

Bell Ringer

1. What is the difference between the dark spots on the moon and the light spots?
2. Europa and Ganymede both have what underneath their icy crusts?
3. What time of day would you expect to see a 1st quarter Moon?

Space Exploration



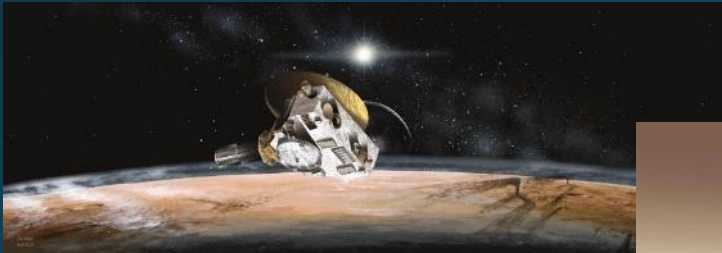
Goals for today

- Understand the various ways in which humans explore space
- Know the most important human exploration programs
- Future of human exploration

Ways in which we explore space

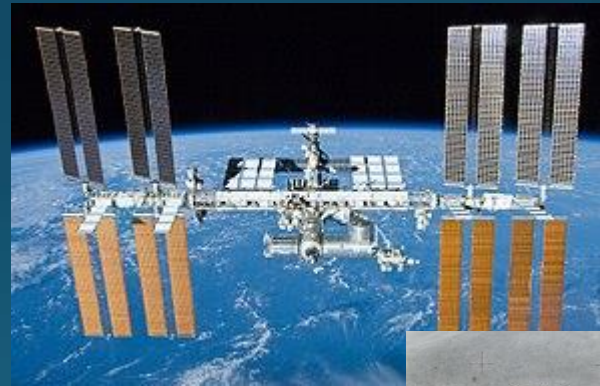
- We send something there:

- Orbiters
- Landers
- Probes
- Rovers



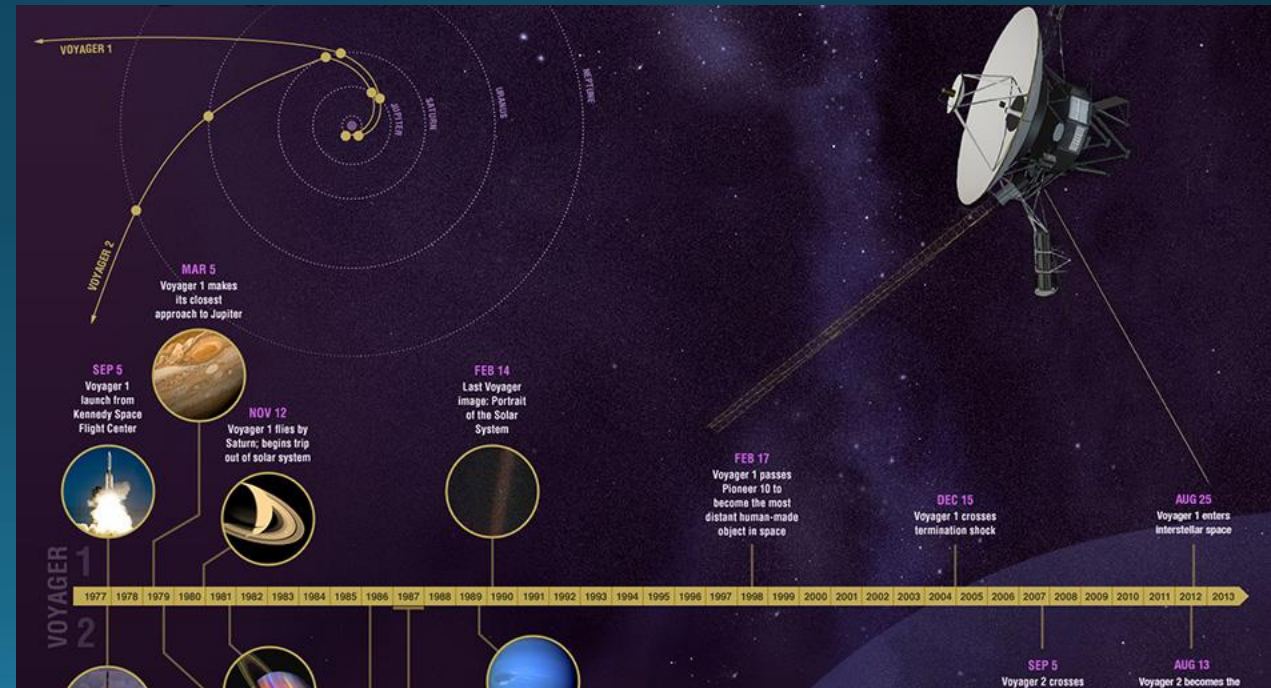
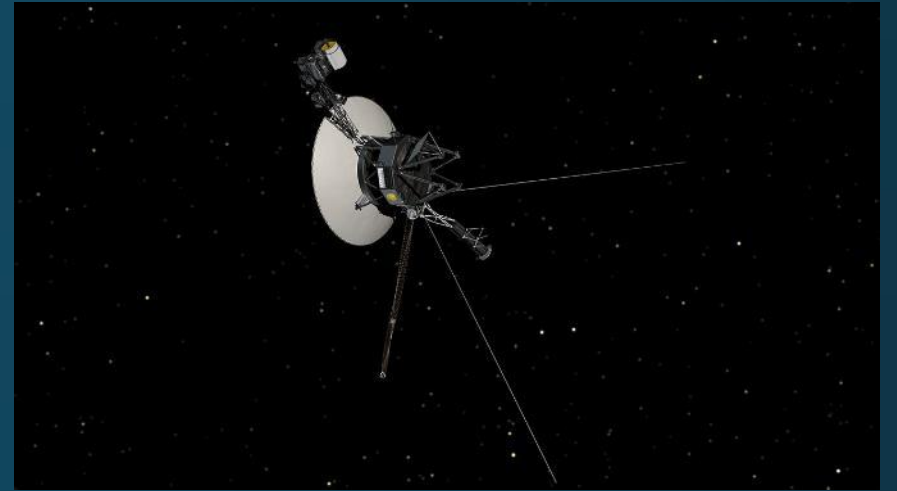
- We go there:

- Apollo missions
- International Space Station



Sending stuff - Probes

- Sent to study specific objects,
but then keep on going
indefinitely.
- Good for when we know very
little about something.
- Example: Voyager probes
- Sent to explore the outer planets and continue on out of the Solar System.
- Another example: New Horizons, studied Pluto and is continuing through the Kuiper Belt.

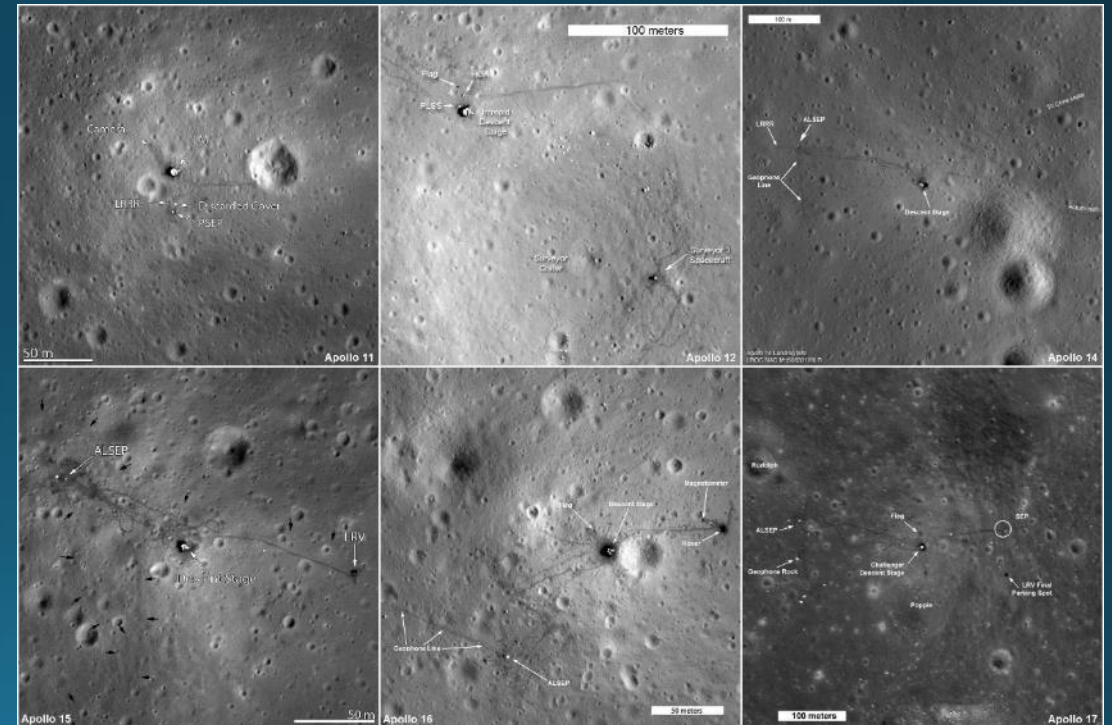


<https://voyager.jpl.nasa.gov/mission/status/>

<https://voyager.jpl.nasa.gov/>

Sending stuff - Orbiters

- Orbiters are sent to go orbit a specific object in space and study it using a variety of sensors.
- Good for a wide, general understanding of an object. (e.g. taking photographs of the whole planet, measuring global ice, etc.)
- Example: Lunar Reconnaissance Orbiter. (LRO)
- Taking live footage of the Moon.
- Picture on the left is every landing site for the Apollo missions.



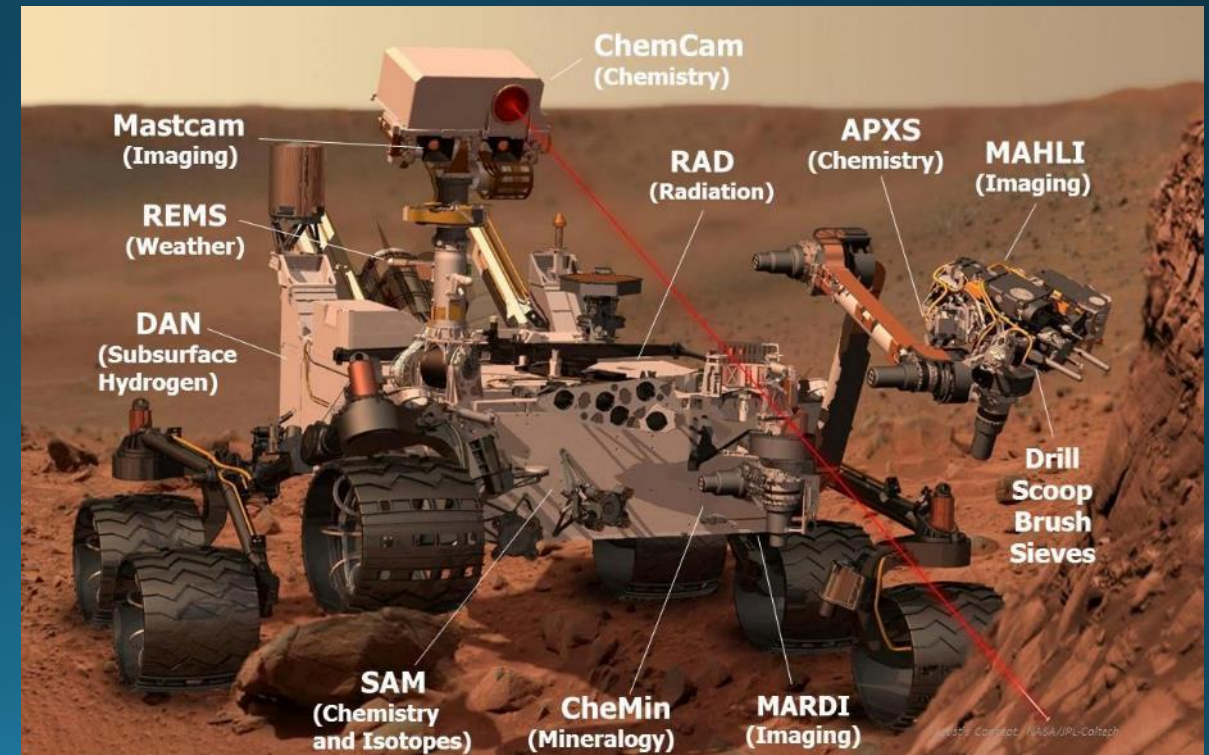
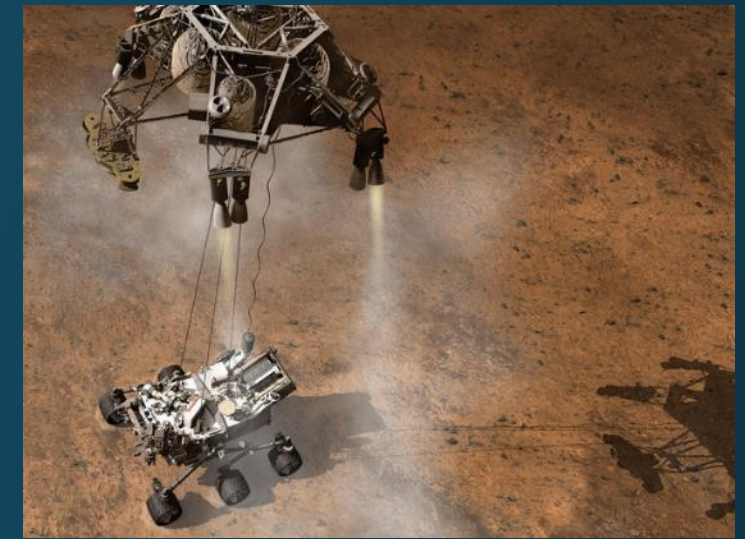
Sending stuff - Landers

- Landers are sent to actually land on an object's surface.
- Good for a more close up view, can also study the surface at that spot.
- Helpful when we can't see the surface
- Example: Venera 13. Soviet mission to Venus. Took pictures.
- Why would we need a lander and not an orbiter for Venus?



Sending stuff - Rovers

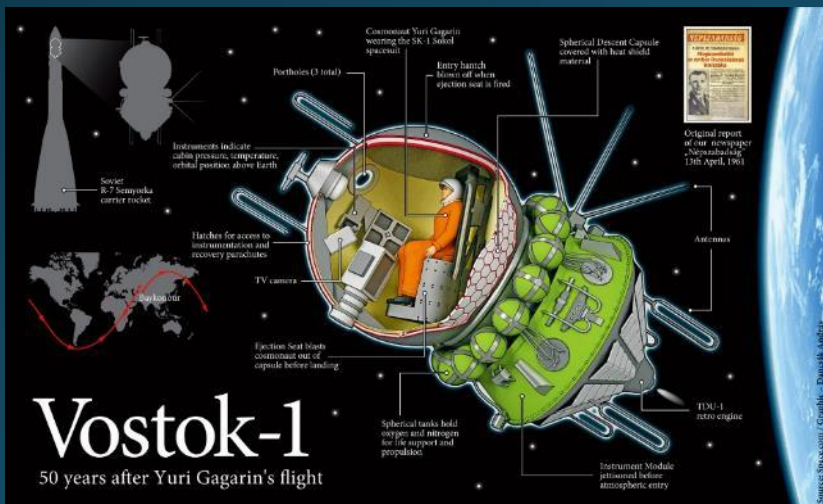
- Rovers are sent to land on an object and then move from place to place.
- Good for when we want to know lots of details about specific properties of an object.
- Example: Curiosity, Spirit, Opportunity, Sojourner.
- Curiosity is finding out what Mars' soil is made out of and if there's water ice and life there.



Going there – From the beginning

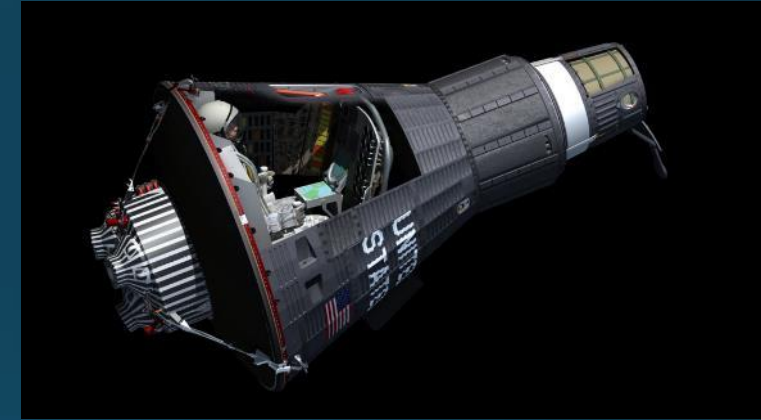


- Yuri Gagarin: First human in space, Soviet Union.
- Along with Sputnik, began the Space Race between the USSR and the United States.
- Yuri made it 203 miles above the surface of the Earth (Space starts at 61 miles)
- 1 orbit, then came back down to Earth
- Had to parachute out of the capsule.



United States responds: Mercury / Gemini

- Mercury program and Gemini program sent Americans into space.
- Program helped us understand if humans can exist in space.
- Alan Shepherd was the first American in space.
- Gemini mission allowed for the first space walk (Getting out of the spacecraft)
- Capsule reenters atmosphere like meteorite. Splashes into ocean.



Project Mercury

Mission Number	Notable events
Mercury 1	Rocket test - Failure
Mercury 2	First American chimp in space 😊
Mercury 3 (Freedom 7)	First American in space
Mercury 4	
Mercury 5	Chimp flight – testing new suit
Mercury 6 (Friendship 7)	John Glenn becomes first American to orbit Earth
Mercury 7	
Mercury 8	
Mercury 9	Last American solo spaceflight

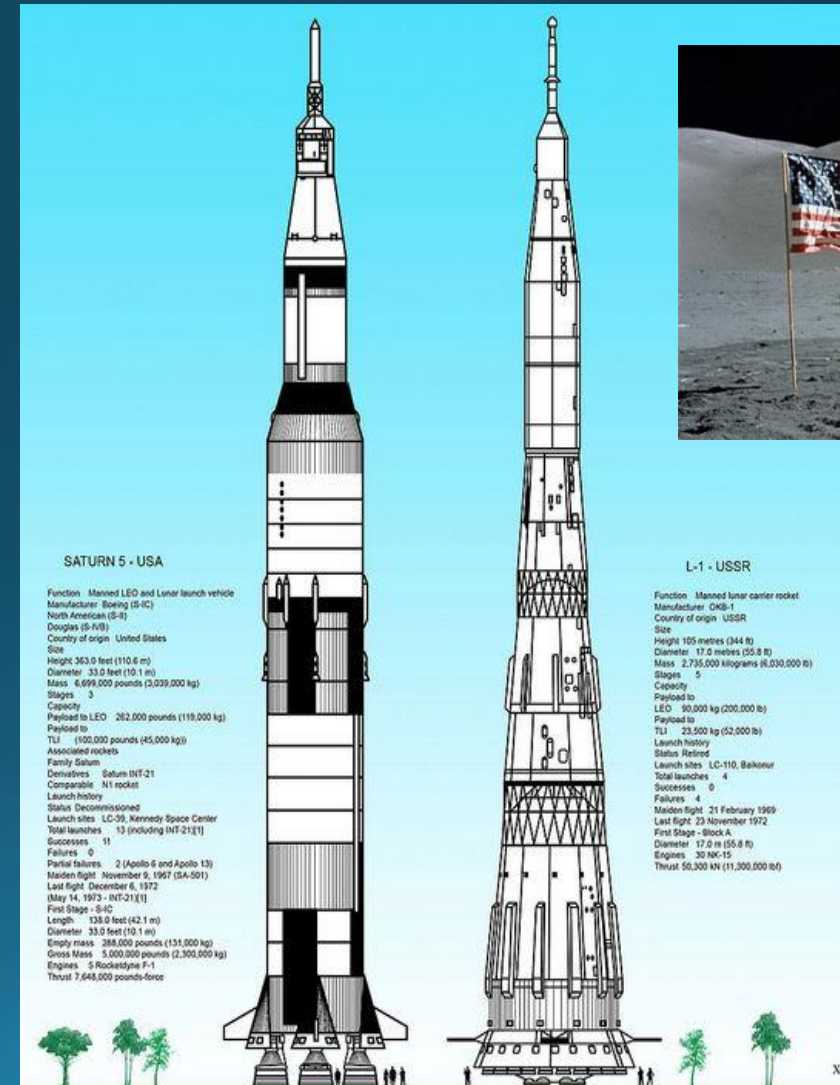
Mercury 1: <https://www.youtube.com/watch?v=7O4V7JfeTSU>

Project Gemini

Mission Number	Notable events
Gemini 1	Test flight
Gemini 2	Heat shield test
Gemini 3	First manned Gemini flight
Gemini 4	First American space walk
Gemini 5	
Gemini 6	Scrubbed. Flew after 7 launched.
Gemini 7	Rendezvoused with Gemini 6 in space.
Gemini 8	
Gemini 9	
Gemini 10	
Gemini 11	
Gemini 12	Final Gemini flight

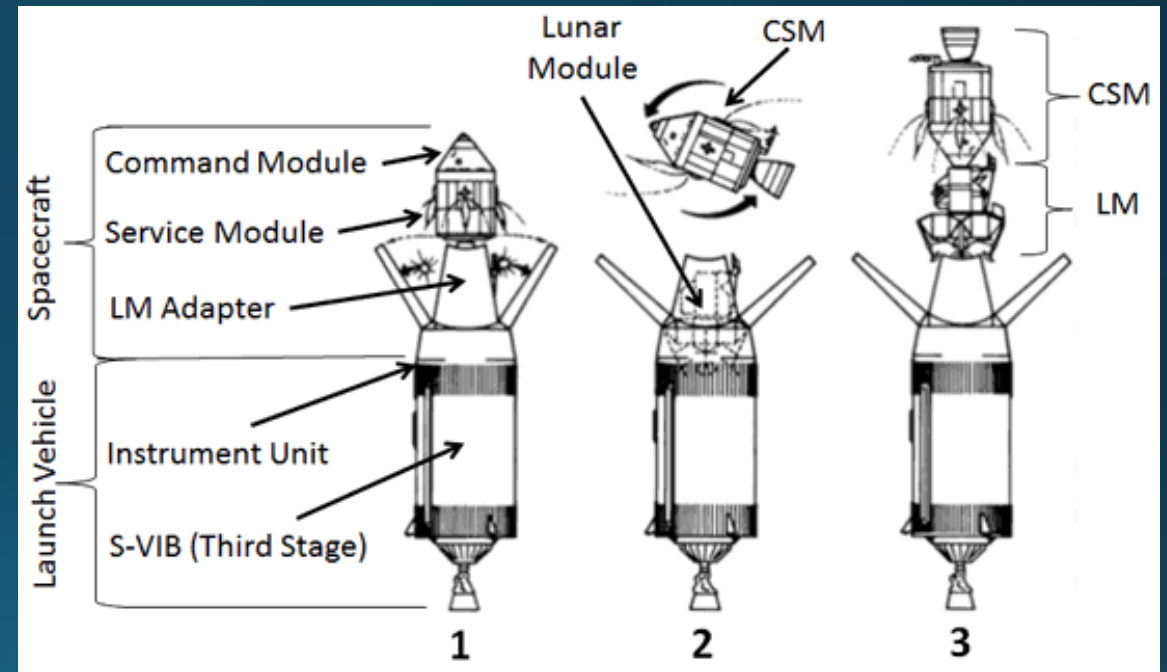
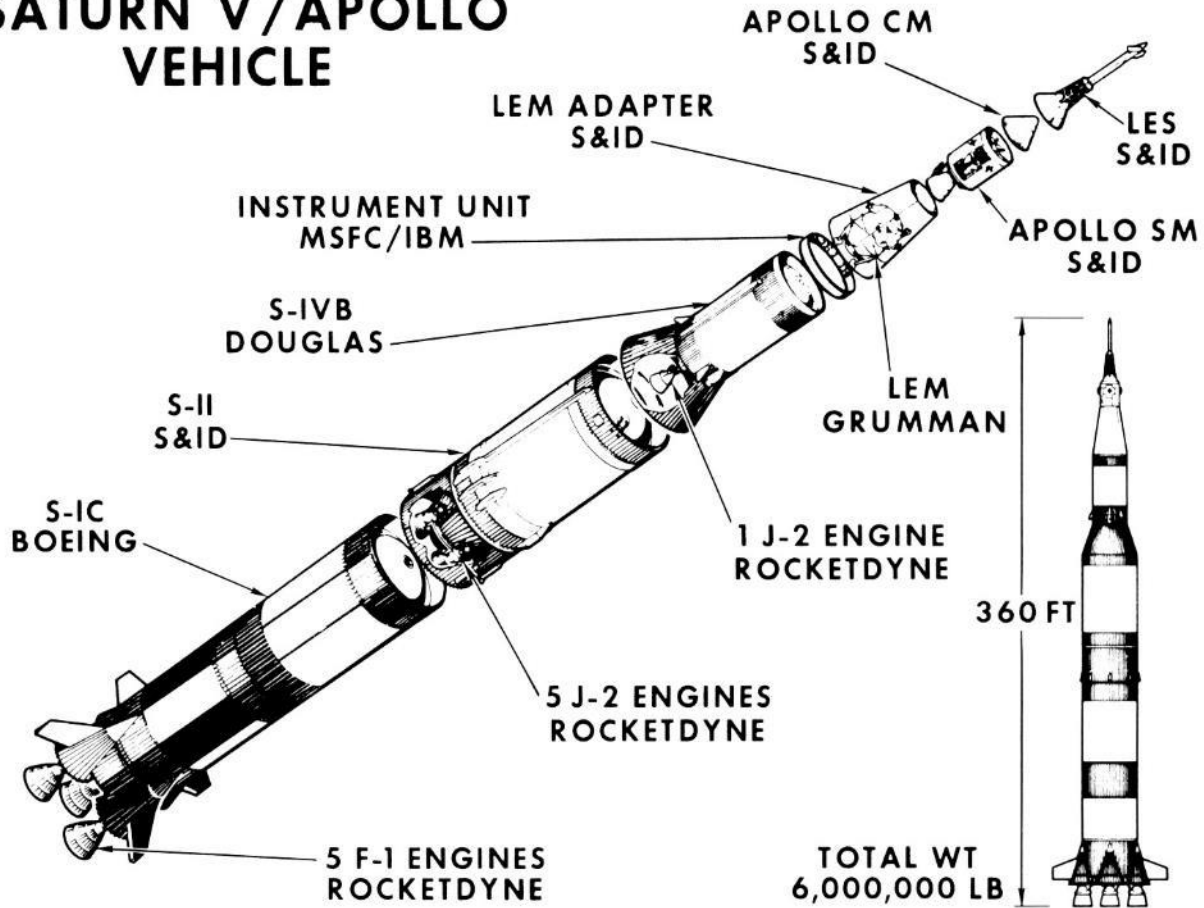
The US pulls ahead of the USSR: Apollo Missions

- <https://www.youtube.com/watch?v=g25G1M4EXrQ>
- Apollo mission answered Kennedy's call to go to the Moon.
- Successfully took American astronauts to the Moon and back.
- Only mission to ever land astronauts on the Moon, or any other object other than Earth.



Apollo Rocket

SATURN V/APOLLO VEHICLE



<https://www.youtube.com/watch?v=Y6F5oHSqbv4>

Apollo 11



- First time any human has stepped on any other celestial body besides the Earth
- Americans were the only ones to ever go to the Moon

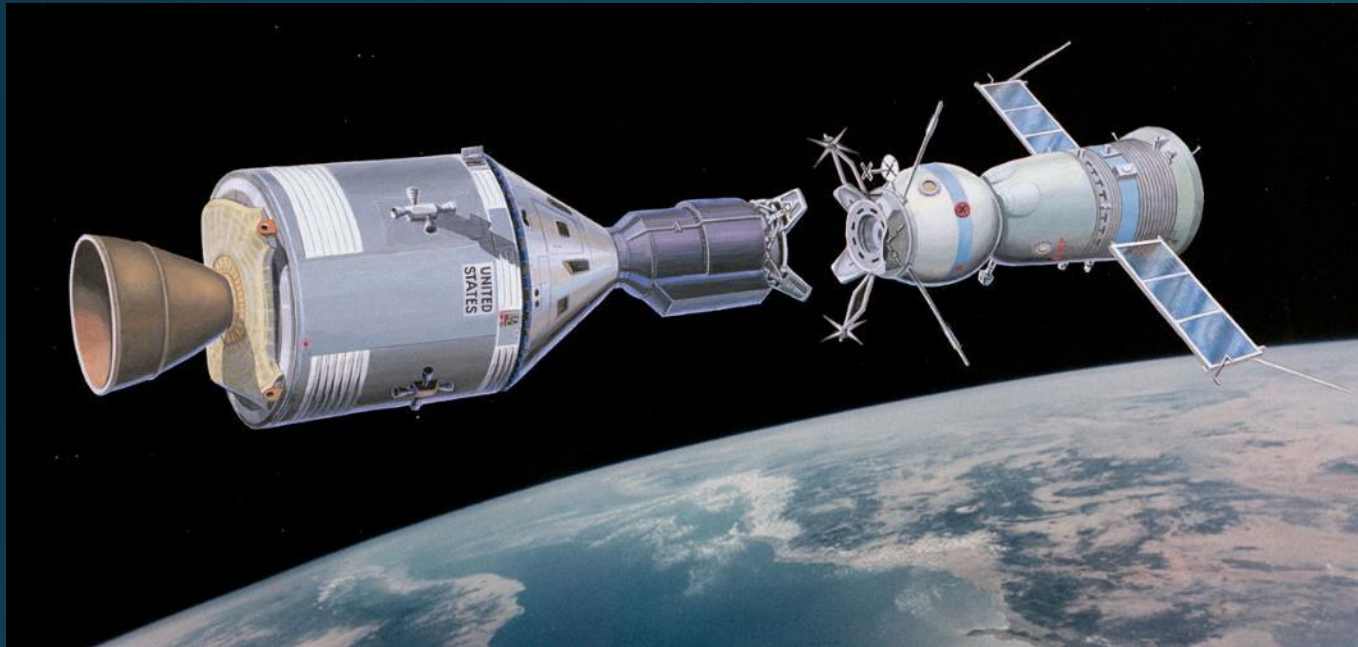
<https://www.youtube.com/watch?v=5F6B1U77dgs>

Was it a fake? No. We have proof: LRO, mirror on the Moon, use a telescope, more...

Project Apollo

Mission Number	Notable events
Apollo 1	Failed before launch. Fire in the cockpit killed all 3 crew.
Apollo 2	Test - Ground
Apollo 3	Test - Ground
Apollo 4	Unmanned flight test
Apollo 5	
Apollo 6	
Apollo 7	First manned orbital demonstration
Apollo 8	Flew to moon and back, never landed, scouted out locations
Apollo 9	
Apollo 10	
Apollo 11	Neil Armstrong and Buzz Aldrin first humans to step on Moon.
Apollo 12	
Apollo 13	Service module explodes in space. Aborts and returns to Earth.
Apollo 14	
Apollo 15	Crew uses first lunar rover.
Apollo 16	
Apollo 17	Final mission. Geologist sent to the Moon.
Apollo 18	Never existed. Hollywood movie nothing more.

Apollo - Soyuz



- First cooperative mission between any countries in space.
- First docking between two spacecraft from different countries.
- Last American mission until the Space Shuttle

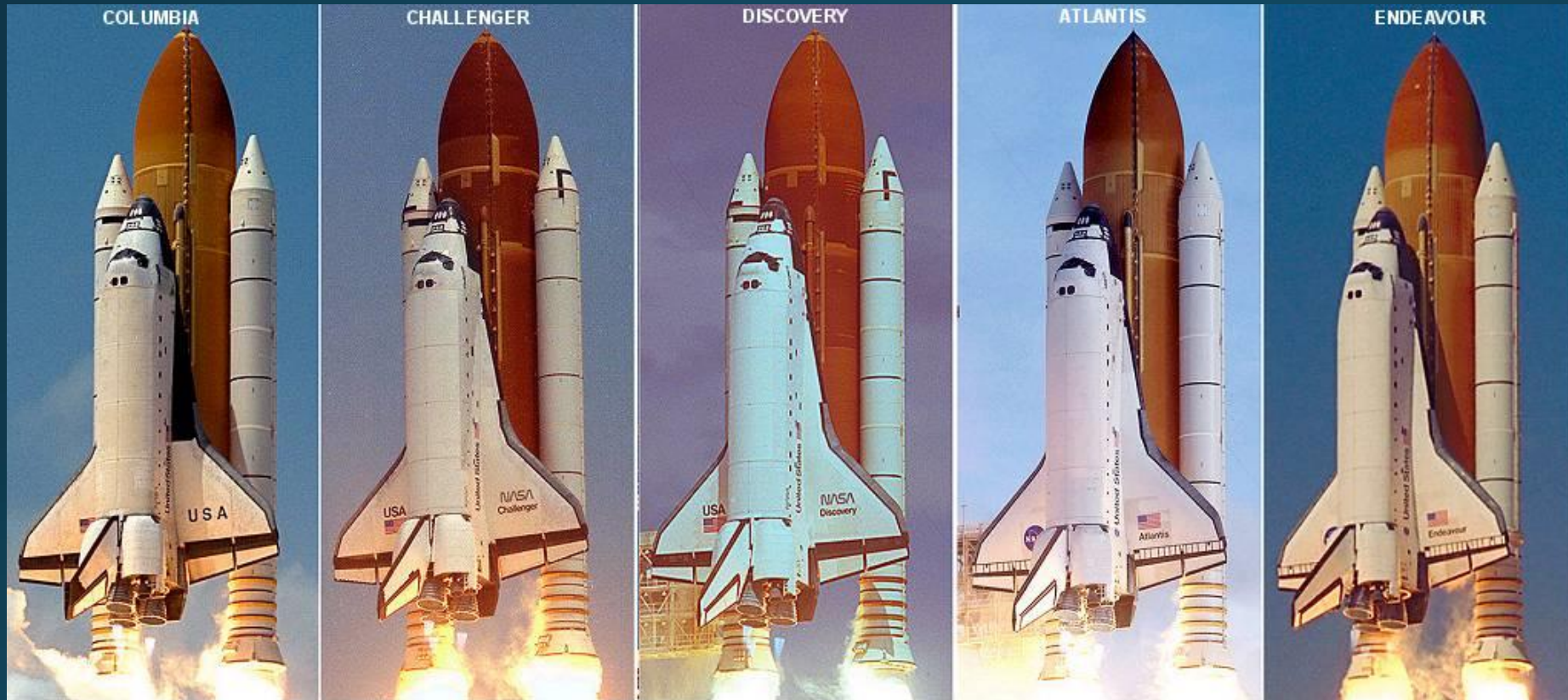


Space Shuttle

- Designed like a plane. Takes off vertically with the help of an external fuel tank and two booster rockets. Returns to Earth by gliding in.
- 135 missions, 134 launches, 133 landings.
- 2 failed missions.
- Crew of about 5-7 for each mission
- Took people and cargo to space for over 30 years
- Known for building the International Space Station.



5 Space Shuttles (+1 test shuttle)



Columbia
Challenger
Discovery
Atlantis
Endeavour

Enterprise



Space Shuttle: Challenger - 1986

- <https://www.youtube.com/watch?v=j4JOjcDFtBE>
- Failed shortly after liftoff
- Cold temperatures caused one of the booster rockets to leak fuel, in turn causing an explosion.
- All seven crew members were lost, including a civilian school teacher.

Space Shuttle: Columbia

- <https://www.youtube.com/watch?v=4PfLCduBM-E>
- Failed during reentry.
- During takeoff a piece of the external fuel tank fell off, damaging the heat shield on the wing of the space shuttle.
- When Columbia came back in for a landing the atmosphere heated up the ship through the small crack in the wing and ripped it apart.



International Space Station

- First international, cooperative space station to exist.
- Continuously orbiting Earth.
- Holds records for longest human presence in space.
- Docks for the Russian Soyuz, as well as the Space Shuttle and SpaceX spacecraft.
- Essentially a science station. Experiments in microgravity effects on humans, animals, plants, and other resources.
- Studies the Earth (climate change, ocean patterns, etc).
- Stepping stone of knowledge for future missions beyond Earth's orbit.



<https://www.youtube.com/watch?v=h8kOAroNNAo>

Explore the ISS

<https://www.google.com/maps/space/iss/@29.5602853,-95.0853914,2a,75y,223h,93t/data=!3m6!1e1!3m4!1szChzPIAn4RIAAQvxgbyEg!2e0!7i10000!8i5000>

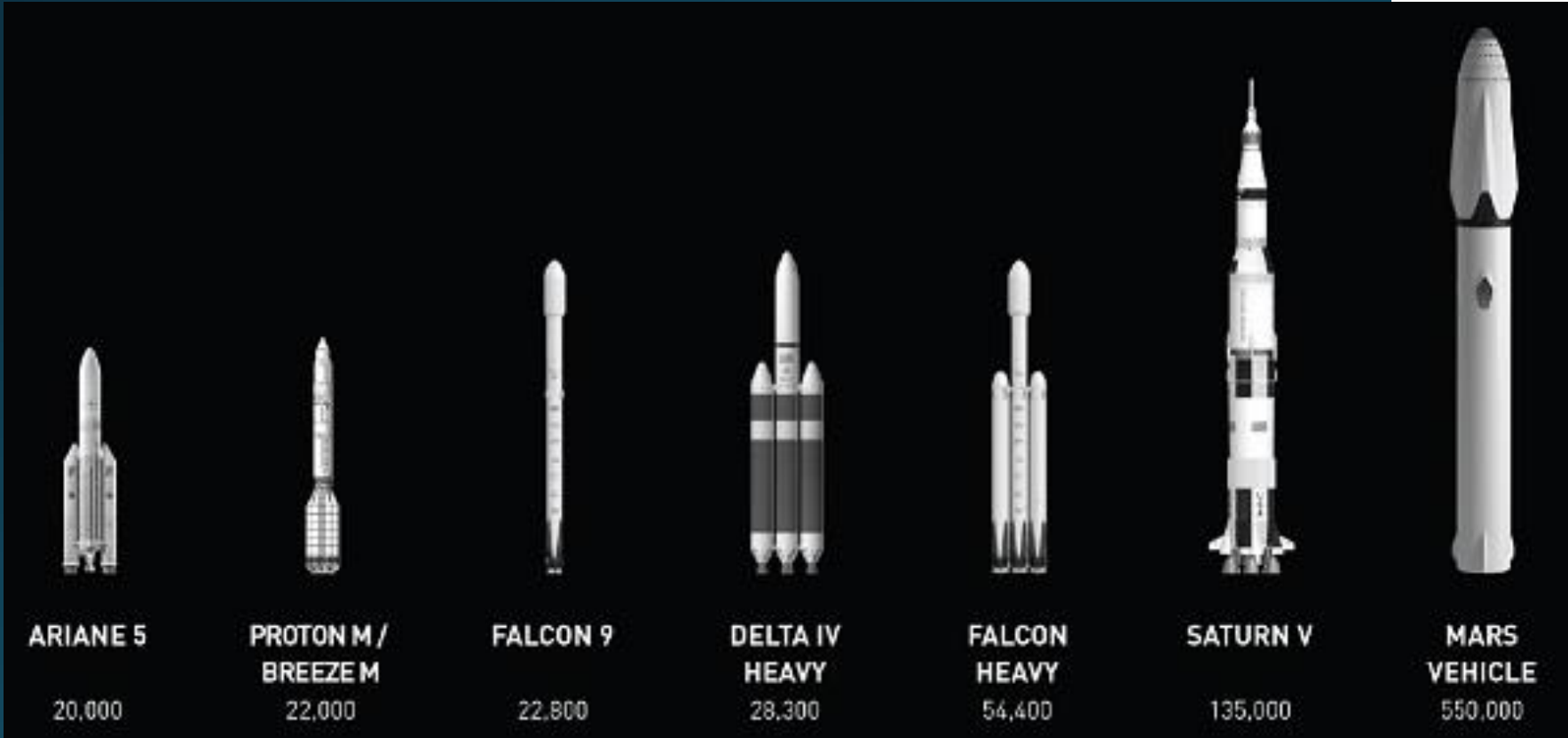
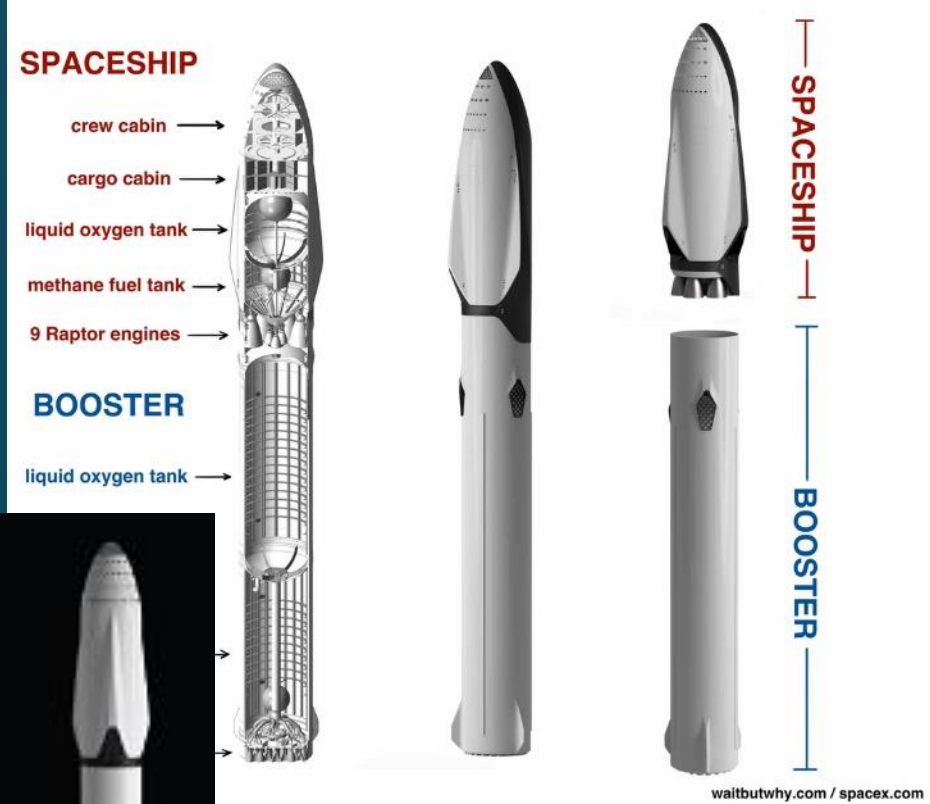
SpaceX

- Leading commercial spaceflight company
- Supplies the ISS
- Plans to send people to Mars by 2022
- Offering trips to the Moon (for lots of money)



BFR

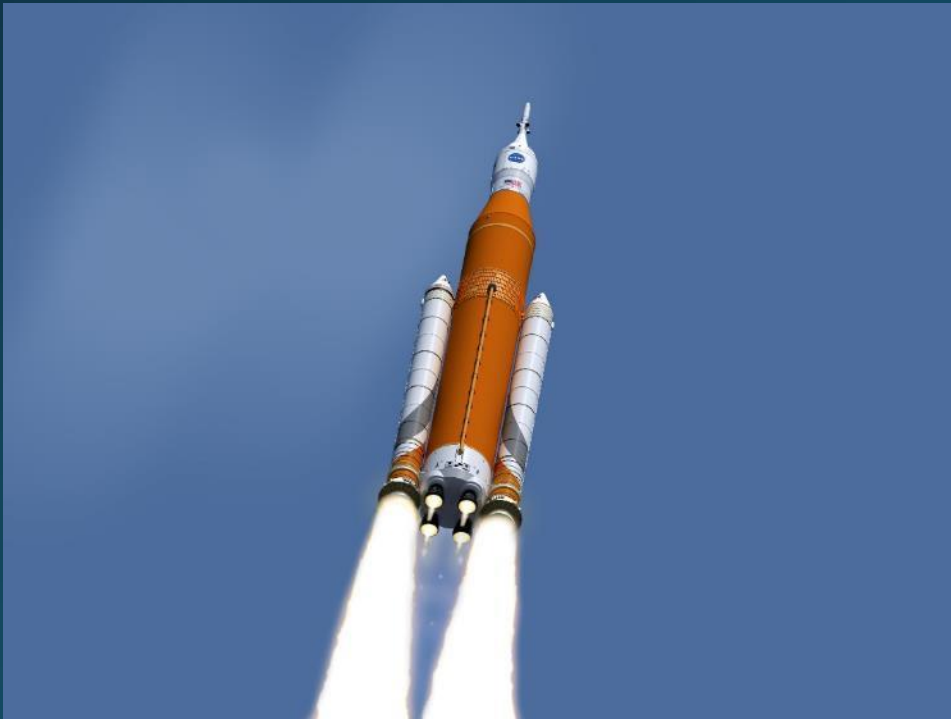
- Take people to Mars
- Stands for Big F----- Rocket. No joke.



Orion Space Program



- NASA's Plan to go to Mars in 2036
- First step, go back to the Moon.
- Then on to Mars.
- After Mars?



Mission	Notes	Year
Exploration Mission 1	Unmanned orbit of Moon	2019
EM 2	Manned Lunar Flyby	2021
EM 3	<u>Send Space Station to Lunar Orbit</u>	2023
EM 4		2025
EM 5		2026
EM 6	Transport Deep Space Transport to Lunar Station	2027
EM 7		2027
EM 8		2028
EM 9		2029
EM 10		2030
EM 11	Mission to Mars	2036

Exoplanet Project!