



# SOLAR TSUNAMIS

PARAWHENUA KŌMARU

Alana Fitzgerald, Timaru Airport

An astronaut in a white spacesuit stands on the lunar surface. The suit features an American flag patch on the right chest. The background shows the dark, cratered terrain of the Moon under a black sky.

# A Song of Ice and Solar Flares

Returning humans to the  
Moon this decade

Daniel Wrench

U3A Timaru

June 2024







# Getting people to the Moon (and beyond) requires 3 things



1961-1972



2022-

1. A reason to go
  - Nationalism
  - Economic benefit
  - Scientific discovery
  - Stepping stone?
2. A way to get there
  - Rocket
  - Capsule
  - Lander
3. A means to stay safe

# TIME

Getting people to the Moon (and beyond) requires 3 things



1961-1972

Monday Evening, October 5, 1957  
**Russians Win Race To Launch Earth Satellite**  
**Man On Threshold Of Space Travel**  
By DANIEL F. GILMORE  
United Press Staff Correspondent  
LONDON (UP)—The pulsating radio "beep" of the first manmade earth satellite signalled today to the world that man had crossed the threshold into the age of travel through space.  
The Soviet Union announced it had won the race into space by launching an earth satellite Friday, a 184-pound, 22-inch globe now orbiting the earth at 18,000 miles an hour, 560 miles up.  
Millions of persons throughout the world heard the "beep-beep-beep..." rebroadcast today by local stations and realized that man had taken his first faltering steps into the new era.  
Launching of the satellite was a tremendous victory for science. It was a more tremendous victory for Soviet propaganda to be able to trumpet to the world the Russians were the first to break through the frontiers of space.  
Bolsters ICBM Claims  
Bolsters ICBM claims to

How To Spot Satellite  
By UNITED PRESS  
Here's how to look for the Russian earth satellite which will be whizzing through the sky at 18,000 miles an hour.  
The best time to spot it is at dawn or dusk when the sky is semi-dark. There is a chance that it could be seen if it travels across the face of the moon at night.  
The best instruments to use are ordinary binoculars or telescopes. Powerful telescopes won't pick it up because of their narrow fields. Through optical instruments, the satellite will look like the faintest star which can be seen with the naked eye.  
Keep a sharp eye out. The satellite travels so fast it may appear on the horizon for only seconds and chances of spotting it have been estimated at one in a hundred.

U.S. May Up Satellite Program  
By SON...  
United Press  
WASHINGTON  
Scientists...  
Russia's...  
man-made...  
the U.S...  
its own...  
gram...  
Russia...  
pou...  
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WEATHER  
WEST VIRGINIA—Partly cloudy with highest in the 60s today and Sunday. Lowest tonight 54 and 56 east portions.  
VIRGINIA—Fair with lowest 49 to 54 west and north and 55 to 58 southeast portions tonight, Sunday mostly sunny and a little warmer. Tides on the coast and lower bay will run a foot or two above normal.

Epic-Making

22 PAGES TODAY  
VOL. 51, NO. 21  
CHICAGO DAILY NEWS SERVICE  
HUNTSVILLE, ALABAMA, WEDNESDAY, APR. 12, 1961  
ASSOCIATED PRESS — WIREPHOTO  
Covers The Valley!  
4c PER WEEK

# Man Enters Space

'So Close, Yet So Far,' Sighs Cape U.S. Had Hoped For Own Launch

Soviet Officer Orbits Globe In 5-Ton Ship Maximum Height Reached Reported As 188 Miles




CAPE CANAVERAL, Fla. (AP) — The Redstone rocket which the United States had hoped would boost the first man into space stands on a launching pad here. The Soviet Union beat its firing date by at least two weeks.  
"So close, yet so far," commented a technician who is helping groom the Redstone to send one of America's astronauts on a short sub-orbital flight, hopefully May.  
"If we hadn't had these two weeks..."  
Hobbs Admits...  
has admitted...  
weapon" for m...  
ICBM. This country...  
tested a successful ICBM...  
American diplomats...  
Russia had scored a notable...  
victory. The milita...

MOSCOW (AP)—A Soviet astronaut has orbited the globe for more than an hour and returned safely to receive the pleads of scientists and political leaders alike. Soviet announcement of the feat brought praise from President Kennedy and U. S. space experts left behind in the contest to put the first man into successful space flight.  
By the Soviet account, Maj. Yuri Alekseyevich Gagarin, guide a five-ton spaceship once around the earth in an orbit taking an hour and 48 minutes. The whole sequence of events and the announcements relating to it raised

VON BRAUN'S REACTION:  
**To Keep Up, U. S. A.**

3. A means to stay safe



A photograph of John F. Kennedy speaking at a podium outdoors. He is wearing a dark blue pinstriped suit, a white shirt, and a dark blue tie. The podium features the Presidential Seal of the United States. In the background, a large crowd of people is visible, many of whom are clapping. The sky is blue with some white clouds. Three speech bubbles are overlaid on the image: one on the left, one on the right, and one below the right one.

Let's explore the universe with a banner of freedom and peace!

Please, let's beat the Soviets at something

And do it before the decade is out!

1962



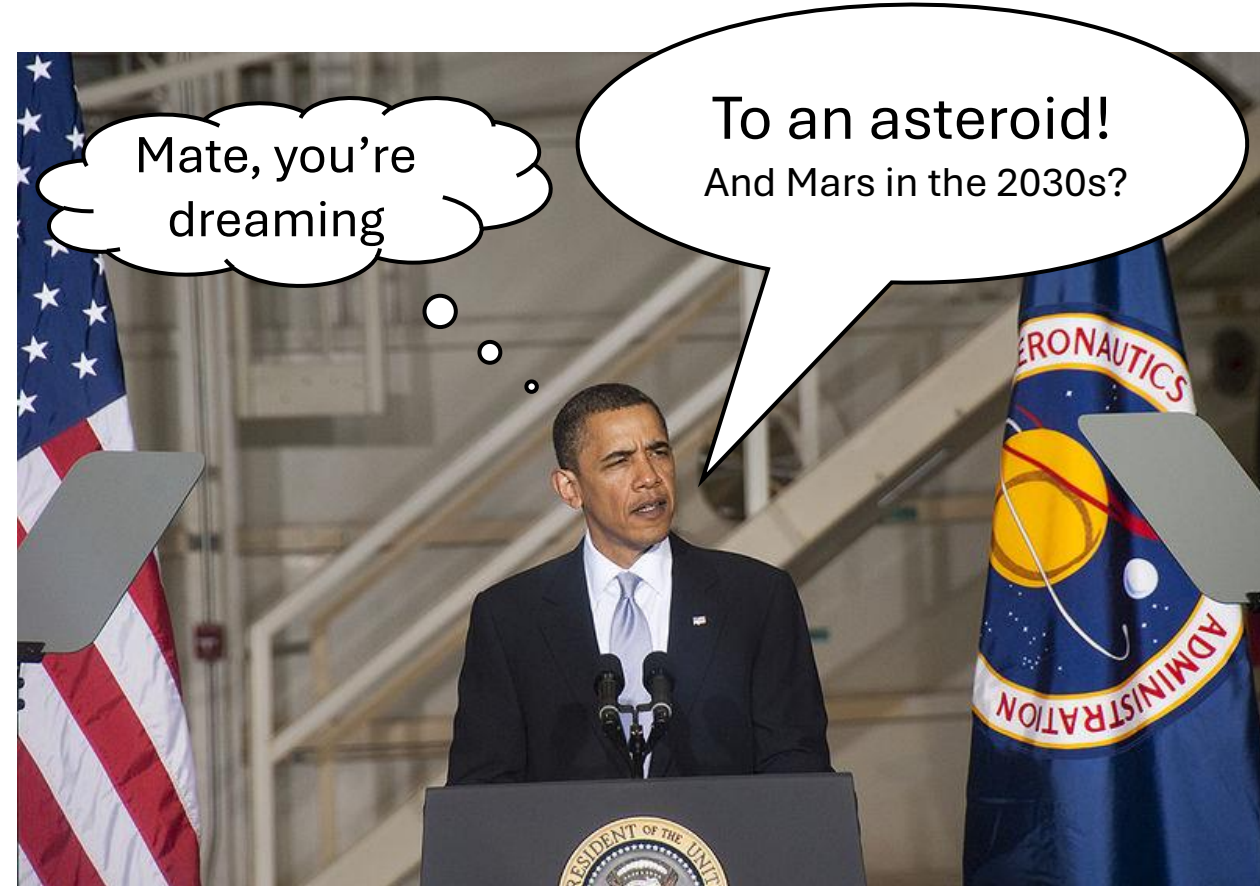




2004



2010





To the  
Moon!





To the Moon!



By 2024!



Donald J. Trump   
@realDonaldTrump · Follow



Under my Administration, we are restoring @NASA to greatness and we are going back to the Moon, then Mars. I am updating my budget to include an additional \$1.6 billion so that we can return to Space in a BIG WAY!

9:34 AM · May 14, 2019



Donald J. Trump   
@realDonaldTrump · Follow



For all of the money we are spending, NASA should NOT be talking about going to the Moon - We did that 50 years ago. They should be focused on the much bigger things we are doing, including Mars (of which the Moon is a part), Defense and Science!

5:38 AM · Jun 8, 2019



2019

# 21<sup>st</sup> century space race

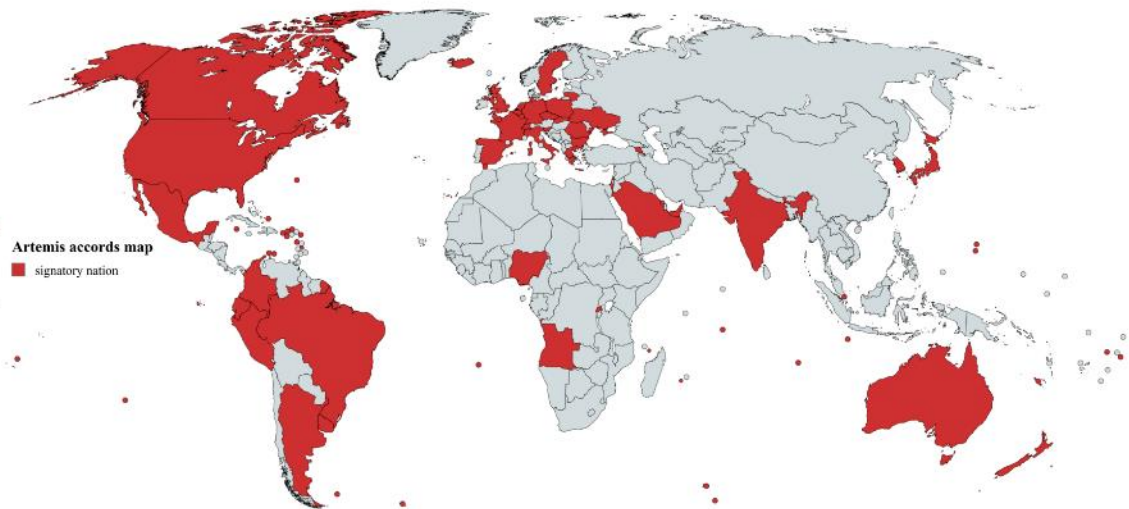
International cooperation *and* competition



SPACEX

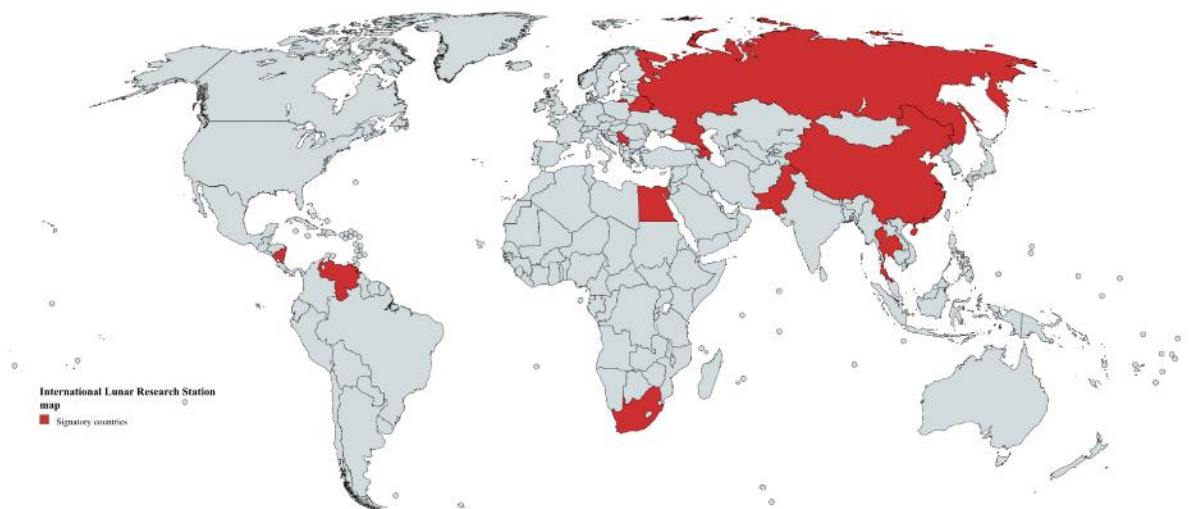


ARTEMIS ACCORDS



Created with mapchart.net

***International Lunar Research Station***



Created with mapchart.net



# Artemis survives a change of administration



**President Biden**  Nov 17, 2022  
@POTUS

NASA's Artemis is in flight.

This ship will enable the first woman and first person of color to set foot on the lunar surface and will lead countless students to become explorers and show America's limitless possibilities to the world.



Scientist!





# Recap: **Reasons to go**

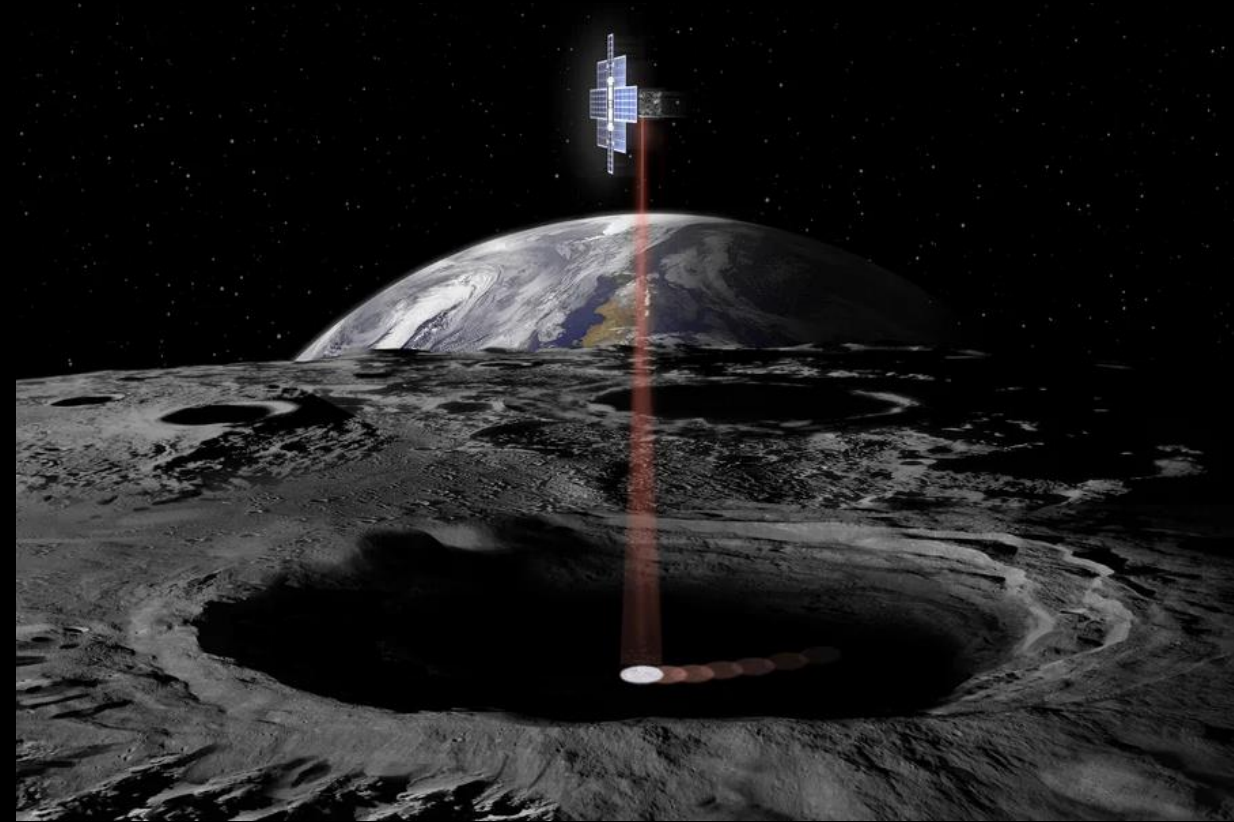


- Nationalism
  - **Beat the Russians**

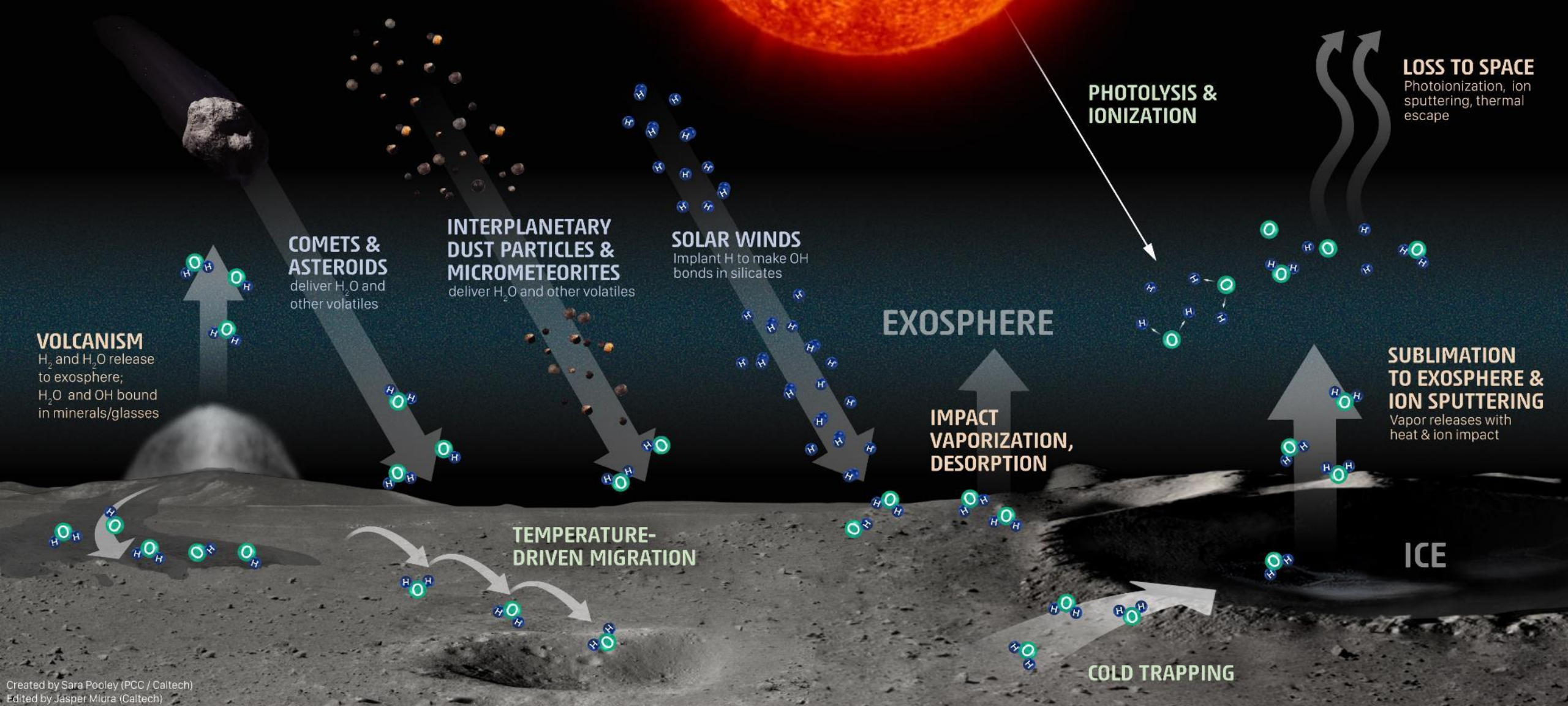


- Nationalism
  - Beat China
  - Put first woman and person of colour on the Moon
  - Go with international partners
- Scientific research
- Create a long-term presence... **and use as a stepping stone to Mars**

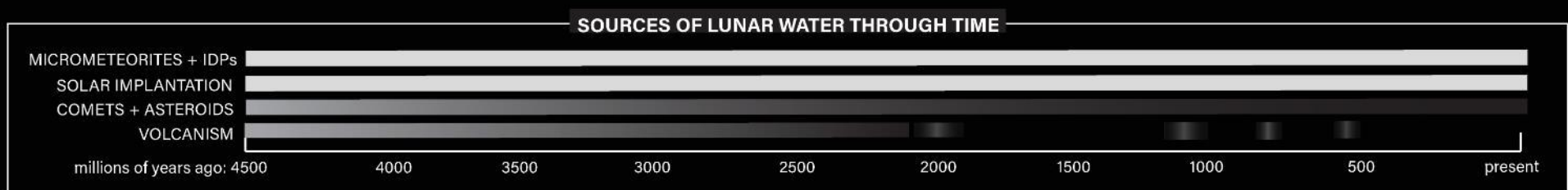
# A very cool discovery







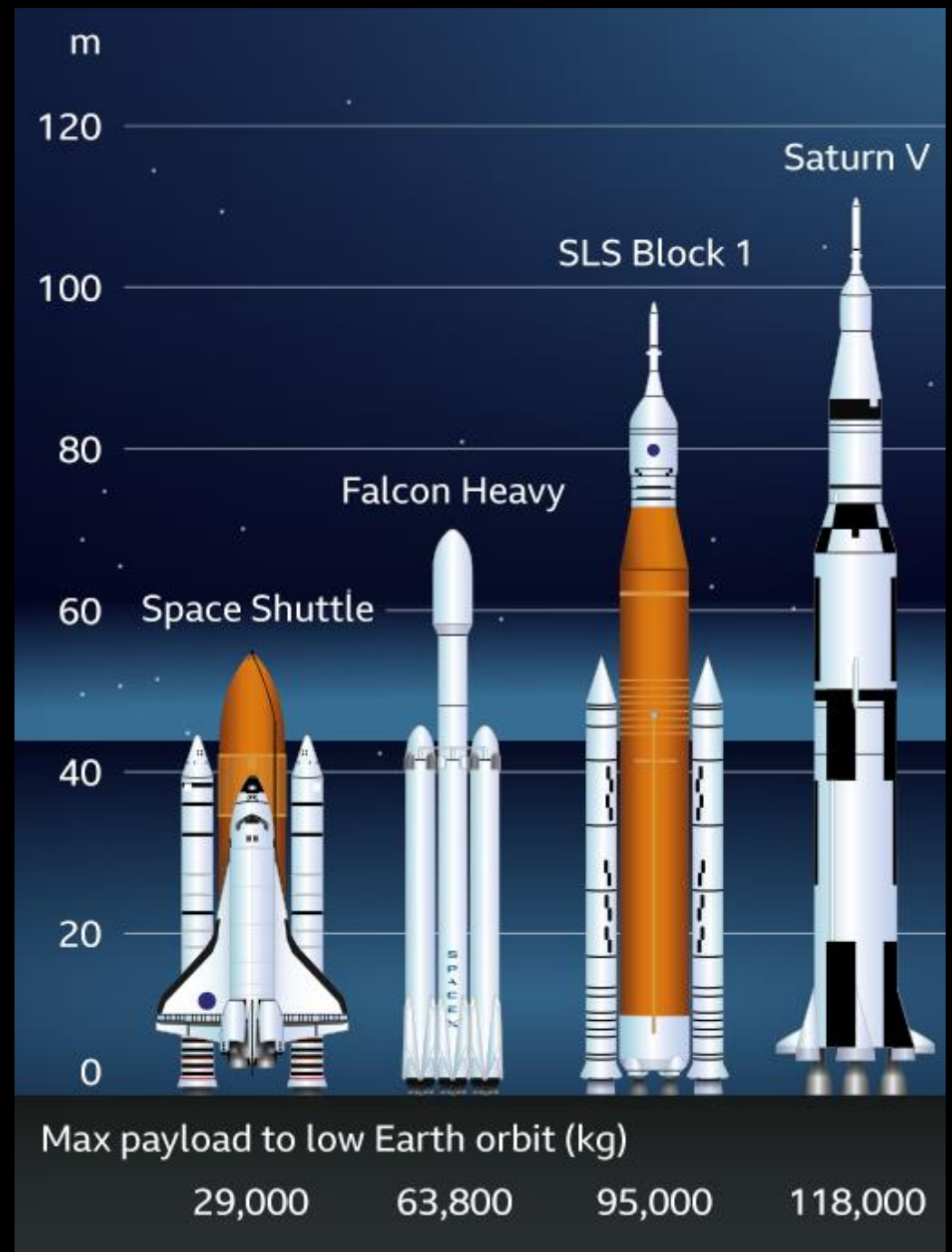
Created by Sara Pooley (PCC / Caltech)  
Edited by Jasper Miura (Caltech)



REQUIREMENT #2

# A way to get there

## Rocket + capsule





# Artemis I November 2022









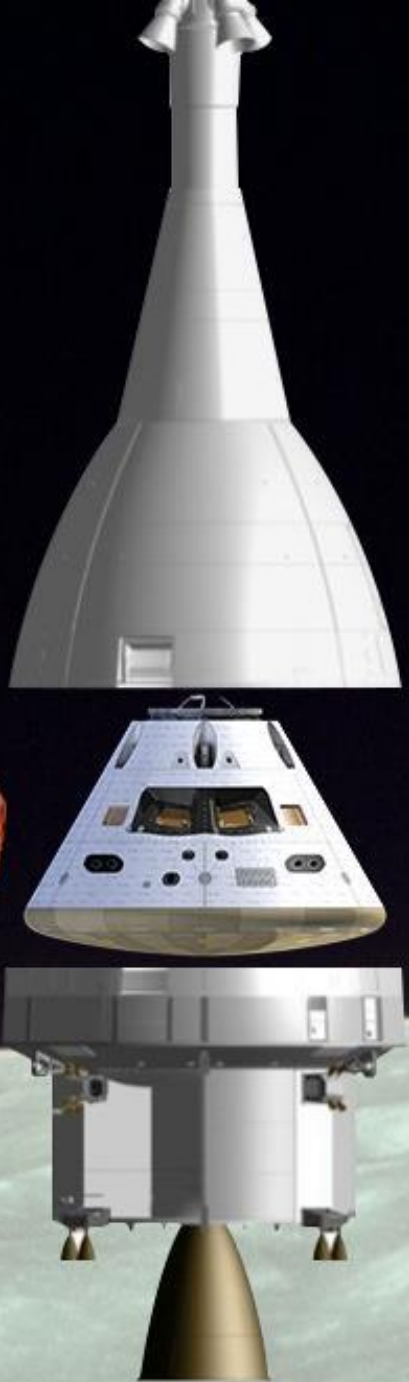
# COMMAND AND SERVICE MODULE

CREW MODULE DIAMETER: 12.8 FT.  
 CREW SIZE: 3  
 SERVICE MODULE DIAMETER: 13 FT.  
 SERVICE MODULE LENGTH: 24.5 FT.  
 SERVICE MODULE MASS: 54,000 LBS.  
 SERVICE MODULE THRUST: 20,500 LBS.  
 POWER: BATTERIES, FUEL CELLS  
 LANDING: WATER  
 DOCKING: LUNAR MODULE  
 DESTINATION: SKYLAB, ASTP, MOON



# ORION

CREW MODULE DIAMETER: 16.5 FT.   
 CREW SIZE: 4 (6 TO ISS)   
 SERVICE MODULE DIAMETER: 16.5 FT.   
 SERVICE MODULE LENGTH: 15.7 FT.   
 SERVICE MODULE MASS: 27,500 LBS.   
 SERVICE MODULE THRUST: 7,500 LBS.   
 POWER: SOLAR ARRAYS, BATTERIES  
 LANDING: WATER  
 DOCKING: MULTI PURPOSE  
 DESTINATION: MARS, ASTEROIDS





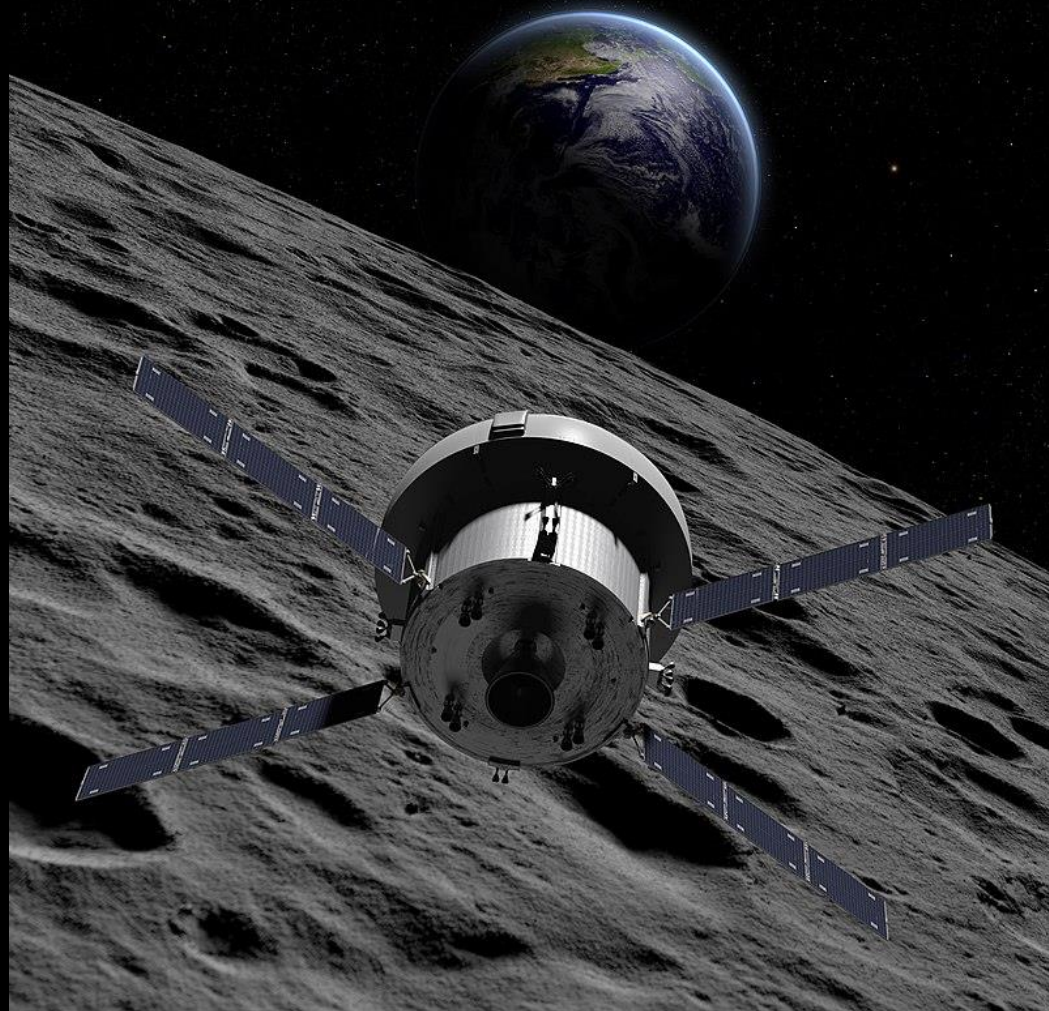


# Artemis I December 2022



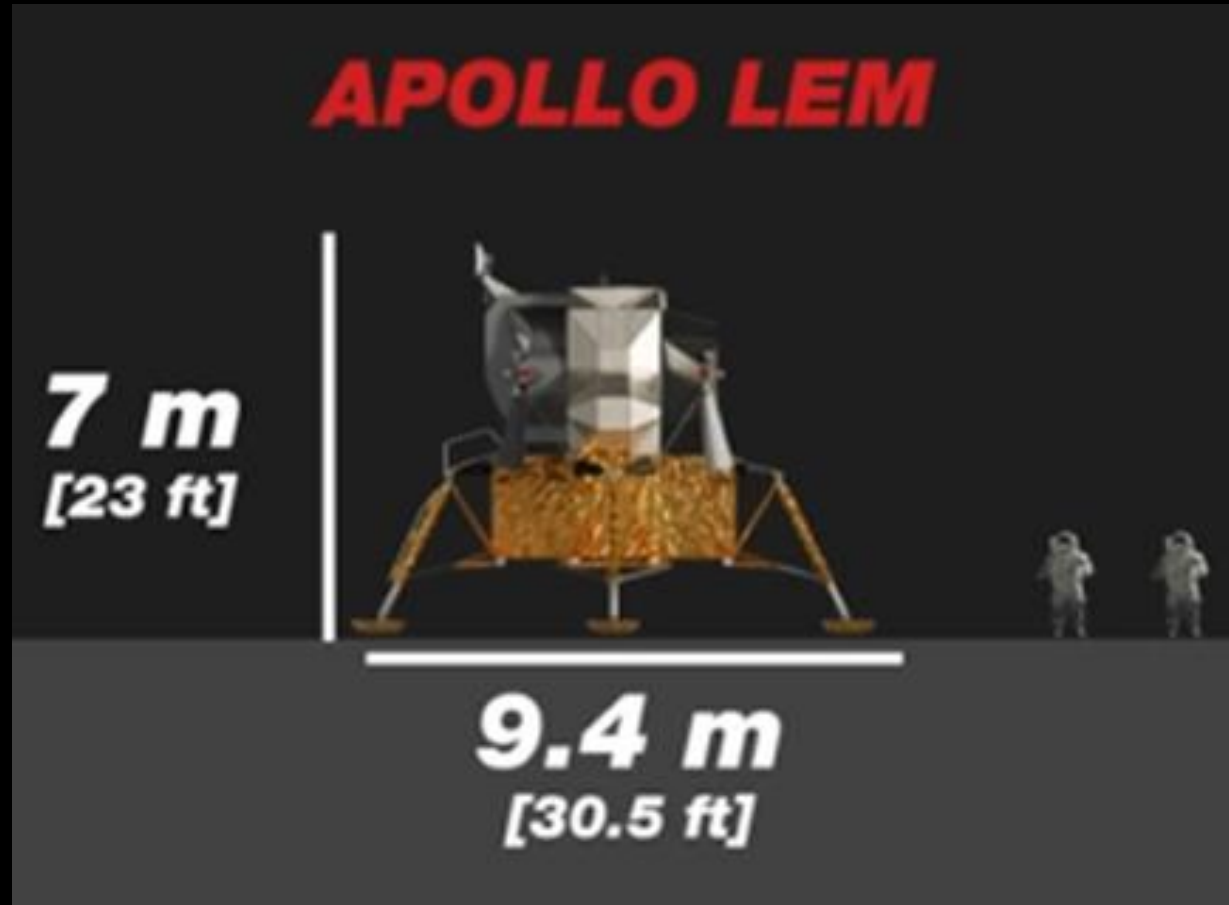


# Artemis II September 2025





# A way to get there: Lander



# LUNAR LANDERS

**SPACEX  
STARSHIP**

**~50 m**  
[164 ft]

**APOLLO LEM**

**7 m**  
[23 ft]

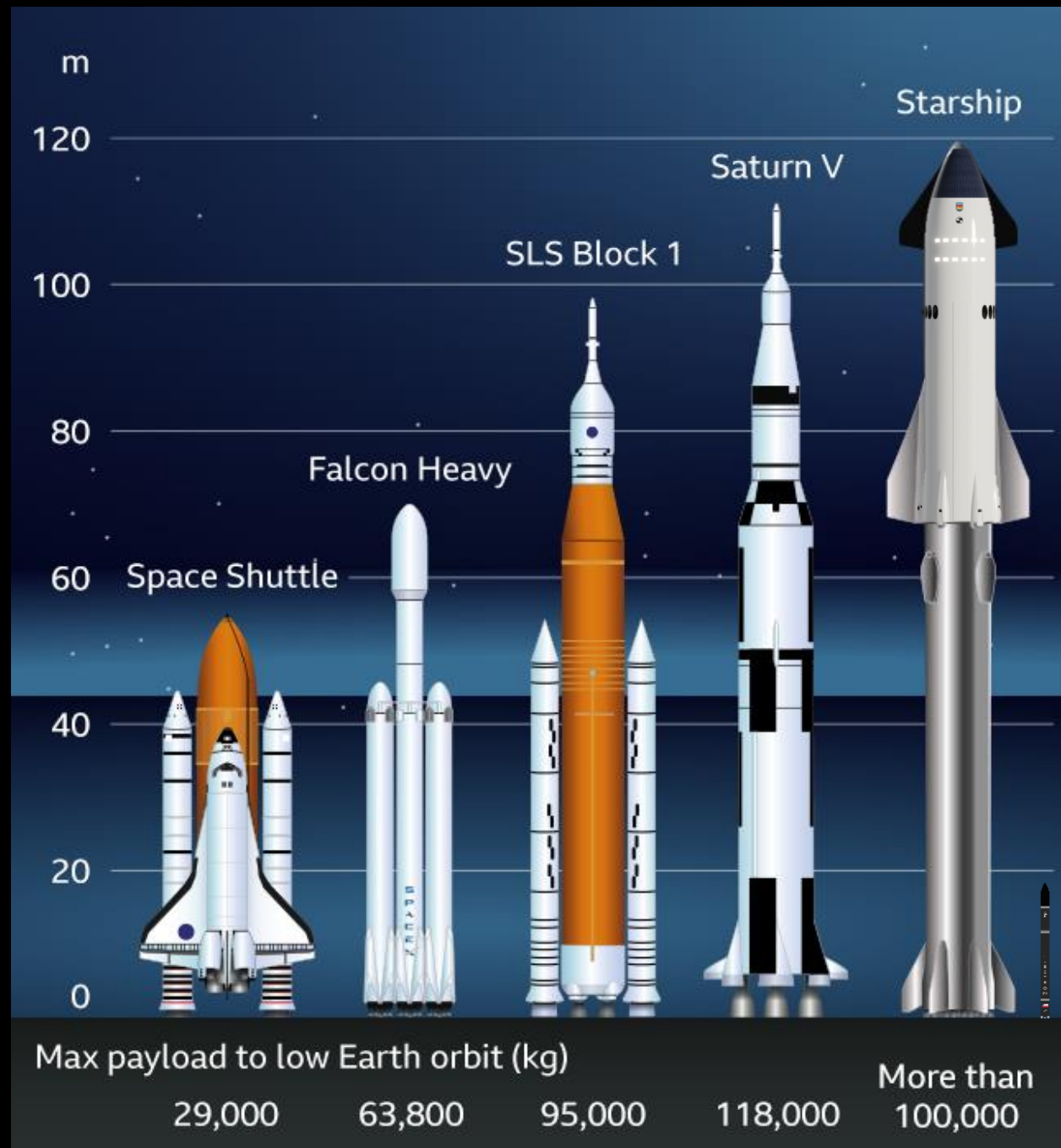


**9.4 m**  
[30.5 ft]

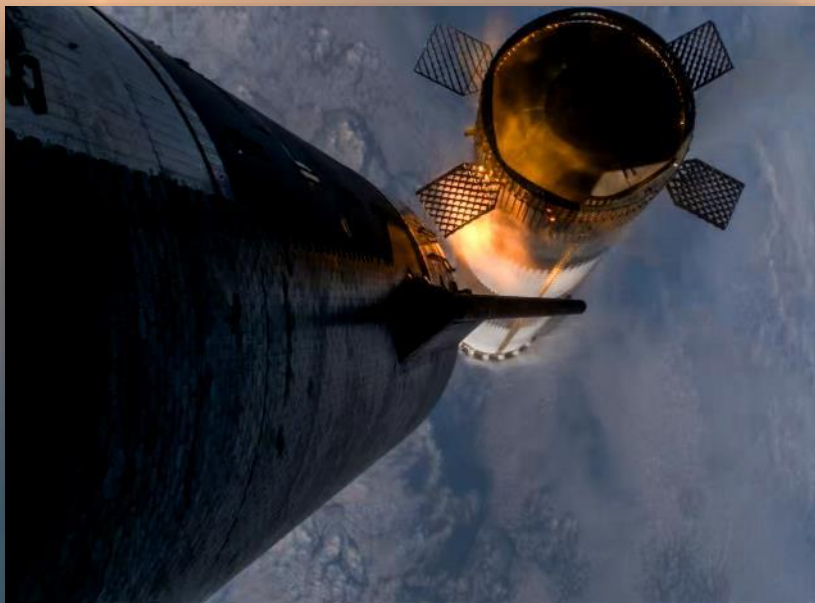


**Over 9 m**  
[29.5 ft]





# Fourth test flight of Starship





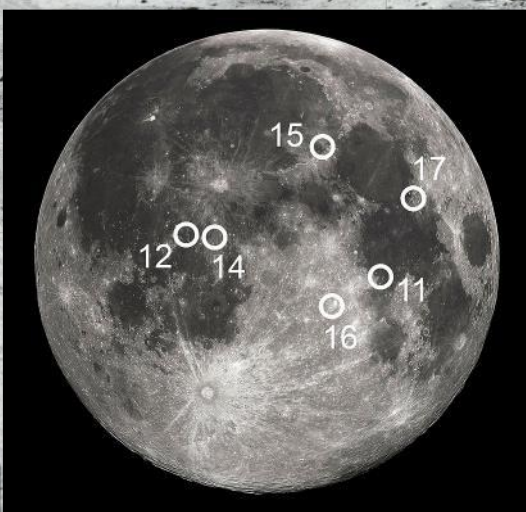
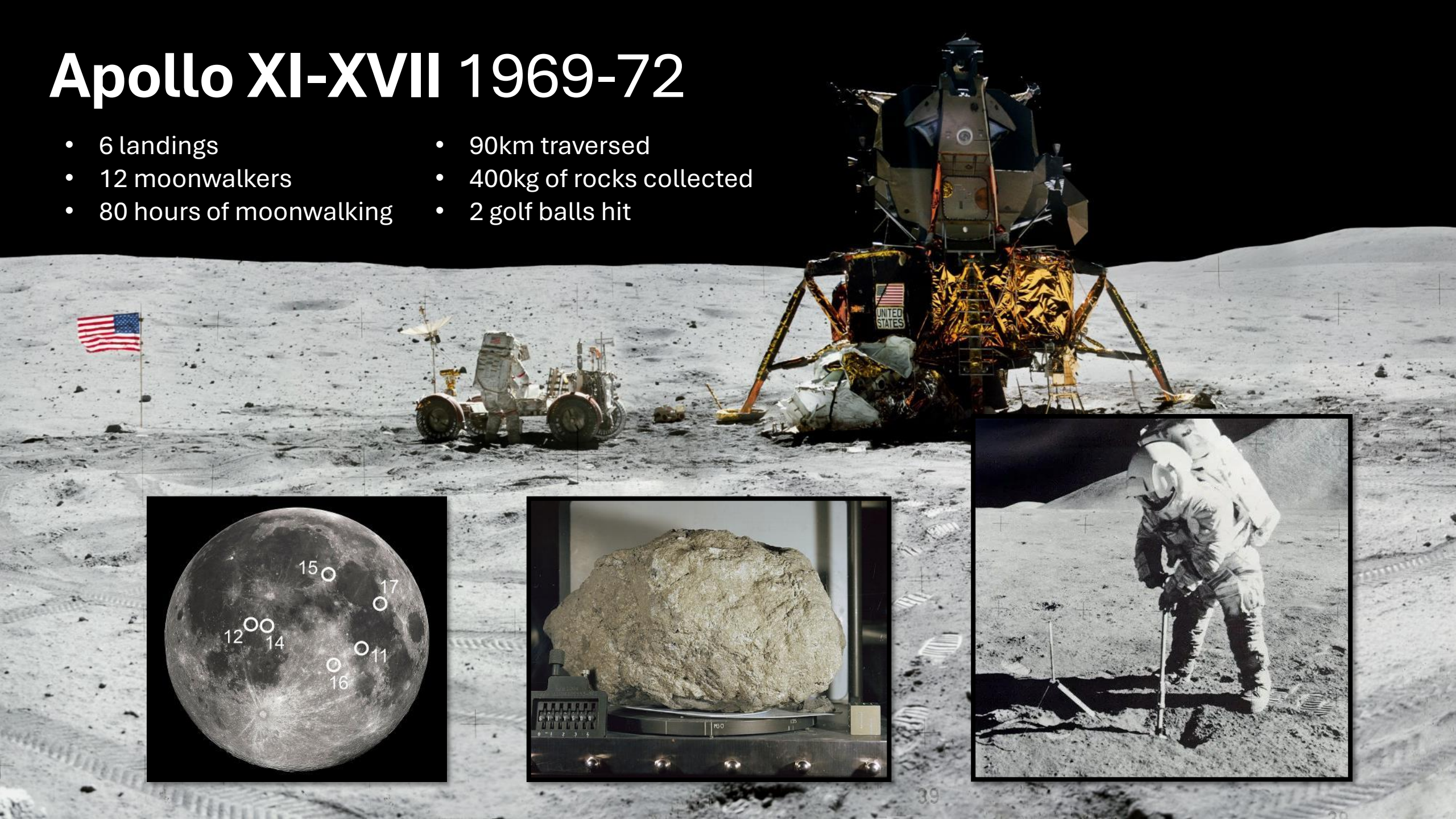
# Artemis III ~~2024~~ 2026?





# Apollo XI-XVII 1969-72

- 6 landings
- 12 moonwalkers
- 80 hours of moonwalking
- 90km traversed
- 400kg of rocks collected
- 2 golf balls hit







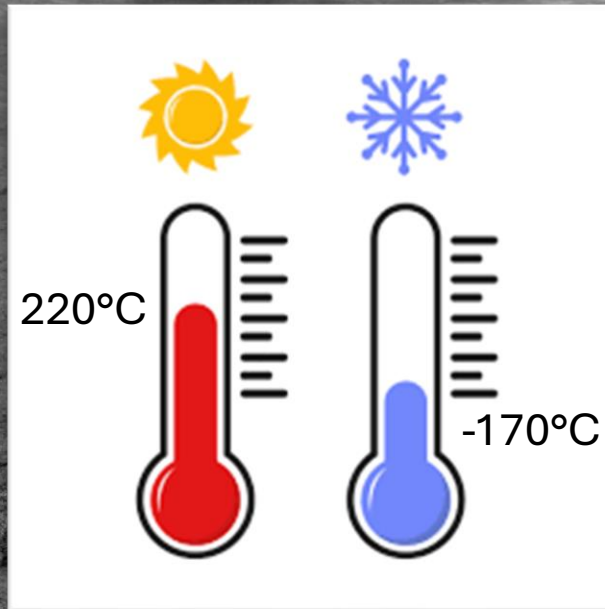
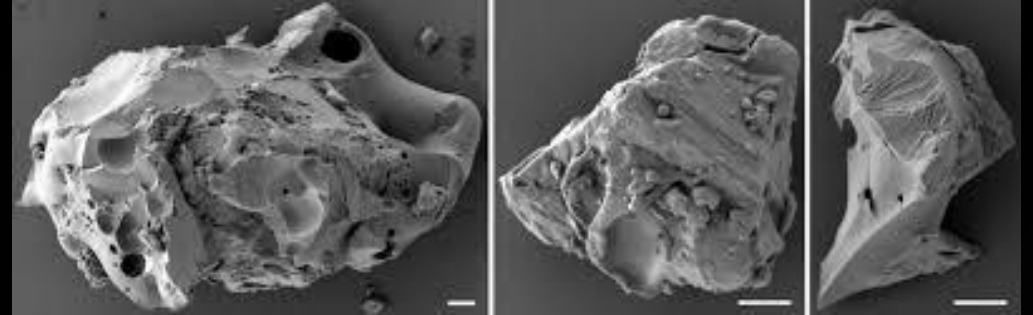
ARTEMIS

2030s?



# A means to stay safe from lunar hazards

- Dust
- 1/6<sup>th</sup> gravity
- Temperature swings
- **Space weather**





# Space weather



## Solar flares

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- Bursts of electromagnetic radiation
- Can cause radio blackouts
- 8min travel time

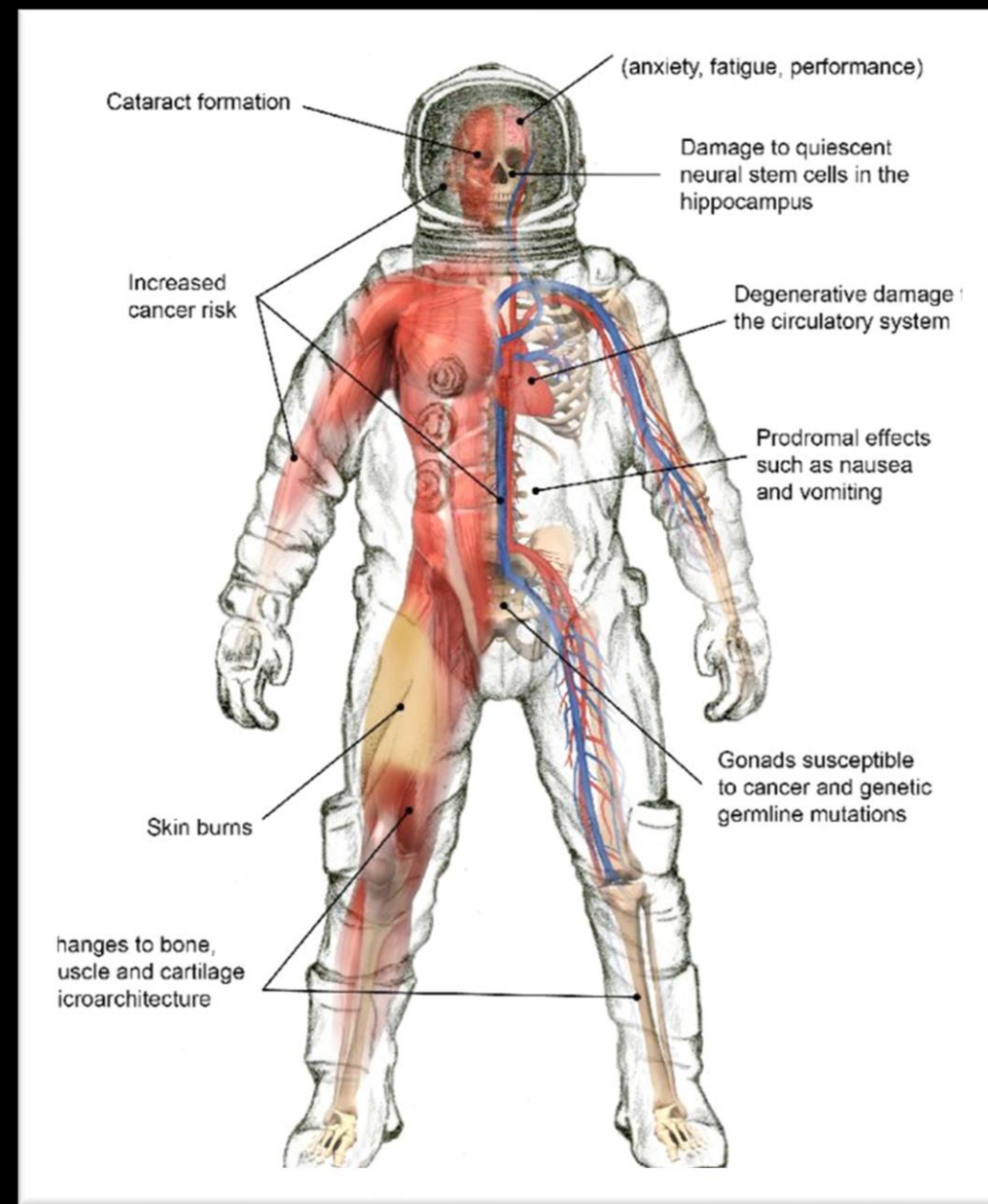
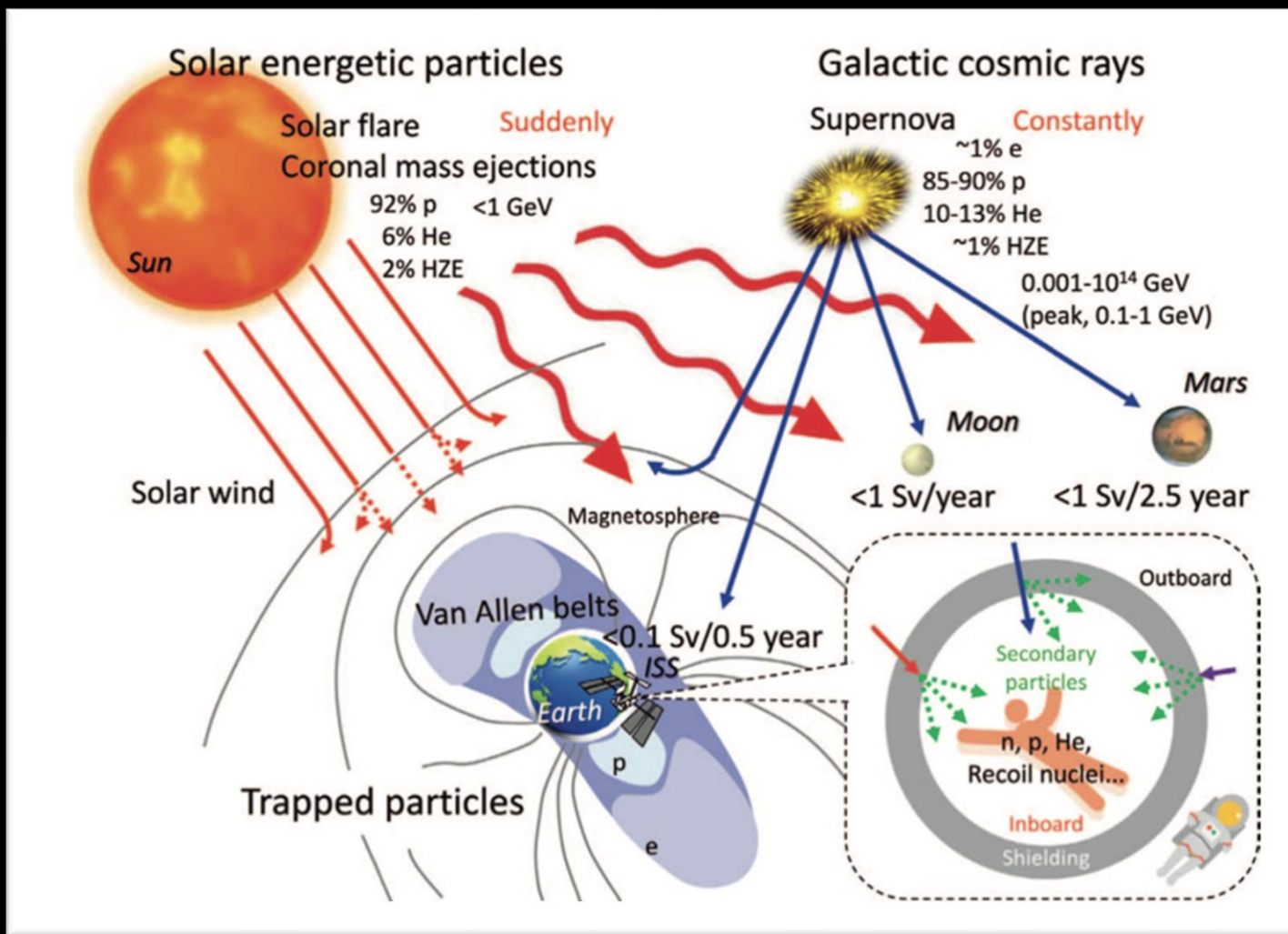
## Coronal mass ejections (CMEs)

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- Bursts of solar material (plasma)
- Distort Earth's magnetosphere, causing **geomagnetic storms**
- Can damage satellites, electricity grids, gas pipelines, astronauts
- 1-2 days travel time

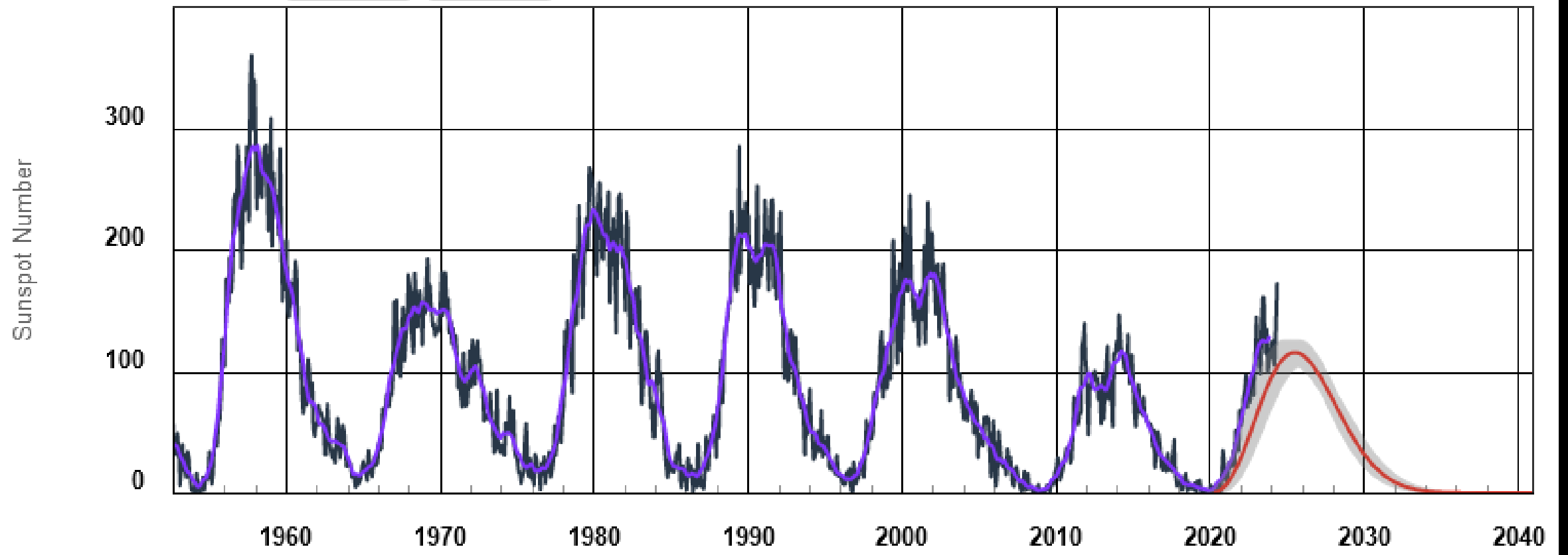


# Radiation sources and effects





# 11-year solar cycle







# Coda: Aotearoa in space



**SOLAR TSUNAMIS**  
PARAWHENUA KŌMARU



# A Waiata of Ice and Solar Flares

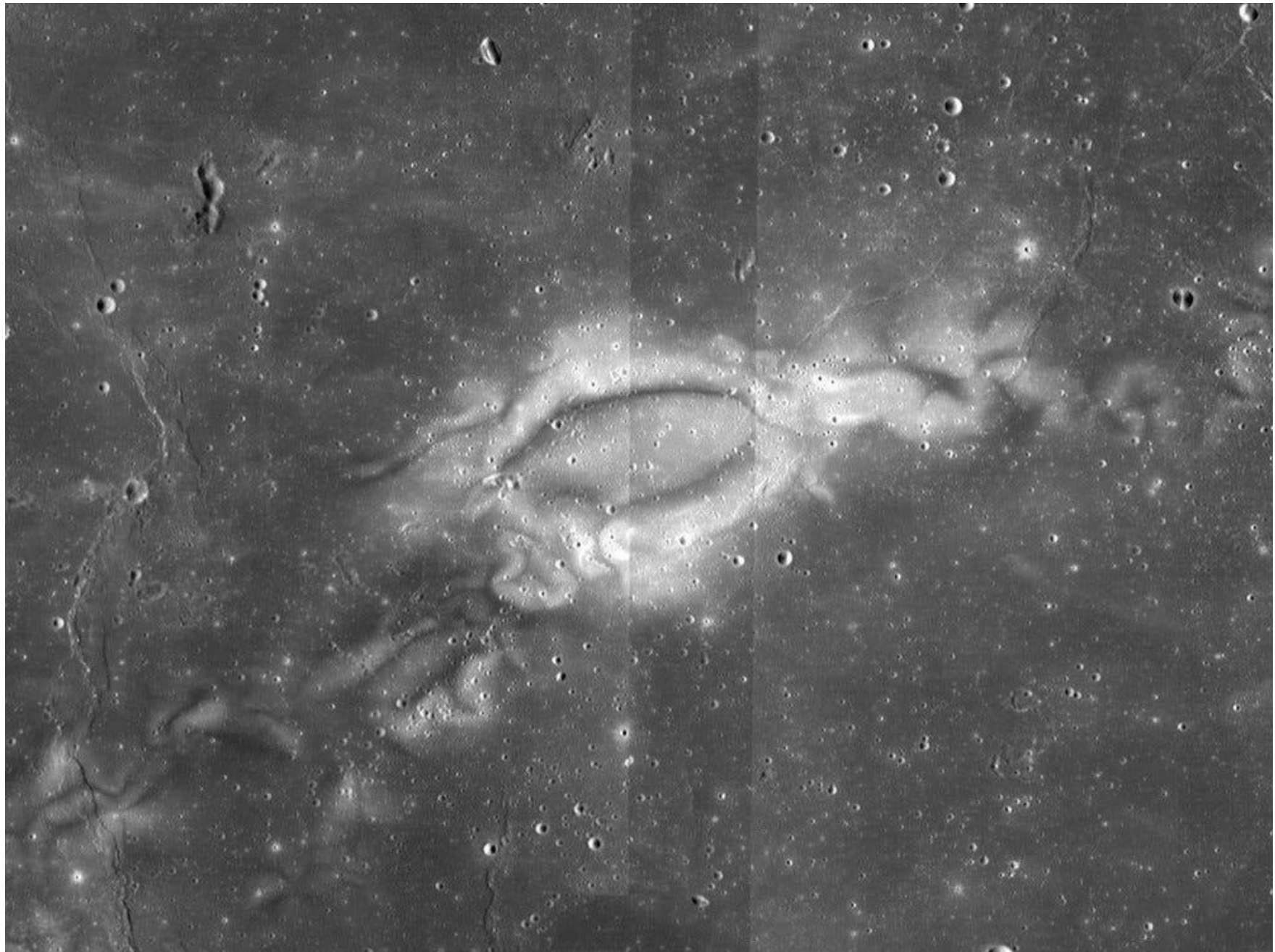
Te Hokinga ki te Marama

Daniel Wrench

U3A Timaru

June 2024







Give me a joke about a New Zealand astronaut to close out my presentation about humans on the Moon.



Why did the New Zealand astronaut take a sheep to the Moon?

Because he wanted to prove it was one giant leap for lamb-kind!

< 7/9 >     