

## Space Exploration Debate

1. Get students to get into groups based on which one of the following they agree with:

- In favor of sending both human and robotic missions to space
- In favor of only sending robotic missions to space
- Not in favor of space exploration
- Undecided

Let the students know that they can change groups at anytime during the debate, as many times as they wish.

2. Give groups about 5 minutes to talk amongst themselves and decide which points are the most important if they were to convince someone of their opinion.

3. Each group gets 2 minutes to state their case (other groups cannot rebuttal until all groups have gone).

4. The debate begins! How this goes will depend on the class. The students can just talk amongst themselves (but step in if it gets too off topic, or certain students are dominating the conversation, etc.). Another way is to get the students to put their hands up when they have something to say, and you choose who talks next. It is useful to put a time limit (30-60 seconds) on how long they can talk for. Let the debate go on for as long as time allows, but make sure there are 10-15 minutes at the end of class for a wrap-up.

5. Interject information or ask questions as the debate goes on if someone is way off base on something or if there is something important that hadn't been covered yet. Try your best, though, not to influence the students.

6. Makes notes of points that were brought up often (typically economics, humans vs. machines, other things (social programs, health research) are more important, etc.)

7. Wrap-up the debate by providing information regarding the points that were brought up often (what percentage of American budget goes to NASA; spin-off technologies; collaboration between humans & robots, we need to find somewhere to live when Earth "explodes", etc.). Write down a table with pros and cons of space exploration. Let the students know that this topic is continually under debate among scientists.

**Resources:**

NASA receives about \$18-19 billion per year (<http://www.nasa.gov/news/budget/index.html>), which is about 0.5% of the American budget (\$3.82 trillion --- <http://www.gpoaccess.gov/usbudget/fy12/index.html>)

Spin-off technologies:

<http://www.nasa.gov/externalflash/nasacity/index2.htm>

Book: Down to Earth: How space technology improves our lives (ESA)

Some Pros/Cons from

[http://www.idebate.org/debatabase/topic\\_details.php?topicID=91](http://www.idebate.org/debatabase/topic_details.php?topicID=91):

\_\_\_\_\_ Pros

Mankind must always struggle to expand its horizons. The desire to know what lies beyond current knowledge, the curiosity that constantly pushes at the boundaries of our understanding, is one of our noblest characteristics. The exploration of the universe is a high ideal - space truly is the final frontier. The instinct to explore is fundamentally human; already some of our most amazing achievements have taken place in space. No-one can deny the sense of wonder, world-wide, when for the first time a new man-made star rose in the sky, or when Neil Armstrong first stepped onto the moon. Space exploration speaks to that part of us which rises above the everyday.

\_\_\_\_\_ Cons

High ideals are all well and good, but not when they come at the expense of the present. Our world is marred by war, famine, and poverty; billions of people are struggling simply to live from day to day. Our dreams of exploring space are a luxury they cannot afford. Instead of wasting our time and effort on macho prestige projects such as the space programme, we must set ourselves new targets. Once we have addressed the problems we face on Earth, we will have all the time we want to explore the universe; but not before then. The money spent on probes to distant planets would be better invested in the people of our own planet. A world free from disease, a world where no-one lives in hunger, would be a truly great achievement.

The exploitation of space has directly changed our world. Satellites orbiting the Earth allow us to communicate instantaneously with people on different continents, and to broadcast to people all over the world. The Global Positioning System allows us to pinpoint our location anywhere in the world. Weather satellites save lives by giving advance warning of adverse conditions, and together with other scientific instruments in orbit they have helped us understand our own world better. Research into climate change, for example, would be almost impossible without the data provided by satellites.

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Space exploration has also led to many indirect benefits. The challenge and difficulty of the space programme, and its ability to draw on some of the finest minds, has brought about great leaps in technology. The need to reduce weight on rockets led to miniaturisation, and so to the micro-chip and the modern computer. The need to produce safe but efficient power-sources for the Apollo missions led to the development of practical fuel-cells, which are now being explored as a possible future power-source for cleaner cars. The effects of zero-gravity on astronauts has substantially added to our knowledge of the workings of the human body, and the ageing process. We can never know exactly which benefits will emerge from the space programme in future, but we do know that we will constantly meet new obstacles in pursuit of our goals, and in overcoming them will find new solutions to old problems.

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Satellite technology has of course had a beneficial effect on our world. However, there is a huge difference between launching satellites into Earth orbit, and exploring space. Missions to other planets, and into interstellar space, do not contribute to life on our planet. Moreover, satellites are largely commercial - they are launched by private companies, and are maintained by the profits which they lead to. True space exploration could never be commercial, and requires huge government subsidies - the Voyager missions alone cost just under \$1 billion. This money could be much better spent elsewhere.

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These spin-off advantages could come from any 'blue-sky' project - they are a result of the huge amounts of money and manpower devoted to the space programme, giving people the resources they need to solve problems, rather than a result of the programme itself. For example, many of the leaps forward in miniaturisation were in fact the result of trying to build better nuclear missiles; this is not a good reason to continue building nuclear weapons. It would be far better to devote similar resources to projects with worthier goals - for example cancer research, or research into renewable energy sources. These too could have many spin-off benefits, but would tackle real problems.

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Space exploration is an investment in the future. Our world is rapidly running out of resources. Overpopulation could become a serious worldwide threat. In this position, it would be foolish to ignore the vast potential of our own solar system – mining resources on asteroids or other planets, or even the possibility of colonising other worlds. If we fail to continue to develop the ability to take advantage of these possibilities, we may in the future find it is too late.

Space exploration is a waste of resources. If we wish to tackle the problems of overpopulation, or of the depletion of resources, we must deal with them on the Earth instead of chasing an elusive dream. There are practical ways in which we can deal with the problems of our planet, and we must pursue them with all the resources and all the political will we have available.

## Debate: Funding for space exploration

From:

[http://debatepedia.idebate.org/en/index.php/Debate:\\_Funding\\_for\\_space\\_exploration](http://debatepedia.idebate.org/en/index.php/Debate:_Funding_for_space_exploration)

### Should governments prioritize spending on the exploration of space?



#### Background and context:

From the moment that the Soviet Union launched Sputnik in 1957 the aim of the space race was to be the first to go where no man had gone before. Yuri Gagarin became the first man in space on 12th April 1961 and over the next couple of decades astronauts and cosmonauts battled to break records and frontiers. Yet since Neil Armstrong set foot on the Moon on 22nd July 1969 man's conquest of space has slowed. By the late 1970s both the USA and USSR had given up on travelling to the Moon, let alone Mars, and were focused on creating a permanent presences in the near-Earth space stations Mir (USSR) and Skylab (USA), both of which have now

been replaced by the International Space Station. The end of the Cold War led to massive budget cuts and NASA was forced to adopt a 'Quicker, Faster, Cheaper' approach which focused its efforts on robotic exploration. After China's success in sending Yang Liwei into space in October 2003 and a second Space Shuttle disaster in February 2003, US President George W. Bush echoed President Kennedy in pledging NASA to manned exploration and an eventual trip to Mars. Yet some commentators claim that man is an unnecessary (and costly) distraction from scientific exploration and that we would be better off staying on Earth. They add that since Dennis Tito became the first 'space tourist' in 2002 and the privately built \$20m SpaceShipOne won the X Prize in 2004 by entering suborbital space twice in five days, the future lies with privately run space tourism with state funding limited to unmanned scientific missions.

### Exploration: Is space an important frontier for human exploration/inspiration?

#### Yes

- [Space exploration is inspiring and pushes humans to advance "Space exploration is not a waste of money". Science Ray. Sep. 30th, 2007](#) --- "The curiosity of humans leads us to do many things. It is probably the reason for outer space research. The evidence that has been gathered supporting interesting information has just fuelled this curiosity. Curiosity is the root to all sciences. Archaeology, biology, chemistry, physics and many other braches of science were only done because of curiosity. Without curiosity, the human race might still be in the Stone Age. Isaac Newton was curious about the falling apple and why it fell. Big curiosity has made us do big things. Space exploration might lead to a good thing too!"
- [Space exploration inspires children to study science \(an investment\)](#)

#### No

- **There is sufficient room for exploration on earth; space is excessive.** Rather than probing Mars for life, we should be looking to the 95% of the world's oceans that have yet to be explored and where we are constantly finding new forms of life and new scientific discoveries. For example, bacteria have been found which survive not by using sunlight as an energy source, but volcanic vents on the ocean floor – a discovery which made scientists looking for life on Mars totally change their approach. And with individuals constantly in the news for attempts to traverse the globe in rowing boats, hot air balloons and tied to gliders, there are clearly enough 'boundaries' on this planet to keep even our keenest explorers happy.

## Science: Does space exploration benefit science, human understanding?

### Yes

- **Manned space--flight has spawned many scientific innovations.** The need to make equipment 'fail-safe' because of its role in keeping humans alive in space means that the level of funding and testing is necessarily higher than for non-manned missions. This has resulted in advances that have included the Teflon found on non-stick frying pans, new ways of testing aerodynamics which have improved planes, huge improvements in computing power and software, etc.

### No

- **The scientific benefits of manned space programmes are severely overstated;** NASA spends over a third of its budget simply keeping the ISS manned and the Space Shuttle working. The vast majority of its spending on scientific research comes through ground based research, telescopes and unmanned missions. China has made no claims that there is a scientific benefit to its manned mission and nor has Russia in recent years.
- **Few missions to space have produced notable scientific results.** There are few experiments so important that they can justify the huge cost needed to allow them to be carried out by humans in zero gravity. NASA made a lot of noise about growing zero-gravity protein crystals as a potential cure for cancer when it was trying to justify building the ISS but has since dropped the claims as experiments have shown the claims were overstated.
- **Going into space to discover the effects of space on humans is circular logic.** The argument that humans need to be in space in order to find out the effects of being in space should be treated with caution; it is essentially a circular argument as with no manned missions, there would be no need to find out the impact of space on humans.



## Funding: Should space exploration be publicly funded?

### Yes

- **Space exploration pays for itself by inspiring funders.**
- **Public funding is necessary to achieve real results in space.**  
While the private market may be able to cater for the rich few who want to see sub-orbital space (and some 11,000 have signed up to fly there with Richard Branson's Virgin Galactica from 2007), ultimately the boundaries of science involve keeping humans in space for long periods (the current record is 439 days), travelling further, discovering what the rest of our solar system holds and, eventually, trying to live on the moon or Mars. It is only through state subsidies that such exploration is financially possible.
- **[Space programs have relatively small budgets](#)** "[Space exploration is not a waste of money](#)". [Science Ray. Sep. 30th, 2007](#) --- "Space exploration is not a waste of money. In fact, USA spends only 1% of the budget on space exploration. If it was not spent, instead of a poor person getting a dollar, he would get a dollar and 3 cents. Does this make that much of a difference?"
- **[Space exploration is more valuable than some other human expenditures](#)** [Virgiliu Pop. "Is Space Exploration Worth the Cost?". Space Daily. January 19th, 2005](#) --- "many of the critics of the space programme on social grounds are "limousine liberals".

### No

- **The costs of pushing the boundaries in space are too high.** Even with a budget of \$16.5bn for 2006, NASA expects it will take more than a decade to return to the moon and has no date for Mars. The cost of really pushing the boundaries of human exploration is too high even for the big-spending Bush administration, so surely we need to examine the scientific and technological returns of the space programme as it really is rather than how it appears in Star Trek.
- **[Space funding would be better spent helping people on earth](#)**  
Dennis Kucinich, responding to president Bush's 2004 space initiatives, said: "I also want to explore planet Earth and planet D.C."[\[1\]](#)
- **[Private markets are better suited to invest in space exploration](#)** What better way to colonise space than to leave it to the private market to develop the space tourism market to include space hotels and moon bases? The success of the \$10m X Prize at attracting interest and private investment in private space programmes has shown that there is no need for the state to be involved in space travel on the non-science side. Given suitable international safety standards (as were agreed on air travel in the inter-war period) it would transfer the investment and risk away from the taxpayer as well as

<p>They point the finger at the US government for wasting their tax money in space instead of helping the poor, but they are not feeling guilty for their own consumerist life style and for their own scale of priorities. For instance, this year, total pet-related sales in the United States are projected to be \$31 billion – the double, almost to the cent, of the \$15.47 billion NASA budget. An estimated \$5 billion worth of holiday season gifts were offered – not to the poor – but to the roving family pets – six times more than NASA spent on its own roving Martian explorers, Spirit and Opportunity, who cost the American taxpayer \$820 million both. Instead of providing a launch pad for the immorally expensive shuttles, Florida can do better and clothe the underprivileged --- a genuine alligator pet collar cost only \$400 a piece."</p> <ul style="list-style-type: none"> <li>• <a href="#"><u>Space exploration has brought many practical benefits to humans</u></a></li> <li>• <a href="#"><u>Humans could benefit from natural resources of other planets</u></a></li> <li>• <b>Space exploration stimulates economic activity and jobs on Earth.</b></li> </ul>	<p>producing the sort of space travel that would really inspire the human race – the sort that tens of thousands of people would actually get a chance to take part in.</p> <ul style="list-style-type: none"> <li>• <b>Significant private capital can be raised for space exploration.</b> Even if NASA is unwilling to fund a particular project does not mean it cannot take place – the Beagle 2 project to search for life on Mars was organised by British scientist Professor Colin Pillinger and raised a significant amount of its ?50m cost from private sources and sponsorship. The Beagle 2 never responded from the surface of the Red Planet but the principle of scientific communities being able to raise sufficient capital for small unmanned missions has been proven.</li> </ul>
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**Planet: Does the human race need to be able to move to another planet?**

<p><b>Yes</b></p> <ul style="list-style-type: none"> <li>• <a href="#"><u>Humans should not rely solely on Earth for their long--term future</u></a> The potential damage done by an asteroid or comet that</li> </ul>	<p><b>No</b></p> <ul style="list-style-type: none"> <li>• <b>The risk of us being wiped out by an asteroid like the dinosaurs is very very small.</b> In any case unmanned missions</li> </ul>
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<p>collides with the Earth could range from the impact of the atomic bombing of Hiroshima to the complete destruction of all life on the planet. A manned mission might be necessary to destroy or divert such an object before it reaches our planet. There is also the potential for other terrible damage to be done to the Earth (whether through climate change, warfare or overcrowding), which could mean that as a race we would have no choice but to leave the planet. In that situation, high levels of knowledge about human space travel and the ability to colonise Mars or other planets would be essential.</p>	<p>(missiles, satellite mounted lasers etc.) would probably be as effective as any manned attempt to divert an asteroid despite what films like Armageddon and Deep Impact might suggest.</p> <ul style="list-style-type: none"> <li>• <b>Humans should not bank on destroying the Earth and moving to another planet.</b> As for the potential for us to mess up the Earth sufficiently to require us to leave the planet, perhaps we should work harder at looking after this planet rather than looking for another one to damage.</li> </ul>
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**Mars: Are missions to mars important, worth funding?**

<p><b>Yes</b></p> <ul style="list-style-type: none"> <li>• Even if 60% of Americans currently oppose funding a research on Mars, if a time for evacuation ever comes no one will be able to oppose the decision to evacuate Earth, thus research on Mars should be made mandatory.</li> <li>• In case of the Earth being over populated or over polluted, Mars can be used to restart civilization anew. Technology can always help make humans adaptable to Earths climate.</li> </ul>	<p><b>No</b></p> <ul style="list-style-type: none"> <li>• <b>60% of Americans oppose funding a mission to Mars.</b> "Do you think the US should fund a Mars mission?" 60% said no. <a href="#">[2]</a></li> <li>• <b>Mars mission is not first in the list of priorities.</b> There are already enough problems at home into which the money could be invested. As Patti Davis argued in 2004, the funding for the mission ~\$750 billion~ would much better be used in alternative energy research and fighting climate change. <a href="#">[3]</a></li> </ul>
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**Robots: Should people be flown to space instead of robots?**

<p><b>Yes</b></p> <ul style="list-style-type: none"> <li>• <b>Humans are able to make</b></li> </ul>	<p><b>No</b></p> <ul style="list-style-type: none"> <li>• <b>Some spin--off technology will</b></li> </ul>
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**judgments in space exploration and testing.**

There is a distinction between collection of data and interpretation of data. Robots are very good at collecting data but not good at responding to that data and acting flexibly on it.

- **Robots are inefficient at collecting data.** The most flexible robots yet to leave Earth, the Mars Rovers, could only travel a few metres and test some nearby rocks. Humans on the Moon were able to travel significant distances, selectively choose rock types from a variety of locations and prioritise experiments based on the results they received as they were on the Moon's surface. Ideally scientists would like to understand other planets and bodies as well as they do on Earth. This would require huge numbers of experiments and surveys which would be much better done by long manned missions or permanent scientific missions (as have been posted to Antarctica for decades) rather than a series of unmanned missions over a decade. This also applies to experiments carried out in zero gravity onboard the ISS or Space Shuttle, such as attempts to grow protein crystals or look at the impact of zero-gravity on the behaviour of organisms.
- **Humans must be in space in order to test the impact space has on them.** Only by having humans in space that we are able to find out what the impact of space does to their physiological

**come from unmanned space travel as easily as from manned space travel**

(e.g. rocket technology, robotics, computing power etc.), and one should bear in mind that most manned space programmes are centred on under-funded programmes using old technology due to budgetary constraints (Russia), low technological development (China) or focused on repetitive operations (USA) which do not involve significant funding into new technologies. As a result of space programmes often being closely linked to the military (in China it is a division of the military), the spin-offs that are sought are usually for military rather than consumer products, and more likely to be kept secret for exactly that reason. However, the problem with the spin-off argument in principle is that investing in developing a non-stick frying pan would surely be cheaper than investing in a manned space programme which produces Teflon as a side-effect. Where there are truly significant problems and areas in need of technological advances either the state should fund research (as it does in many ways through research grants, support for universities etc.) or the free market will step in and exploit a market for a new technological solution to a problem.

- [Funding should only go to cost-effective robotic space exploration "Mars Rising?". The Economist. January 22, 2009.](#) "Luckily, technology means that



<p>and psychological well being. This makes future manned exploration more possible as well as teaching us about humans. Discoveries on bone and muscle depletion during space travel have helped in the care of bedridden patients and on how to speed up the rate of muscle growth.</p> <ul style="list-style-type: none"> <li>• <b>Manned missions force spacecraft to have greater weight-bearing capacities for rocks.</b> A second reason why manned experiments and exploration would be more effective is that any manned mission will necessarily be heavier. This is because it has to carry the weight of humans and their life support equipment. For this reason the cost of returning samples or carrying extra scientific equipment will be more possible because of the negligible weight they add to the payload. This means that even if the mission is primarily about political grandstanding, science will still benefit. Compare the USSR's ability to bring back 321g of lunar rock using robots with the 382kg brought back by the US Apollo missions. The latter proved the 'giant impact' theory, told us a lot about the evolution and geological change of the Moon and our own Earth, and are still being studied today.</li> </ul>	<p>man can explore both the moon and Mars more fully without going there himself. Robots are better and cheaper than they have ever been. They can work tirelessly for years, beaming back data and images, and returning samples to Earth. They can also be made sterile, which germ-infested humans, who risk spreading disease around the solar system, cannot."</p>
<p><b>International relations: Is sending humans to space good for international relations?</b></p>	
<p><b>Yes</b></p>	<p><b>No</b></p>

- **Multinational space programs are good for international diplomacy.** Since the “historic handshake in space” when a US Apollo and Soviet Soyuz capsules docked in 1975, the two countries have grown increasingly close. This relationship involves sharing technology (which is almost all ‘dual use’ i.e. it could be used for military purposes as well as civilian, thus requiring a high degree of trust), scientific knowledge and working side-by-side to build and support the ISS. With the involvement of the 11 member states of the European Space Agency as well as Canada, Japan and Brazil in the project, space is one of the few spheres where governments have been able to put aside their differences in pursuit of something more fundamentally important to humanity – surely something that we should continue.

- **Flag--staking is occurring in space and spread nationalistic sentiments.** Sending humans into space or to other planets so that they can erect the flag of a particular nation is a distinctly nationalistic act and one that is likely to create aggressive 'races' in the future just as it has before. China’s manned programme is openly intended to challenge the US dominance of space for the Communist regime’s huge propaganda benefit. George W. Bush’s pledge to boost spending on NASA and to restart the manned mission to Mars programme was a direct response. This is damaging not only because of the potential for space race conflicts to escalate into greater international hostility, but also because of the way such races could result in the militarization of space (as several Chinese hawks have called on the leadership to do), thereby turning something which should be preserved for the common good of humankind into a neo-colonial battlefield.

**Taxpayers: Should opponents of space exploration still be required to contribute?**

**Yes**

- **Individuals are not always good at judging what is beneficial in the long term.** If people are told they do not have to pay, they will probably choose not to pay. This is despite the fact that space travel has many benefits which should be

**No**

- **People should not be forced to contribute towards something they oppose.** Even when people do not want to fund space travel, they are currently forced to do so. This is unfair as people should have a choice on issues like this, as not paying will not harm



<p>supported with public money.</p>	<p>anyone.</p> <ul style="list-style-type: none"><li>• <b>People can be trusted to make the right choices.</b> When people are given the choice of whether they want contribute towards space travel, they are likely to choose the one that is best for themselves and society, whether space exploration or no space exploration is a better choice.</li></ul>
<p><b>Yes</b></p> <ul style="list-style-type: none"><li>• <a href="#">"Why are we wasting money in space?". Everything2. August 1st, 2005</a></li><li>• <a href="#">"Space exploration is not a waste of money". Science Ray. Sep. 30th, 2007</a></li><li>• <a href="#">Virgiliu Pop. "Is Space Exploration Worth the Cost?". Space Daily. January 19th, 2005</a></li><li>• <a href="#">NASA</a></li><li>• <a href="#">European Space Agency</a></li><li>• <a href="#">Space Daily</a></li><li>• <a href="#">Chinese National Space Administration</a></li><li>• <a href="#">Chinese Academy of Launch Vehicle Technology</a></li><li>• <a href="#">Shuttle Press Kit</a></li><li>• <a href="#">Europe &amp; Russia collaboration</a></li><li>• <a href="#">Reasons to support space exploration</a></li><li>• <a href="#">"Mission To Nowhere?". Transterrestrial Musings.</a></li></ul>	<p><b>No</b></p> <ul style="list-style-type: none"><li>• <a href="#">Reasons for opposition to space exploration</a></li><li>• <a href="#">Anne Applebaum. "Mission to Nowhere". Washington Post. January 7, 2004</a></li><li>• <a href="#">"Mars Rising?". The Economist. January 22, 2009.</a></li></ul>
<p><a href="#">[Edit]</a></p> <p><b>See also</b></p> <ul style="list-style-type: none"><li>• <a href="#">Debate: Mission to the Moon or Mars?</a></li><li>• <a href="#">Debate: Space exploration</a></li><li>• <a href="#">Debate: Colonization of the Moon</a></li><li>• <a href="#">Debate: Mission to Mars</a></li><li>• <a href="#">Debate: Should humans colonize outer space?</a></li><li>• <a href="#">Debate: Moonbase</a></li></ul>	



- [Debate: One-way, one-person mission to Mars](#)
- [Debate: Manned space flight](#)
- [Debate: Manned mission to Mars](#)
- [Debate: International space organization](#)
- [Debate: Value of NASA](#)
- [Debate: Colonization of Mars](#)

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## External links

- [NASA](#)
- [European Space Agency](#)
- [Space Daily](#)
- [X Prize](#)
- [Space.com coverage of SpaceshipOne](#)
- [China's manned space programme](#)
- [Chinese National Space Administration](#)
- [Chinese Academy of Launch Vehicle Technology](#)
- [BBC: Space Exploration](#)
- [BBC: Mars Exploration](#)
- [BBC web discussion](#)
- [Shuttle Press Kit](#)
- [NASA Budget](#)
- [Europe & Russia collaboration](#)
- [Political Base](#)

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## Books

- [Failure is Not an Option: Mission Control from Mercury to Apollo 13 and Beyond](#) : Gene Kranz
- [China's Space Program: From Conception to Manned Space Flight](#) : Brian Harvey
- [Advanced Space System Concepts and Technologies](#) : Ivan Bekey
- [Space Tourism: Adventures in Earth's Orbit and Beyond](#) : Michel van Pelt
- [We Have Capture: Tom Stafford and the Space Race](#) : Tom P. Stafford
- [The Story of the Space Shuttle](#) : David M. Harland
- [Space Tourism: Do You Want to Go?](#) : Karen Rugg