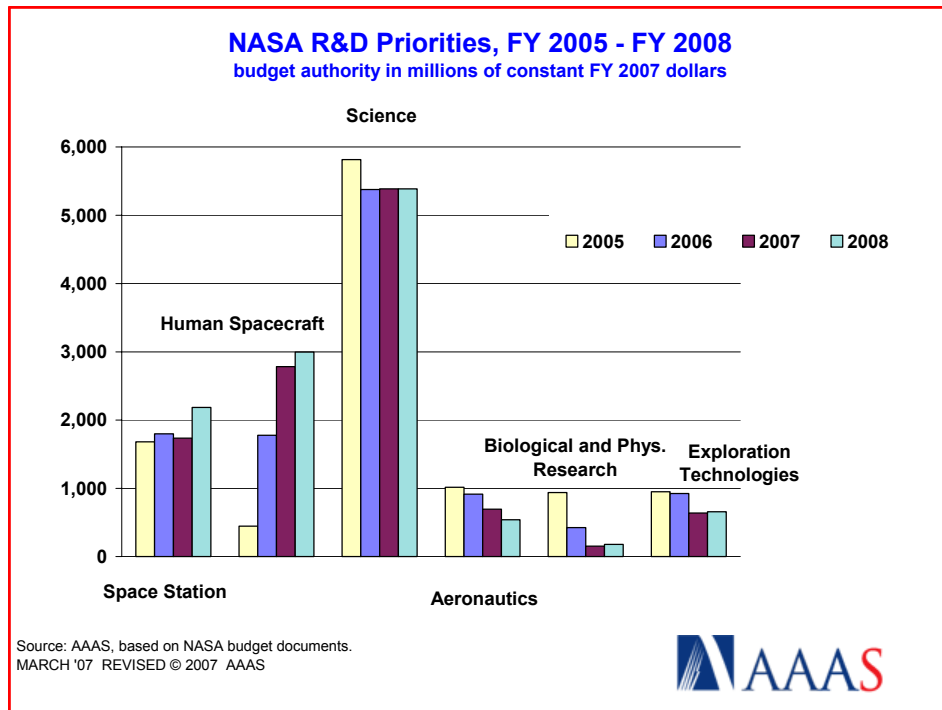


Figure 2. (click on image for PDF)

The Science portfolio of earth observations, astronomy, and robotic exploration of the solar system and universe would be protected overall from cuts in the 2008 budget, but the portfolio's funding has been flat in real terms since last year and is well below the funding levels of previous years (see Figure 2). Science funding is also considerably below previous years' projected budgets, resulting in the downsizing, reworking, and cancellation of numerous projects. **The total Science portfolio of \$5.5 billion (up 2.4 percent) would just keep pace with inflation, but would be down more than \$1 billion from NASA's earlier planning projections, forcing cuts to many missions.** Science has been reorganized into the four themes of Earth Science, Heliophysics, Planetary Exploration, and Astrophysics (see Table II-12). Funding for all four themes would increase compared to 2007. The increase would allow work on the Stratospheric Observatory for Infrared Astronomy (SOFIA) project to restart in 2008 after an abrupt halt in 2007, would allow the James Webb Space Telescope to ramp up development efforts to \$545 million toward a 2013 launch, and would fund a 2008 servicing mission for the current Hubble Space Telescope (\$278 million). But there would be continuing cuts in research and analysis funds for grants to analyze data obtained from science missions, and there would be deferred launch dates in several projects.

In the Earth Science portfolio in particular (up 3.7 percent to \$1.5 billion), previous funding reductions and escalating future mission costs are leaving their mark. Development costs for future missions such as the multi-agency NPOESS satellites, the Global Precipitation Measurement (GPM) mission, and the Landsat Data Continuity Mission have expanded, but funding for research and analysis to analyze earth science data and make sense of them has been shrinking steadily. A recent National Academy of Sciences decadal survey of earth science expresses concern that the number of earth-observing sensors on NASA spacecraft could decrease by 40 percent during this decade if current trends continue, such as a 30 percent real decline in earth science funding so far this decade. As a result, NASA contributions to climate change research, for example, are in serious decline. NASA's role in the multiagency Climate Change Science Program would total \$1.5 billion in 2008, mostly from Earth Science, down steeply from \$2.0 billion as recently as 2004.

Impacts of the NASA Budget

The proposed increase to NASA's R&D portfolio in FY 2008 would continue a modest upward trend for the last few years after hitting bottom in 2005, as shown in Figure 1. NASA's R&D funding has just kept

pace with inflation going back to FY 1991, and recent increases have been just barely ahead of inflation. Although the Bush Administration's moon and Mars plan ignited hopes of increasing resources in a time of fiscal austerity, NASA committed to carrying out its ambitious plans with a budget plan that would just keep pace with expected inflation over the next decade. Although inflationary increases are more than most R&D funding agencies are likely to get in the next few years, NASA's big plans for the next few years will require NASA to reshuffle its resources and to meet ambitious targets for deployment, construction, and then phase-out of the Space Shuttle and Space Station programs to make room for moon and Mars programs. Thus, NASA's R&D funding is likely to stay at this year's levels in inflation-adjusted dollars for the foreseeable future, with increases in priority programs offset by cuts in other areas.

Although much of NASA's R&D portfolio funds development and facilities projects such as the Space Station, **NASA is responsible for 8 percent of all federal support for basic and applied research, with far larger roles in key fields.** Engineering research makes up the largest part of the NASA portfolio (see Figure 3). NASA funds nearly a quarter of total federal support for engineering research. NASA supplies nearly all the federal support for some engineering sub-fields such as astronautical engineering and aeronautical engineering. NASA is the leading federal sponsor of the environmental sciences (oceanography, atmospheric sciences, geological sciences). The environmental sciences are a quarter of NASA's portfolio, but NASA accounts for almost a third of total federal support for environmental sciences research. NASA also invests heavily in the physical sciences (astronomy, chemistry, and physics). NASA is the second largest federal sponsor of physical sciences behind the Department of Energy, and is by far the leading sponsor of astronomy research with more than 70 percent of the federal total.

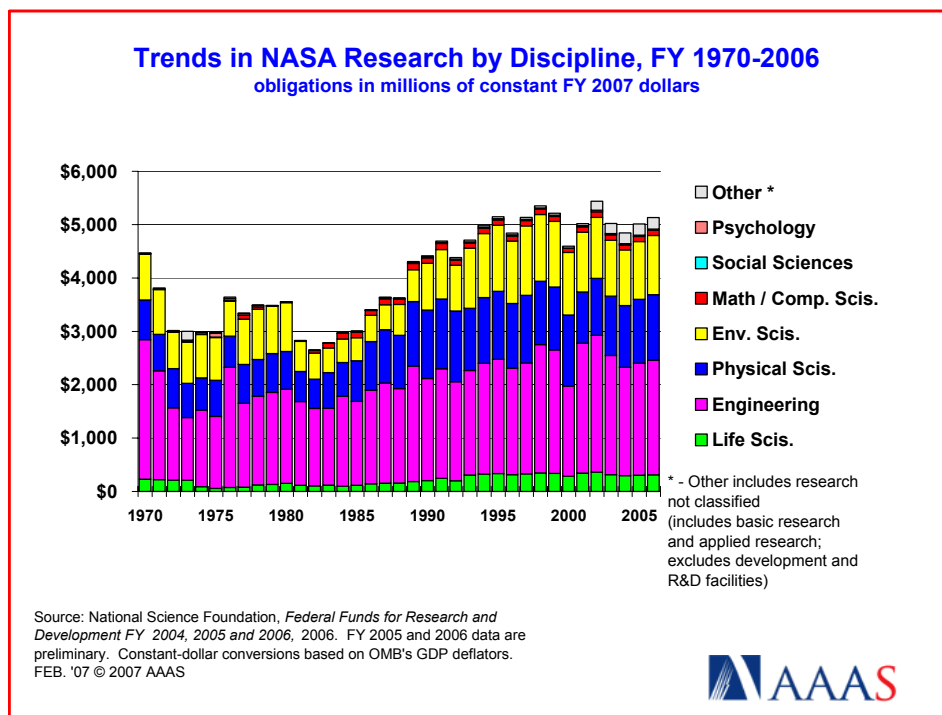


Figure 3. (click on image for PDF)

NASA's research funding has been flat to declining in recent years (see Figure 3), and the 2007 and 2008 budgets are set to continue that trend. NASA support of the physical sciences and environmental sciences have been in steady decline over the past decade, and wild swings in NASA engineering research support from year to year are mostly on a downward trend. With NASA devoting more and more of its resources to development of new spacecraft and construction of large R&D facilities such as the ISS, these trends are likely to continue.

Outlook for the NASA Budget

There is growing congressional dissatisfaction over NASA's course of doing everything it has promised within a flat real budget. Congressional appropriators and authorizers have criticized the agency for siphoning resources away from research to keep the Space Shuttle, ISS, and moon and Mars programs on track, but have mostly been unable to come up with the additional money needed to sustain research. It remains to be seen whether the 2008 appropriations process will be any different: although lawmakers of both parties would like to boost NASA funding above the requested \$17.3 billion, they were unsuccessful in 2007 and budgetary conditions are just as tight heading into the 2008 process.

(More materials on R&D in the FY 2008 budget, historical data and charts, and more information on *AAAS Report XXXII: Research and Development FY 2008*, can be found on the AAAS R&D Web site at <http://www.aaas.org/spp/rd>.)

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Table II-12. NASA R&D

Table II-12. R&D in the National Aeronautics and Space Administration
(budget authority in millions of dollars)

	FY 2006 Actual	FY 2007 Estimate ^	FY 2008 Budget	Change FY 07-08	
				Amount	Percent
Detail of NASA Budget:					
1. Exploration Capabilities (EC)					
Space Operations					
International Space Station	1,753	1,735	2,239	503	29.0%
Space Shuttle *	4,813	3,956	4,008	51	1.3%
Space and Flight Support	339	323	546	223	69.2%
Total Exploration Capabilities	6,905	6,014	6,792	778	12.9%
2. Science, Aeronautics, and Exploration (SAE)					
Science					
Earth Science:					
Earth Science Research	461	447	429	-18	-4.1%
Applied Sciences	95	46	40	-6	-12.6%
Earth Sci. Multi-Mission Ops.	190	190	204	14	7.5%
Earth Systematic Missions	356	516	608	92	17.8%
Earth System Sci. Pathfinder	133	163	136	-27	-16.7%
Education and Outreach	20	26	24	-2	-7.9%
Earth Science Technology	70	56	57	1	2.2%
Total Earth Science	1,326	1,443	1,497	54	3.7%
Heliophysics:					
Heliophysics Research	197	218	206	-12	-5.5%
Deep Space Mission Sys.	255	251	263	12	5.0%
Living with a Star	259	229	253	24	10.4%
Solar Terrestrial Probes	103	87	127	39	45.0%
Heliophysics Explorer Prog.	125	77	76	-1	-1.4%
Near Earth Networks	71	63	66	3	5.1%
New Millennium	58	88	66	-22	-25.0%
Total Heliophysics	1,067	1,013	1,057	44	4.3%
Planetary Science:					
Mars Exploration	662	711	626	-85	-12.0%
Discovery	132	177	185	8	4.3%
New Frontiers	118	156	147	-9	-5.5%
Technology	57	72	68	-5	-6.6%
Planetary Science Research	330	275	371	96	34.8%
Total Planetary Science	1,299	1,391	1,396	5	0.4%

(continued)

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				Amount	Percent
Astrophysics:					
Astrophysics Research	309	315	315	0	0.0%
Gamma-Ray Large Space Teles.	120	89	42	-47	-52.8%
Discovery	148	103	93	-10	-10.1%
James Webb Space Telescope	364	462	545	84	18.1%
Hubble Space Telescope	277	338	278	-60	-17.9%
Navigator	146	123	57	-66	-53.5%
SOFIA 1/	91	0	77	77	--
Astrophysics Explorer	71	68	99	31	44.9%
Int'l Space Sci. Collaboration	13	20	27	7	35.8%
Beyond Einstein	15	22	32	11	48.3%
	<u>1,553</u>	<u>1,540</u>	<u>1,566</u>	25	1.6%
Total Astrophysics					
Total SCIENCE	5,245	5,388	5,516	128	2.4%
Exploration Systems					
Constellation Systems:					
Crew Exploration Vehicle	839	862	951	89	10.3%
Crew Launch Vehicle	384	789	1,175	386	49.0%
Ground Operations	0	0	357	357	--
Mission Operations	0	0	47	47	--
Commercial Cargo Crew Cap.	0	0	236	236	--
Other	510	1,133	302	-831	-73.3%
	<u>1,734</u>	<u>2,784</u>	<u>3,068</u>	285	10.2%
Total Constellation Systems					
Advanced Capabilities:					
Lunar Precursor Robotic Prog.	150	245	278	33	13.5%
Exploration Tech. Development	696	378	394	16	4.2%
Human Research Program	415	154	183	30	19.3%
Centennial Challenges	0	10	0	-10	-100.0%
Prometheus Propulsion	57	5	0	-5	-100.0%
	<u>1317</u>	<u>792</u>	<u>856</u>	63	8.0%
Total Advanced Capabilities					
Total EXPLORATION SYSTEMS	3,050	3,576	3,924	348	9.7%
Aeronautics Research					
Aviation Safety	148	101	74	-27	-26.6%
Airspace Systems	174	122	98	-24	-19.4%
Fundamental Aeronautics	571	402	293	-108	-26.9%
Aeronautics Test Prog.	0	71	88	17	24.4%
	<u>893</u>	<u>695</u>	<u>554</u>	-141	-20.3%
Total AERONAUTICS RES.					

(continued)

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Cross-Agency Support Programs					
Education	162	181	154	-27	-15.0%
Advanced business systems	156	105	103	-2	-2.0%
Innovative Partnerships	215	232	198	-34	-14.7%
Shared Capabilities	0	24	34	10	--
Total CROSS-AGCY. SUPPORT	534	542	489	-53	-9.8%
Total SAE	9,721	10,201	10,483	282	2.8%
3. Inspector General (non-R&D)	32	32	35	3	8.1%
TOTAL NASA Budget	16,658	16,247	17,310	1,063	6.5%
<i>minus non-R&D activities:</i>					
Space Shuttle	-4,813	-3,956	-4,008	51	1.3%
Other non-R&D	-495	-428	-649	221	51.7%
Inspector General	-32	-32	-35	3	8.1%
Education & Training	-24	-25	-25	0	0.0%
TOTAL NASA R&D	11,294	11,806	12,594	788	6.7%

Source: OMB R&D data for FY 2008, agency budget justification, and agency documents.
All figures are rounded to the nearest million. Changes calculated from unrounded figures.

NASA has proposed to restructure its programs in FY 2008.

Figures for all years have been adjusted to reflect the proposed structure.

FY 2007 and 2008 figures are in a new full-cost simplification method.

FY 2006 figures reflect the previous accounting method.

* FY 2006 Shuttle figures include emergency supplementals for hurricane damages.

1/ Stratospheric Observatory for Infrared Astronomy

Please see Chapter 10 for a discussion of NASA R&D.

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^ - FY 2007 figures are latest estimates of final 2007 appropriations (P.L. 110-5).