History of Space Exploration
900 – Chinese Fire Rocket
Battle of Pollilur

1780 – Tipu Sultan
1810 – William Congreve Rockets
1930s – Konstantin Tsiolkovsky
Robert Goddard – 1920s-1940s
V2 Rocket – 1940s
Sputnik
Explorer 1
Vostok
Soyuz
Apollo Command and Service Modules

LAUNCH ESCAPE ASSEMBLY

- Nose cone and "Q-ball"
- Canard assembly
- Pitch control motor
- Tower jettison motor
- Launch escape motor
- Electrical power system radiator panels (8)
- Fuel cells (3)
- Reaction control thruster assembly (4 locations)
- Cryogenic oxygen and hydrogen storage tanks
- VHF scimitar antenna (2)
- Environmental control system radiator panels (2)
- Launch escape tower
- Forward boost protective cover
- Aft boost protective cover

COMMAND MODULE

- Docking mechanism
- Drogue parachutes (2)
- Side hatch
- Aft compartment (tanks, reaction control engines, wiring, plumbing)
- Fuel cells (3)
- Reaction control thruster assembly (4 locations)
- Cryogenic oxygen and hydrogen storage tanks
- VHF scimitar antenna (2)
- Environmental control system radiator panels (2)
- Launch escape tower
- Forward boost protective cover
- Aft boost protective cover
- High-gain (deep space) antenna

SERVICE MODULE

- Helium tanks (2)
- Reaction control system assembly (4 locations)
- Service propulsion system tanks (4)
- Service propulsion engine nozzle

APOLLO COMMAND AND SERVICE MODULES AND LAUNCH ESCAPE SYSTEM
Apollo Lunar Excursion Module
Apollo Sites and Samples
Apollo-Soyuz
Mir
Shuttle
International Space Station
Chinese Human Space Program

- Shenzhou 5, First manned mission, October 15, 2003, Yang Liwei, 21 h.
- Shenzhou 6 followed two years later.
- More Shenzhou missions, including multiple taikonauts, space walks, and docking, planned.
- Long March 2F launcher, Jiuquan Satellite Launch Center.
- In February 2004, the PRC formally started unmanned Moon exploration project.
  - orbiting the Moon (US$170 million)
  - landing (before 2010)
  - returning samples (before 2020)
Shuttle-Derived Launch Vehicles for Constellation
Robotic Spacecraft
Lunar probes
Robotic Spacecraft – Part 2

**Mars probes**
* Zond program - failed Soviet flyby probe
* Mars probe program - Soviet orbiters and landers
* Viking program - Two US orbiters and landers (1974)
* Phobos program - Failed Soviet orbiters and Phobos landers
* Mars Surveyor '98 program (Mars Climate Orbiter and Mars Polar Lander) - Failed US probes
* Mars Global Surveyor - US Orbiter
* Mars Odyssey - US orbiter
* Mars Observer - failed US Mars orbiter
* Mars Express (Mars Express Orbiter and Beagle 2) - European orbiter and failed lander 2003
* Mars Reconnaissance Orbiter - US, launched 2005
* Phoenix - scheduled to launch on August 3, 2007
* Mars Science Laboratory - US, to be launched 2009
General solar system probes
* Venera program - Soviet Venus orbiter and lander
* Vega program - Soviet mission to Venus and Comet Halley
* Zond program - Soviet flyby missions to the Moon, Venus, and Mars
* Pioneer Venus project - US Venus orbiter
* Mariner program - US Mercury, Venus and Mars flybys
* Pioneer program - US Jupiter and Saturn flybys
* Voyager program - US Jupiter, Saturn, Uranus and Neptune flyby and study of interstellar space
* Giotto mission - European flyby of Comet Halley (1986)
* Sakigake probe - Japanese flyby of Comet Halley (1986)
* Galileo probe - US Jupiter orbiter and atmosphere probe
* Magellan probe - US Venus orbiter
Robotic Spacecraft – Part 4

**General solar system probes (Cont.)**

* NEAR Shoemaker - US asteroid lander, launched 1996
* Genesis - first solar wind sample return mission, 2001-2004 (crash)
* CONTOUR - US comet flyby mission; launch failure in 2003
* Hayabusa - Japanese asteroid orbiter, lander and sample return, launched 2003
* Rosetta - European comet orbiter and lander (Philae); launched 2004
* MESSENGER - US Mercury orbiter, launched 2004
* Deep Impact - successful US comet impactor, launched 2005
* Venus Express - ESA probe to be sent for the observation of the Venus's weather in 2005.
* New Horizons - launched on January 19, 2006, it will be the first probe to visit Pluto (in July 2015)
* Interstellar Boundary Explorer (IBEX), scheduled to launch in the summer of 2008.
Robotic Spacecraft – Part 5

Extra-solar system missions

* NEAR Shoemaker - US asteroid lander, launched 1996
* Genesis - first solar wind sample return mission, 2001-2004 (crash)
* CONTOUR - US comet flyby mission; launch failure in 2003
* Hayabusa - Japanese asteroid orbiter, lander and sample return, launched 2003
* Rosetta - European comet orbiter and lander (Philae); launched 2004
* MESSENGER - US Mercury orbiter, launched 2004
* Deep Impact - successful US comet impactor, launched 2005
* Venus Express - ESA probe to be sent for the observation of the Venus's weather in 2005.
* New Horizons - launched on January 19, 2006, it will be the first probe to visit Pluto (in July 2015)
* Interstellar Boundary Explorer (IBEX), scheduled to launch in the summer of 2008.
### Nations with space agencies and their budgets 2007

<table>
<thead>
<tr>
<th>Nation</th>
<th>Budget (B)</th>
<th>Nation</th>
<th>Budget (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>People's Republic of China</td>
<td>$0.5B</td>
<td>Israel</td>
<td>--</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>$1.3B</td>
<td>Italy</td>
<td>$0.9B</td>
</tr>
<tr>
<td>United States</td>
<td>$16.3B</td>
<td>India</td>
<td>$0.82B</td>
</tr>
<tr>
<td>Argentina</td>
<td>--</td>
<td>Japan</td>
<td>$1.8B</td>
</tr>
<tr>
<td>Brazil</td>
<td>--</td>
<td>South Korea</td>
<td>--</td>
</tr>
<tr>
<td>Canada</td>
<td>--</td>
<td>Malaysia</td>
<td>$0.03B</td>
</tr>
<tr>
<td>Europe (ESA)</td>
<td>$3.8B</td>
<td>Pakistan</td>
<td>--</td>
</tr>
<tr>
<td>France</td>
<td>$2.2B</td>
<td>Rep. of China (Taiwan)</td>
<td>--</td>
</tr>
<tr>
<td>Germany</td>
<td>$1.0B</td>
<td>Spain</td>
<td>--</td>
</tr>
<tr>
<td>Indonesia</td>
<td>--</td>
<td>Ukraine</td>
<td>--</td>
</tr>
<tr>
<td>Iran</td>
<td>--</td>
<td>United Kingdom</td>
<td>$2.0B</td>
</tr>
</tbody>
</table>