

The Greatest Engineering Race:  
Russia vs USA in  
The Race to Space  
Part 1: The Orbital Race

By Glenn Chapman



Konstantin Tsiolkovski: Russian Father of Cosmonautics



“Earth is the cradle of  
Mankind, but one cannot  
live in the cradle forever”

**Left:** Konstantin Tsiolkovski (1857-1935) is now the revered “Father of Cosmonautics” in the Soviet Union. A school teacher in the town of Kaluga, he derived the theoretical mathematics of rocketry which inspired others like Korolyov actually to design and fly rockets. Although he died virtually unknown, he is now considered a hero.

## 1930's Race: Liquid Fueled Rockets Robert Goddard USA



1926: 1<sup>st</sup> Liquid Rocket  
Launch: Lox/Gasoline:  
reached 40 ft

New York Times Editorial  
against Goddard: "Rockets  
cannot work in vacuum"



1936 New Mexico  
rockets



Jet Propulsion Lab  
established 1939

## 1930's Race: Russian GRID & GDL



Sergei Korolev



GRID: Group for Studying Reaction Propulsion  
GRID 6 Liquid/Solid Hybrid

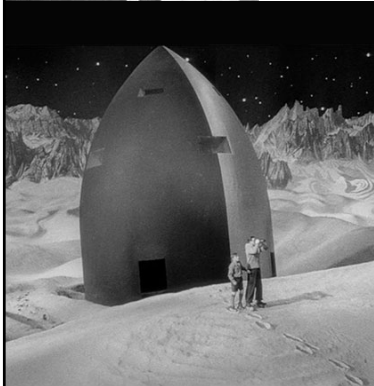


Russian Grid Group  
Sergei Korolev  
Launches Liquid 1930

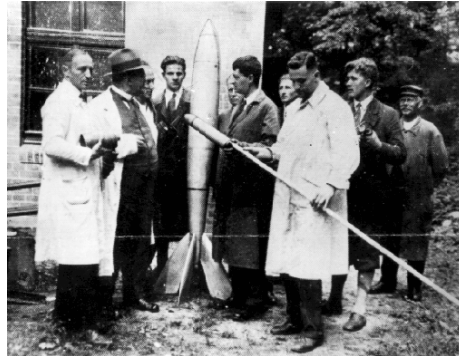
## 1930's Race: German VfR



Herman Oberth: Thesis 1922  
Publishes Rockets into Interplanetary Space



Frau im Mond Movie by Friz Lang 1929



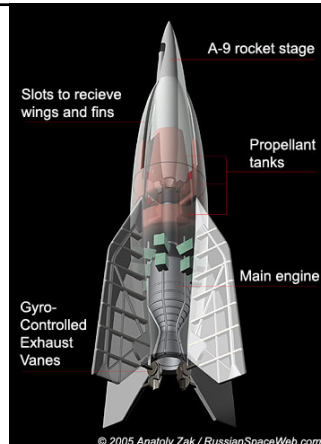
Werner von Braun: VfR  
Verin für Raumschiffahrt,  
Liquid Fuel Rocket 1931

## German World War 2: 1st Big Rocket



V2 (A4): First big liquid Rocket  
25 Tonne Thrust, 200 Km range

Planned A9/10 2 stage: A10 400 T Thrust

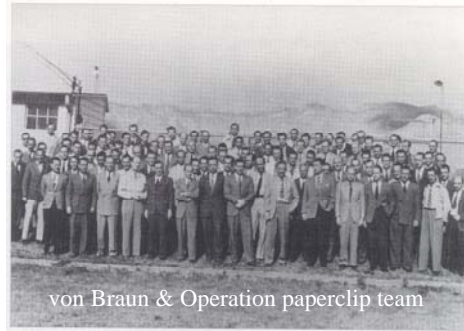


1945 Russian & US Capture V2



Korolev in Germany 1945

American Modified German V2



von Braun & Operation paperclip team

Sergey Korolev  
Russia's Grand Designer

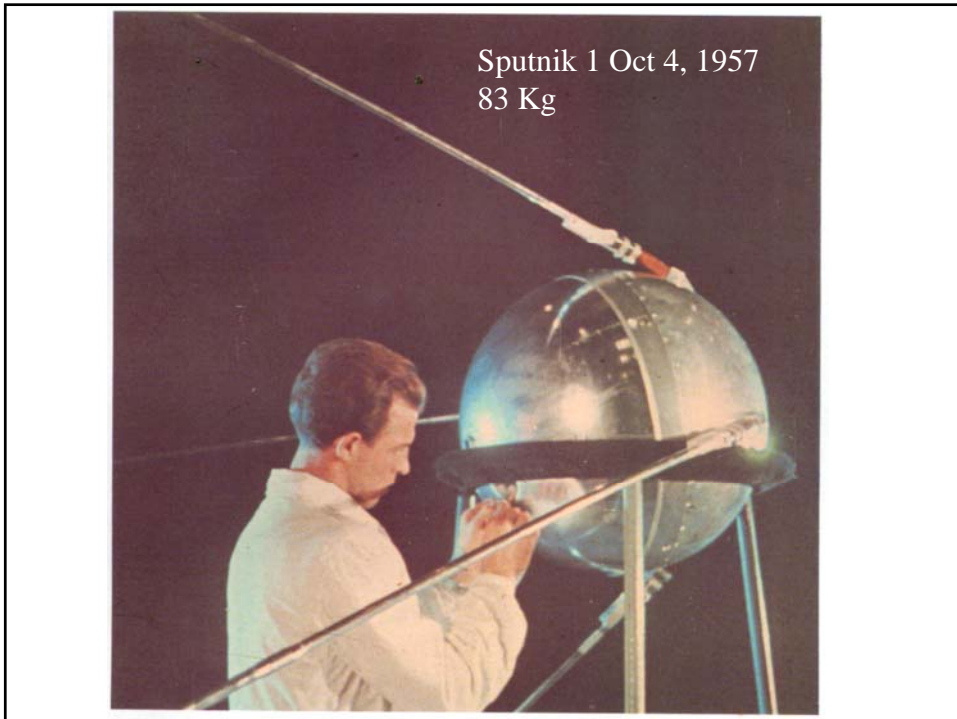


**Sergey Pavlovich Korolev**  
The founder of practical cosmonautics.  
Chief Designer of the first rocket / space systems.  
The founder and first manager of OKB-1 (1946-1966)

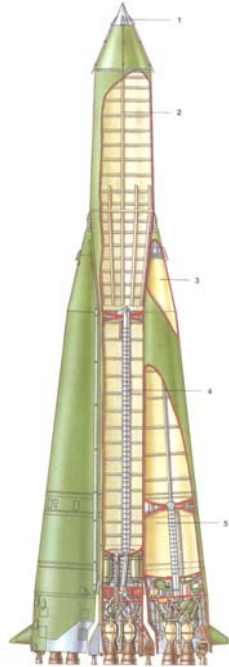
Wernher Von Braun: America's Chief Rocket Engineer



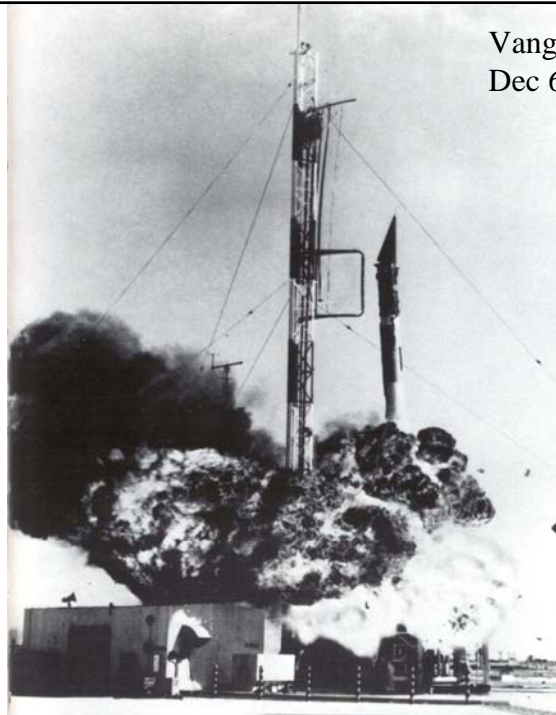
Sputnik 1 Oct 4, 1957  
83 Kg

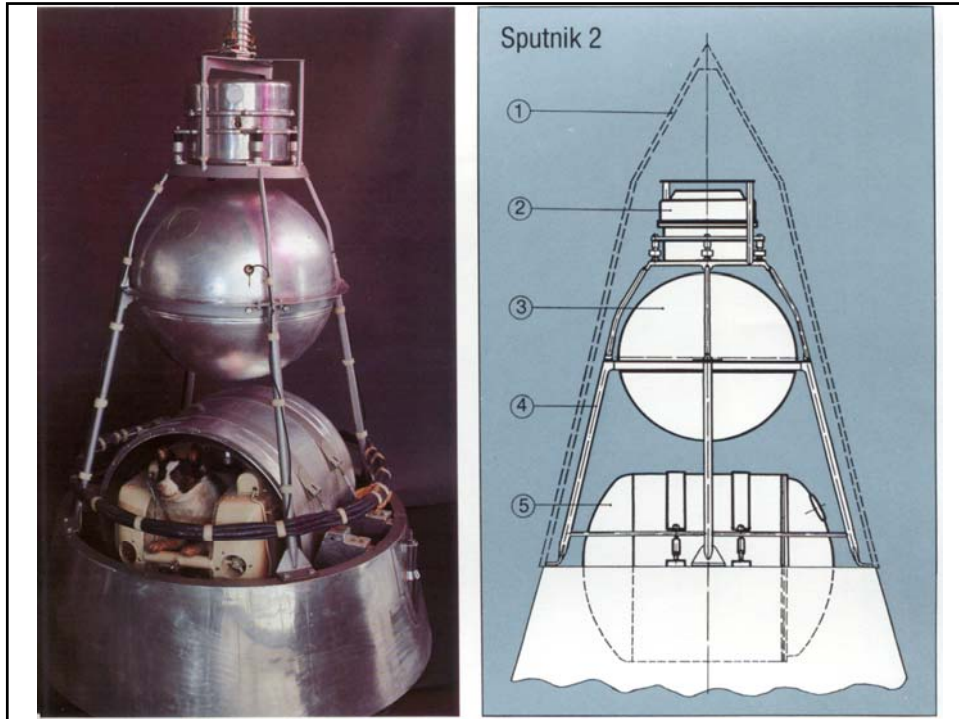


Russian R7  
Sputnik Launcher



Vanguard Flopnik  
Dec 6 1957



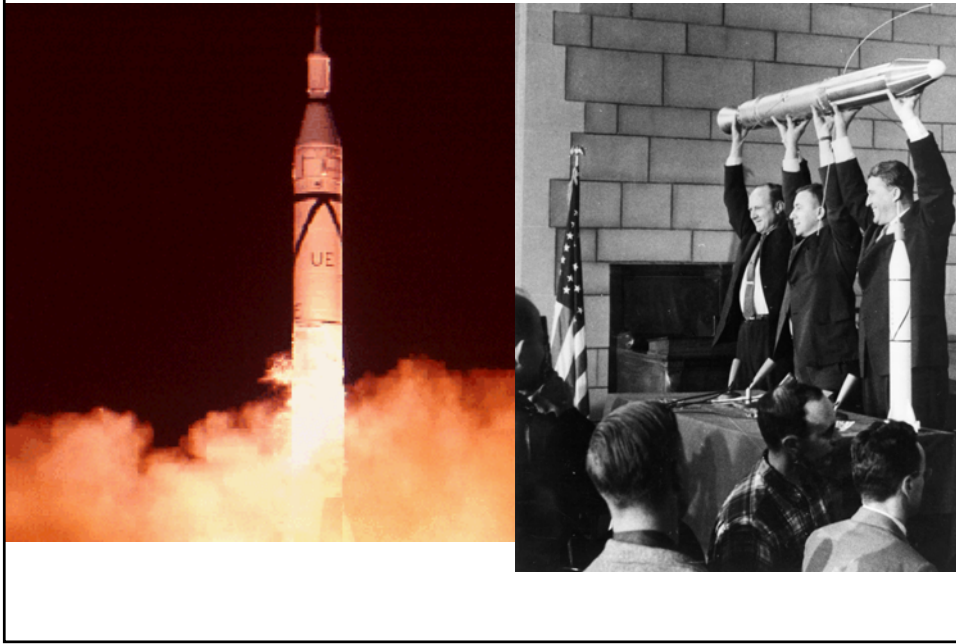


**Sputnik 2 Nov. 3 1957:  
508 Kg**

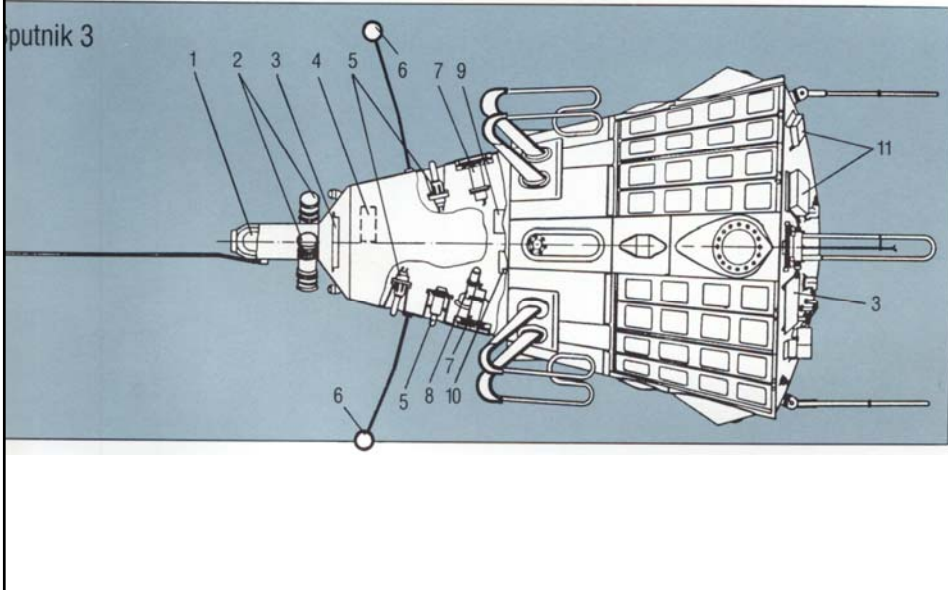


*Above: Laika, the first animal to be launched into orbit around the Earth. This husky-type bitch was launched inside a pressurised cabin as part of the Sputnik 2 payload, but no recovery was possible at the end of the mission.*

**Explorer 1: Jan 31, 1958: 1<sup>st</sup> US satellite**



**Sputnik 3 May 15, 1958: 1.3 Tonne**





Russian Soyuz Booster on way to the Launch Pad



Russian Soyuz Booster being Erected



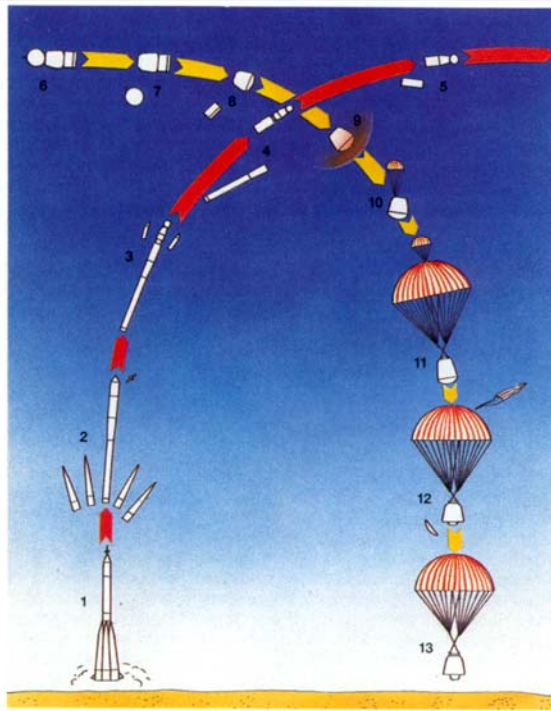
Installation of the four-stage launch vehicle with an automatic interplanetary station onto the launch pad.

## Russian Soyuz Launch

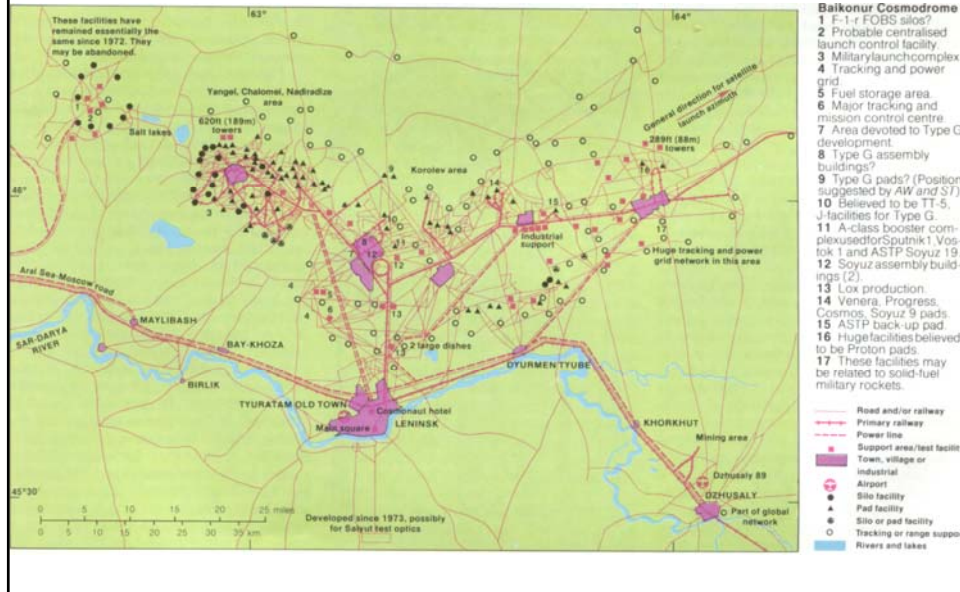


### Launch and Landing Sequences of a Typical Soyuz Mission

- 1 Launch atop an SL-4 booster.
- 2 Separation of the four strap-on boosters.
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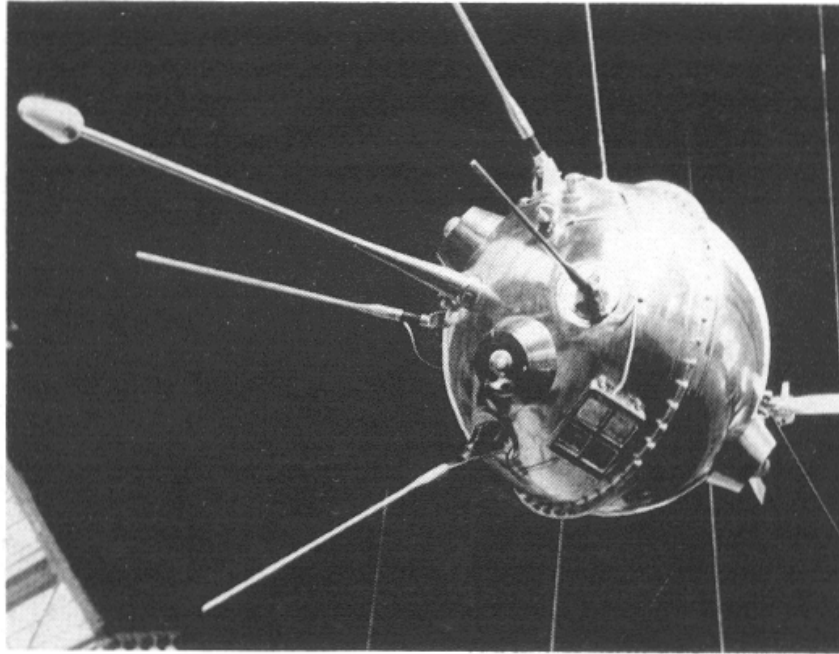
## USSR's Baikonur Cosmodrome



## USA Kennedy Space Center

- Kennedy Space Center**
- 1 Launch Complex 39B (Apollo/Saturn V, Skylab/Saturn IB, ASTP/Space Shuttle)
  - 2 LC-39A (Apollo/Saturn V, Skylab/Saturn V, Space Shuttle)
  - 3 C-41 (Titan III-Centaur)
  - 4 C-40 (Titan III)
  - 5 C-37A and B (Apollo/Saturn IB), dismantled
  - 6 C-34 (Apollo/Saturn IB), dismantled
  - 7 C-20 (Titan), deactivated
  - 8 C-19 (Gemini-Titan II), deactivated
  - 9 C-16 (Pershing), deactivated
  - 10 C-15 (Titan), deactivated
  - 11 C-14 (Mercury-Atlas), dismantled
  - 12 C-13 (Atlas Agena), deactivated
  - 13 C-12 (Atlas Agena), deactivated
  - 14 C-11 (Atlas), deactivated
  - 15 C-36 (Atlas-Centaur)
  - 16 C-31 and -32 (Minute man), deactivated
  - 17 C-18 (Blue Scout), deactivated
  - 18 C-17 (Delta)
  - 19 Air Force Space Museum (formerly C-26)
  - 20 C-30, deactivated
  - 21 C-25 (Trident)
  - 22 C-29, standby
  - 23 Missile assembly area
  - 24 Antenna field
  - 25 Missile propellants
  - 26 Command control building
  - 27 Spin test facility
  - 28 Liquid fuel storage
  - 29 Control centre
  - 30 Propellant inspection area
  - 31 Solid propellant storage
  - 32 Engine storage
  - 33 Spin test facility
  - 34 Solid motor assembly building
- Legend:
- Road
  - Railway
  - Base facility
  - Launch complex
  - Launch pad

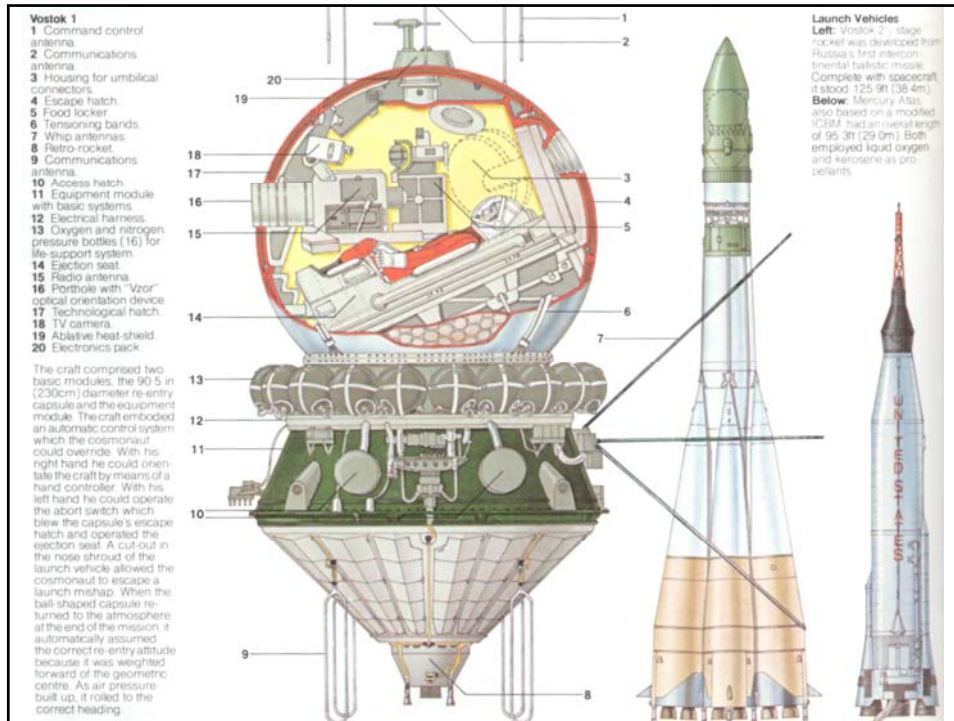




*Luna 2.* Russian Luna 2 hits Moon Sept 12, 1959



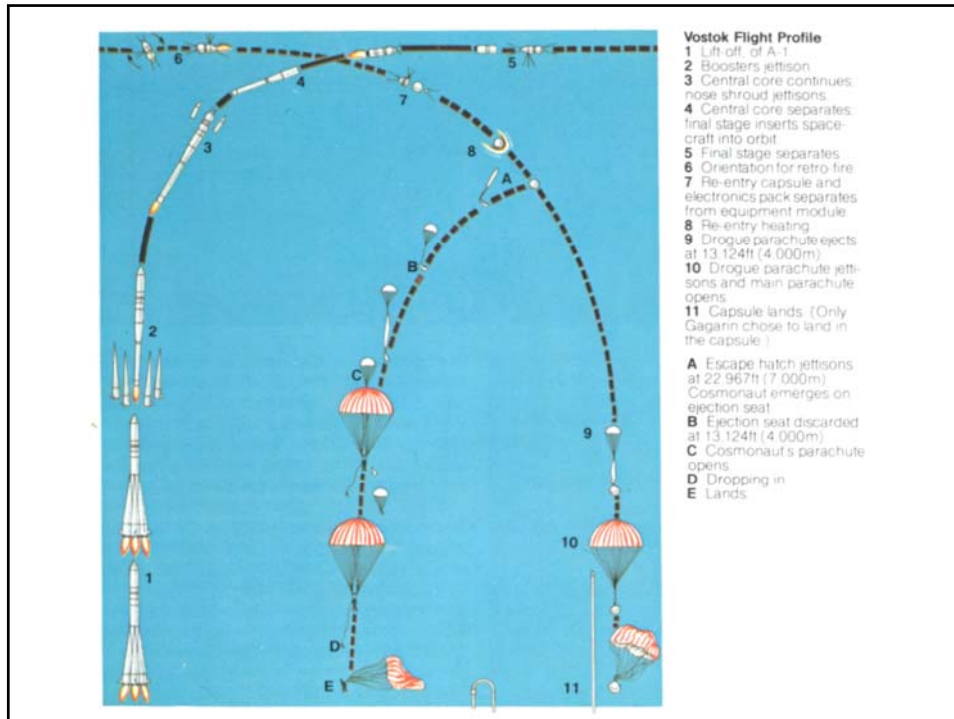
Gagarin with Sergei Korolev shortly after the flight, 1961

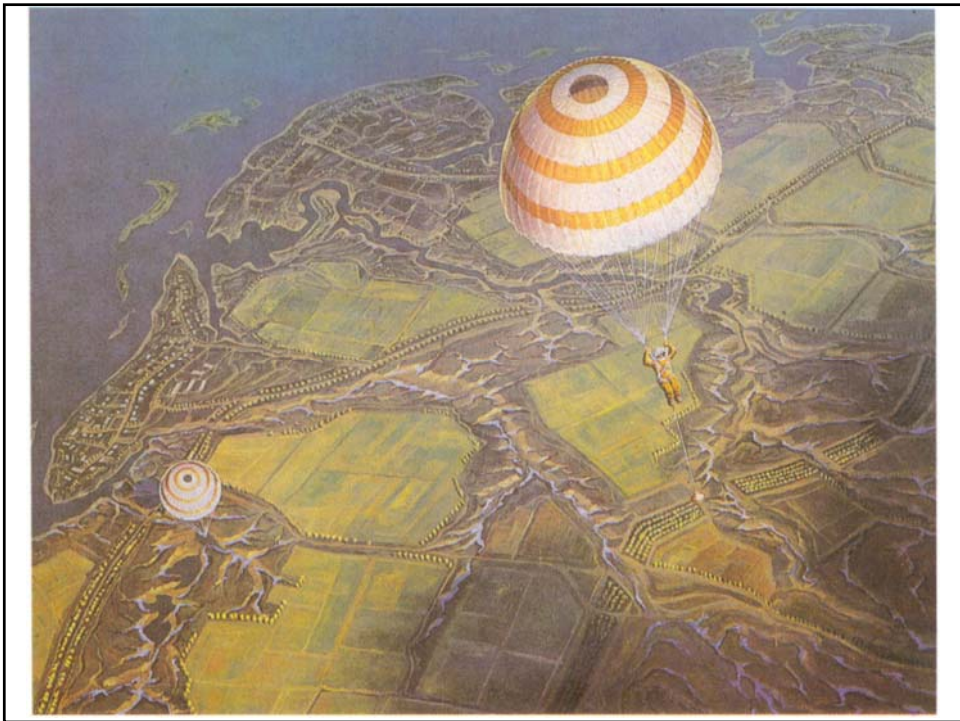


Vostok 1 Capsule  
Apr. 12 1961



Above: The Vostok craft at assembly stage  
Note the oxygen and nitrogen life-support system bottle 'necklace'. Right: Vostok on display.  
Note the Kosmos-designated rocket.





## Gagarin's Capsule on Landing



*Above: Making an interesting comparison with the drawing of the cosmonaut ejecting, this photograph shows a Vostok sphere on display, with the top of an ejector seat and cosmonaut mock-up clearly shown inside.*

*Left: Reputedly Gagarin's capsule, this is a recovery photograph of a Vostok sphere. Vostok 1 was apparently in a bad condition after landing and had to be heavily repaired prior to being displayed.*

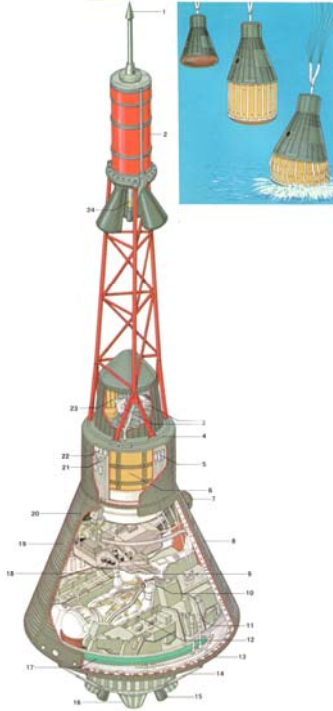
Friendship 7  
John Glenn  
Feb 20 1962





US Mercury Capsule

John Glenn  
Feb 20 1962



**President Kennedy's Challenge: Sept. 12, 1962**

**We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills,**

## Russian & US Space Philosophy

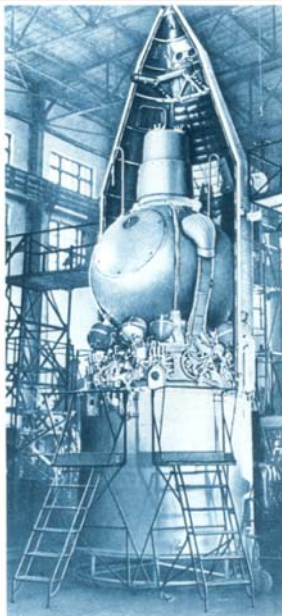
### Russian/USSR

- KISS: Keep It Simple Stupid
- Reuse what you have & improve
- Simplify the design & the analysis
- Tradeoff performance for ruggedness
- Logical progression in space

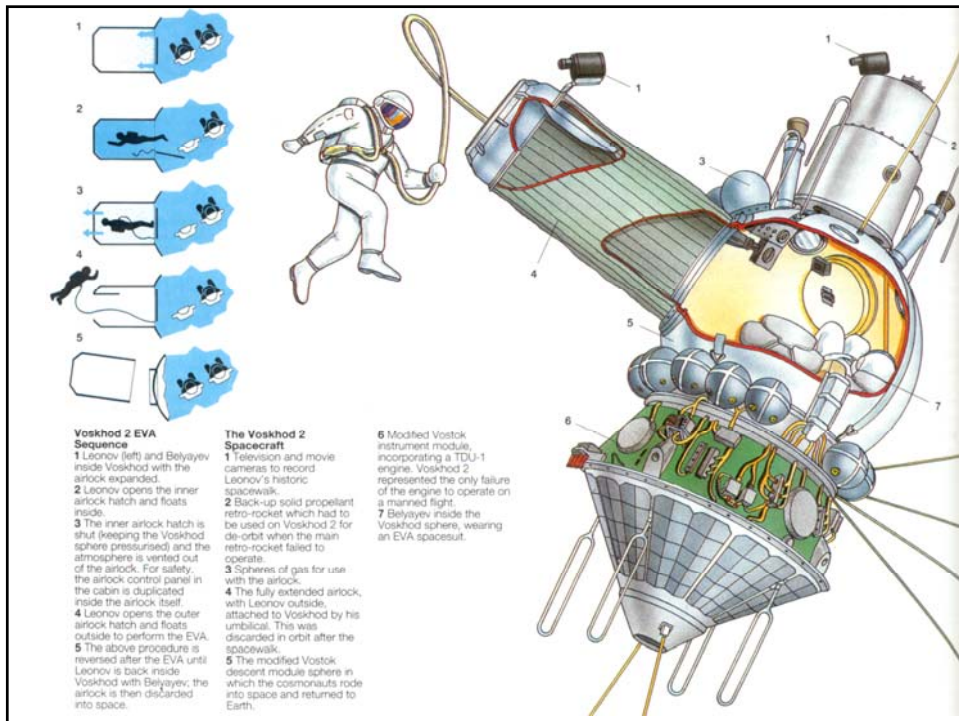
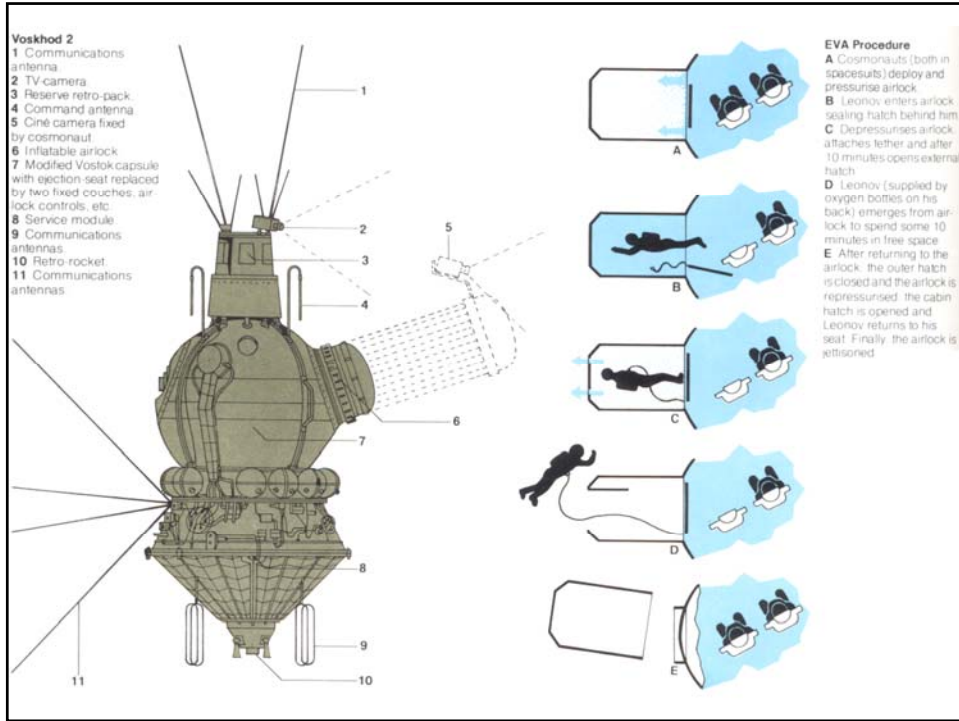
### USA

- Highest technology available even if complex
- Make major leaps in design
- Highly complex design & detailed analysis
- Maximize performance even if fragile
- Make great leaps in goals
- Best idea: concentrate on electronics

Voskhod 1  
Apr. 13, 1964



*Above: A rare photograph of a Voskhod spacecraft in assembly. The instrument module is surrounded by the adapter at the base; atop the modified Vostok sphere is the back-up retro-rocket.*

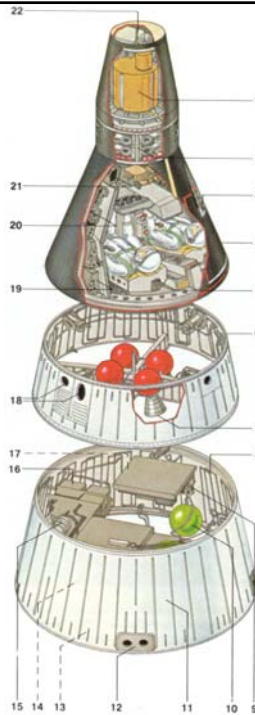


Voskhod 2  
Aleksai Leonov  
First Spacewalk  
Mar. 18, 1965



*These three stills are from the external movie camera on Voskhod 2, which recorded Aleksai Leonov's historic spacewalk in March 1965. (files of Prof Siddiq)*

US Gemini  
Gemini III  
Mar. 23, 1965



**Above:** Titan II lifts a two-man Gemini spacecraft from the pad at Cape Canaveral. Longest flight of the series was that performed by astronauts Borman and Lovell in Gemini 7 in December 1965. They were aloft 330hr 35min.

Russian Grand Designer  
Dies 1966

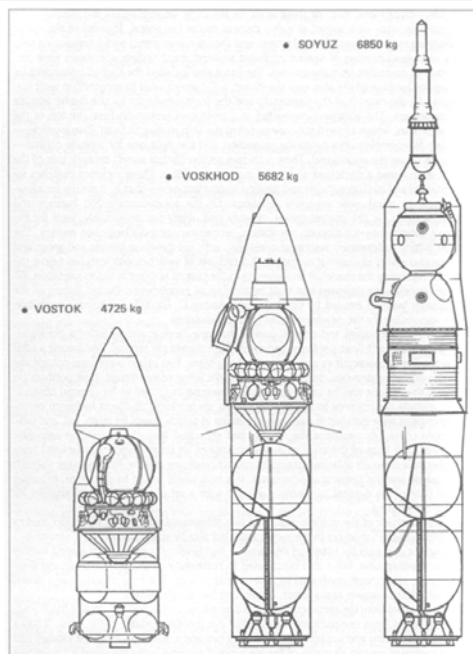


Vassily Mishin  
replaces Kovolev



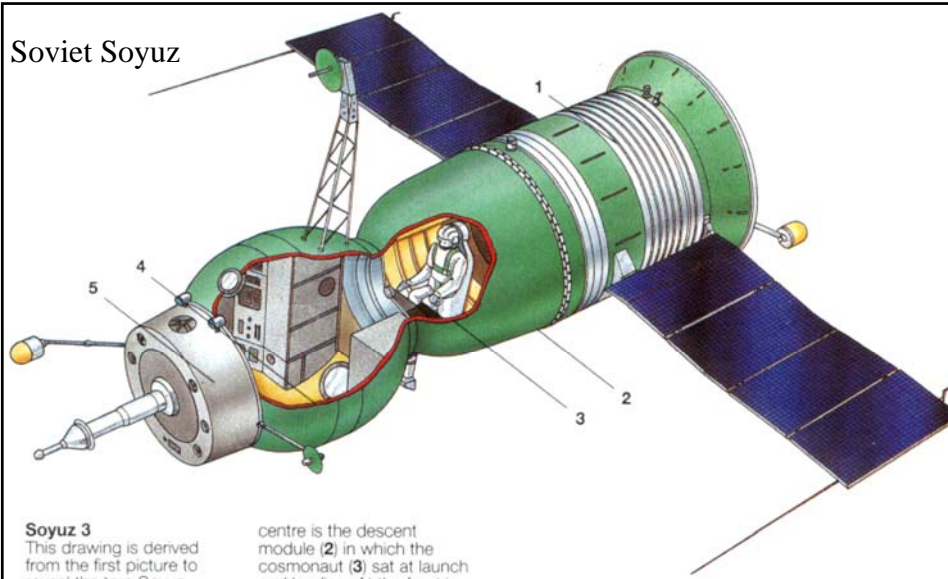
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USSR's  
Capsule Evolution



Here are the early generations of Soviet piloted Earth-orbital spacecraft side by side. The Voskhod variant shown in the middle is the 3KD or spacewalk version. Almost identical versions of the R-7A core plus strap-on would be below each of these payloads. The launch vehicles are the 8K72K for the Vostok, the 11P57 for the Voskhod and the 11B511L for the Soyuz. (copyright D. R. Woods)

## Soviet Soyuz



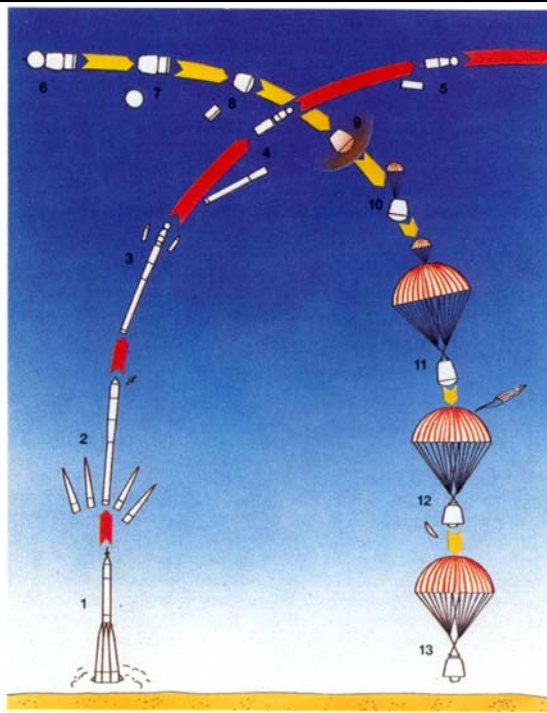
### Soyuz 3

This drawing is derived from the first picture to reveal the true Soyuz design, depicting Soyuz 3. On the right is the instrument module (1) with the main propulsion system and solar panels for electrical power. In the

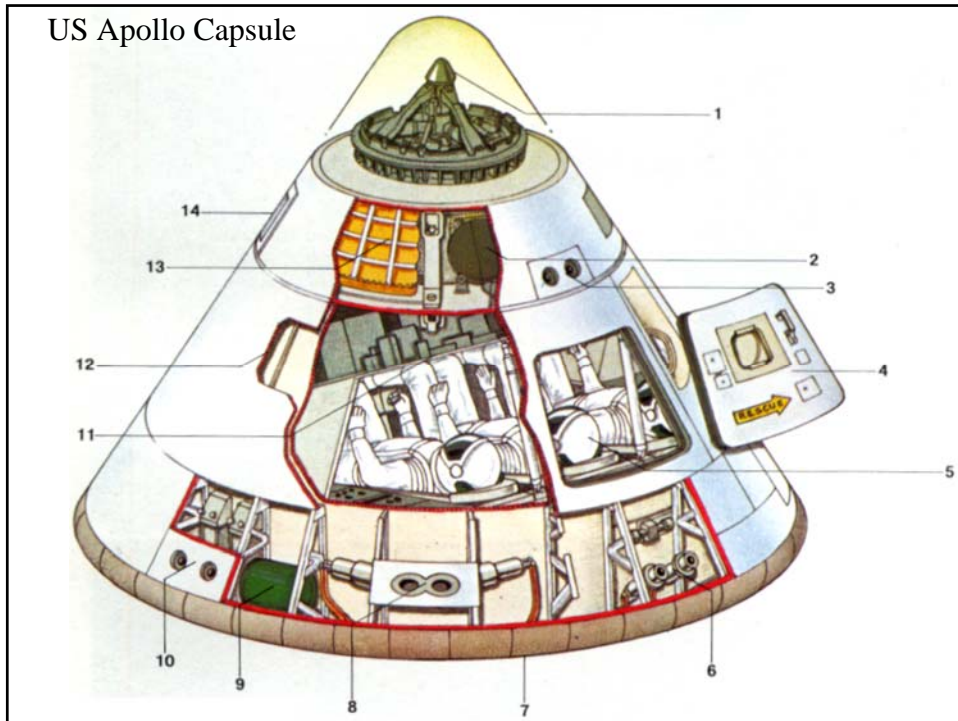
centre is the descent module (2) in which the cosmonaut (3) sat at launch and landing. At the front is the orbital module (4) and the original Soyuz docking system (5) which was not designed to allow internal crew transfers between Soyuz spacecraft.

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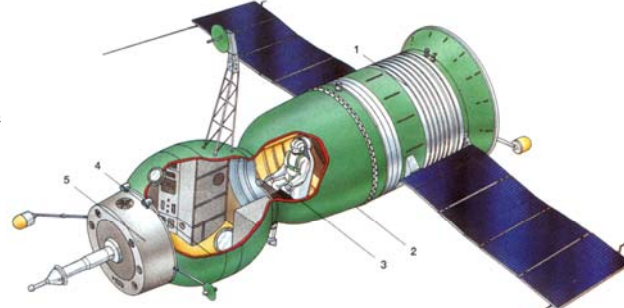
## US Apollo Capsule



The interior of CM 012 (Apollo 1), showing the effects of the intense heat of the flash fire which claimed the lives of the three Apollo 1 astronauts, Grissom, White and Chaffee. Jan. 27, 1967 Apollo 1 fire: US program stops for 2 years

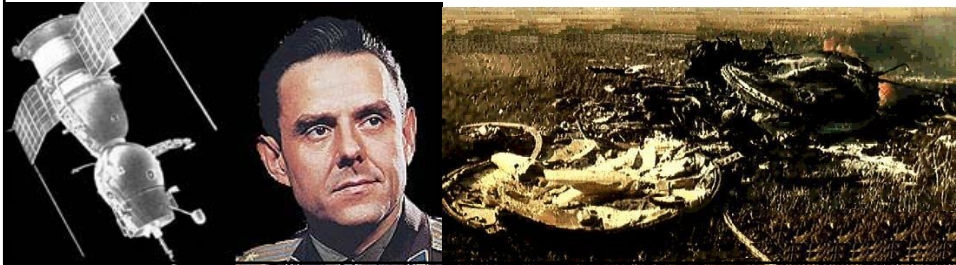
**Soyuz 1 Apr. 23 1967:**

Failure: Komarov dies  
Vassily Mishin in charge



**Soyuz 3**  
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Next:  
The Race to the Moon

