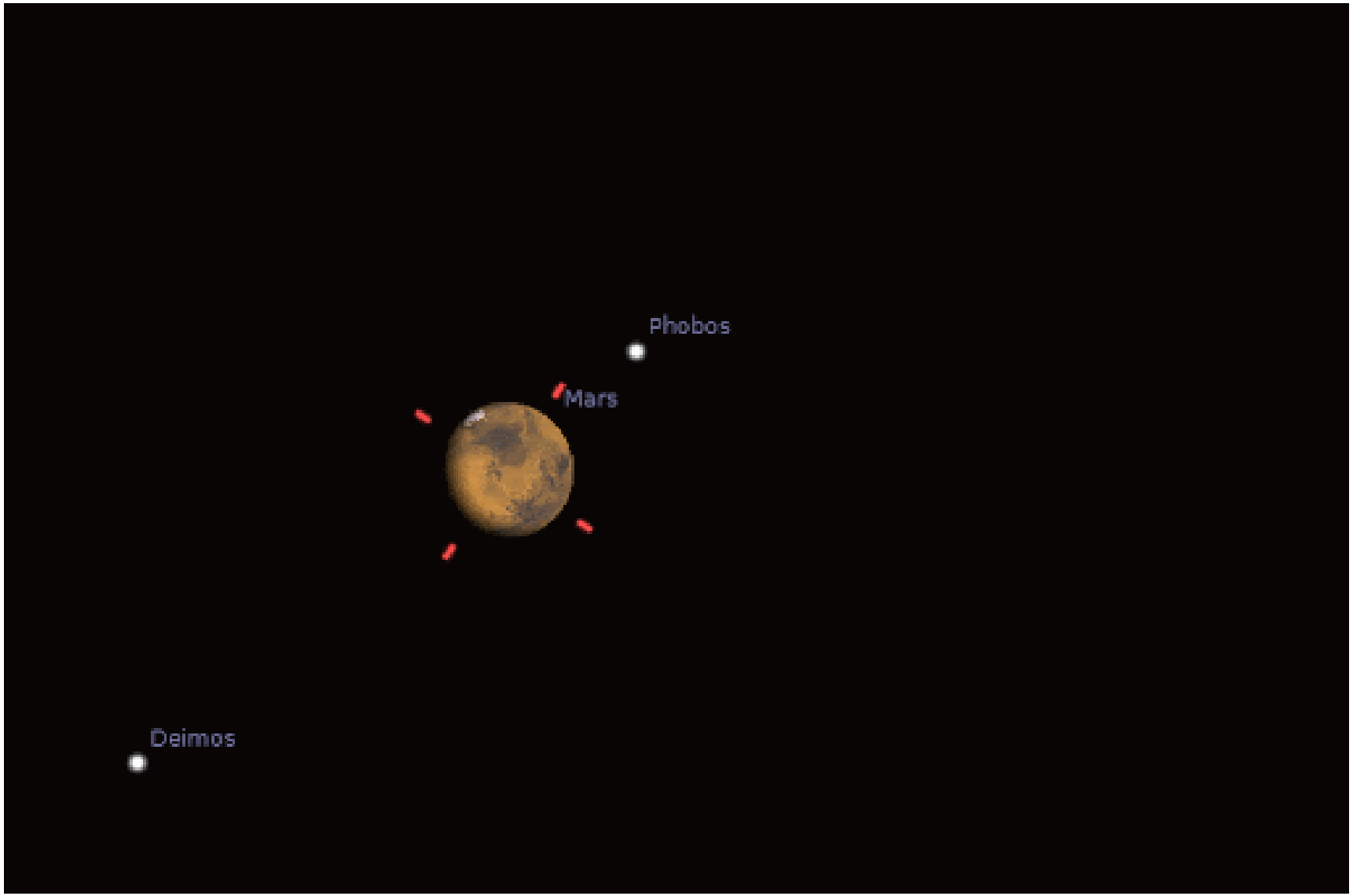
MARS, IT'S 2 MOONS AND SPACECRAFT THAT HAS AND IS GOING THERE



COMPILED BY HOWIE BAUM

MARS

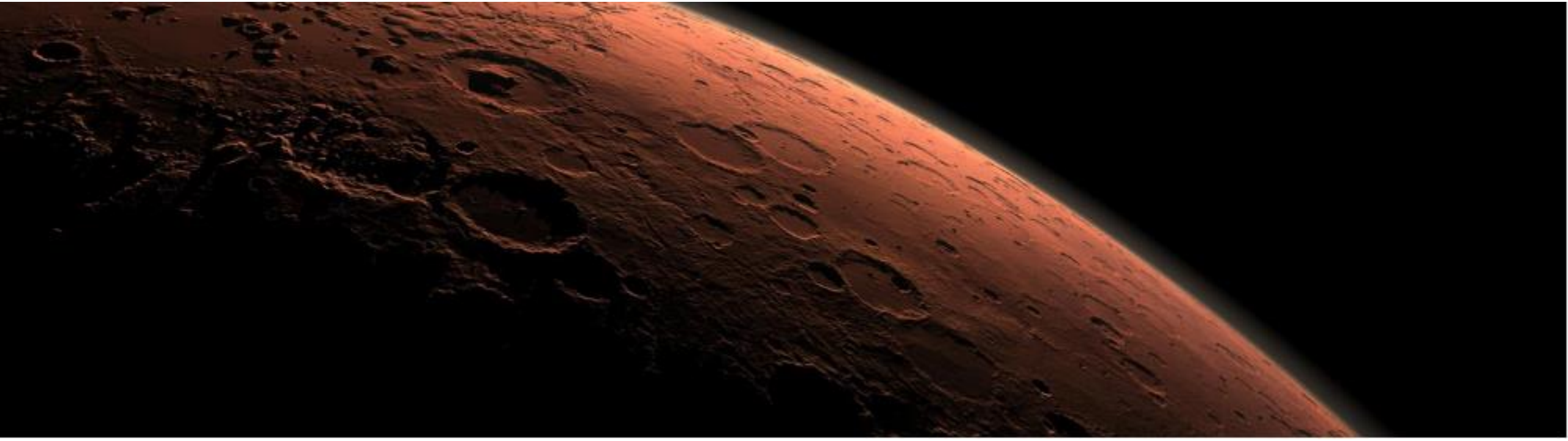
- The 4th planet from the Sun
- The second-smallest planet in the Solar System, after Mercury.
- Called the "Red Planet" because **the iron oxide prevalent on its surface gives it a reddish appearance.**
- It has a thin atmosphere which is mostly carbon dioxide (CO_2
- Has valleys, deserts, and polar ice caps, like Earth.

Mars is a dusty, cold, desert world.

This dynamic planet **has seasons, polar ice caps and weather and canyons and extinct volcanoes, evidence of an even more active past.**

Mars is one of the most explored bodies in our solar system, and it's the only planet where we've sent rovers to roam the alien landscape**.** **NASA currently has three spacecraft in orbit, one rover and one lander on the surface and another rover under construction here on Earth. India and ESA also have spacecraft in orbit above Mars.**

These robotic explorers have found lots of evidence that Mars was much wetter and warmer, with a thicker atmosphere, billions of years ago.

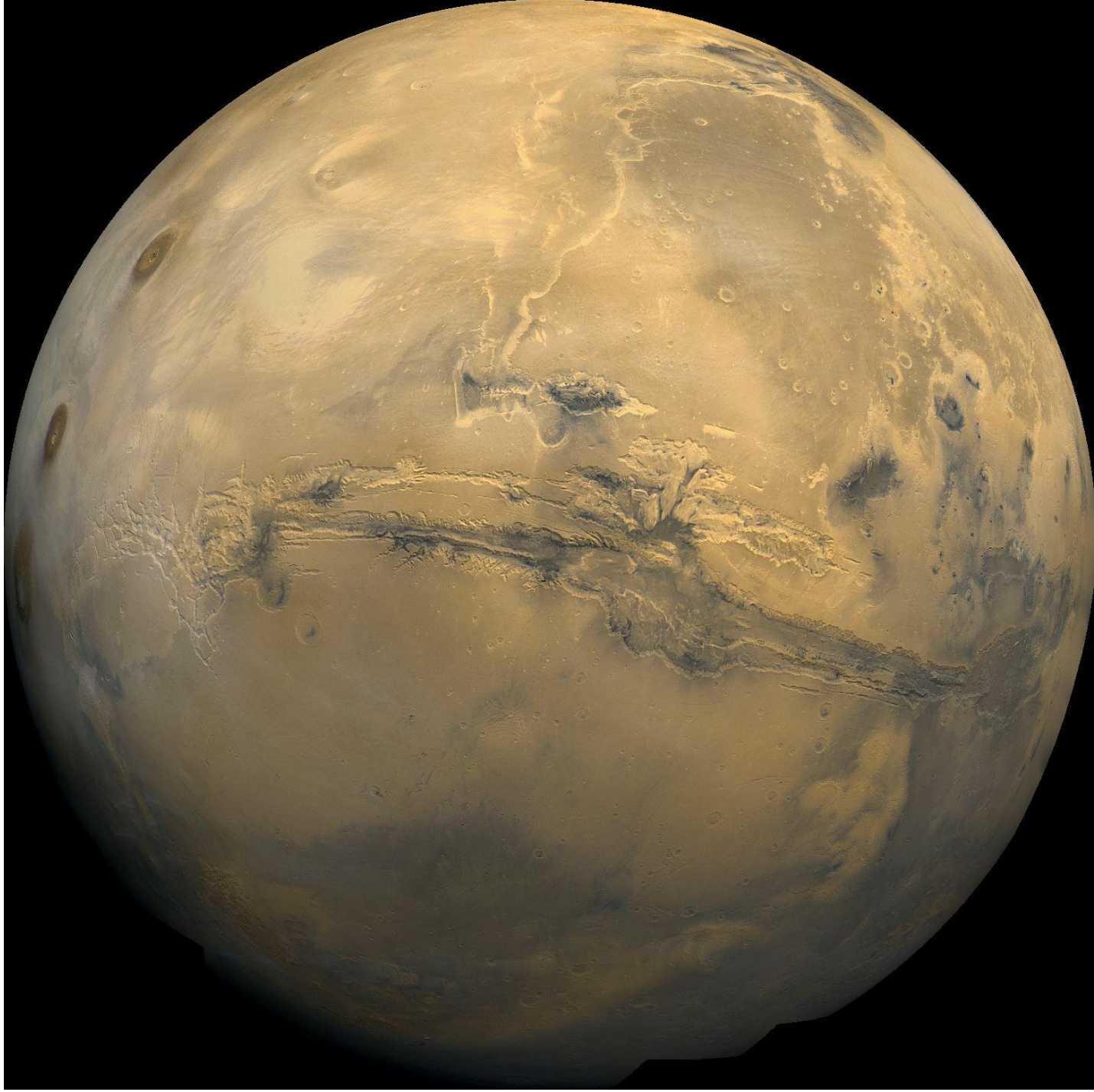


Mars is tilted on its axis 25.2° (Earth is 23.4°) so it has daily and seasonal cycles like we do.

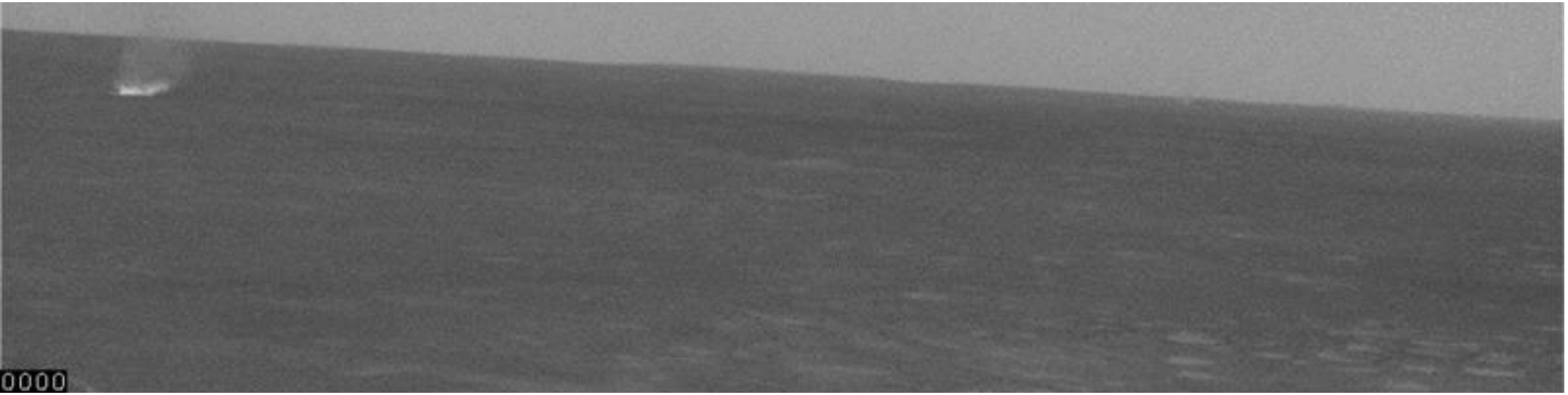
The surface features of Mars change from season to season.

The dust on Mars is blown by strong winds often reaching over 60 – 80 miles per hour (hurricane force). The storms are so strong that sometimes they can cover the whole planet with dust.

Mariner 9 visited Mars in 1971. When it arrived, there was a planet-wide dust storm. If it had been a fly-by mission to take photos, it would have been a failure.



MARS ALSO HAS DUST DEVILS: SMALL, TORNADO-LIKE WEATHER EVENTS



Earth and Mars Comparison

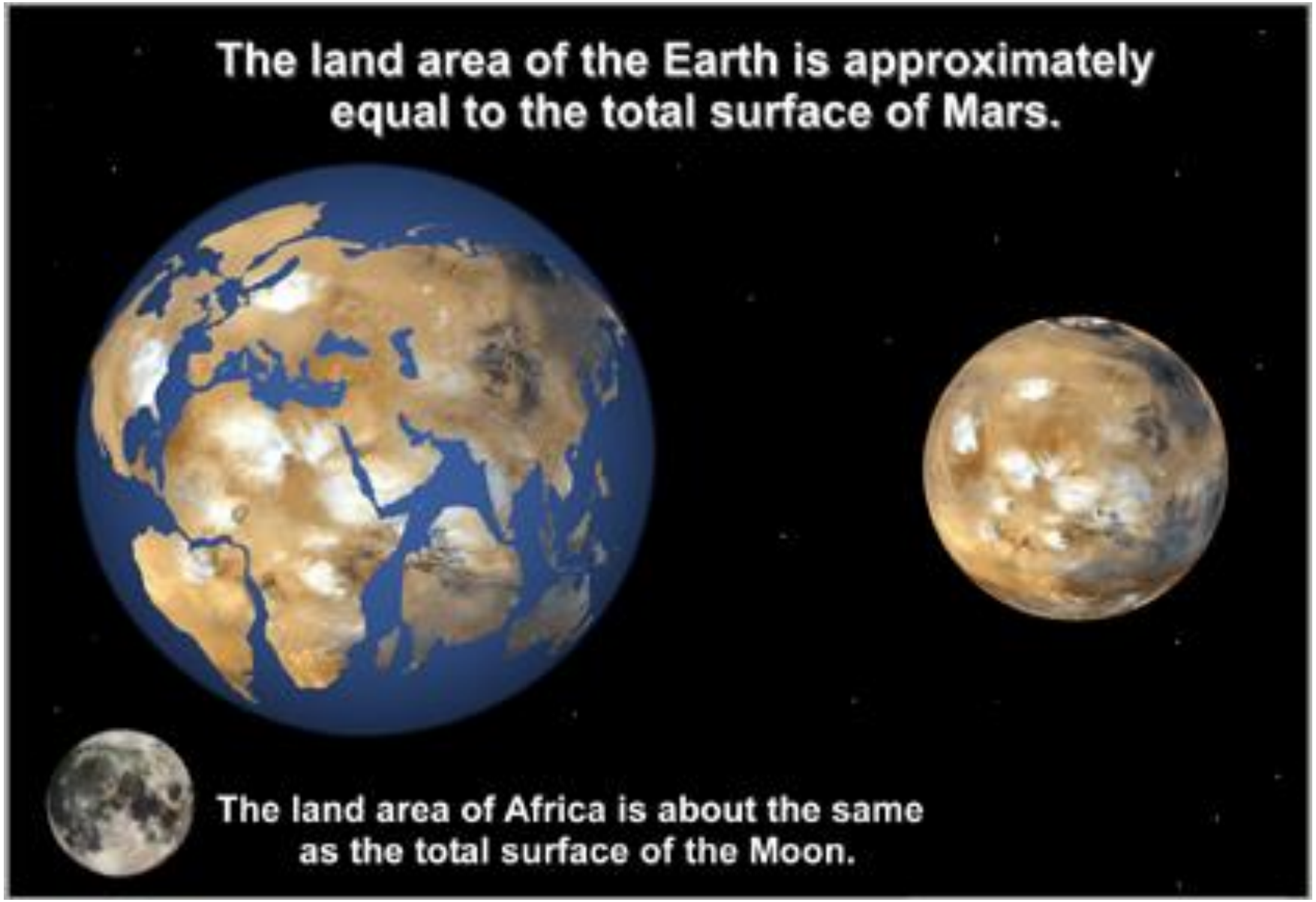


Image Courtesy of NASA/JPL-Caltech

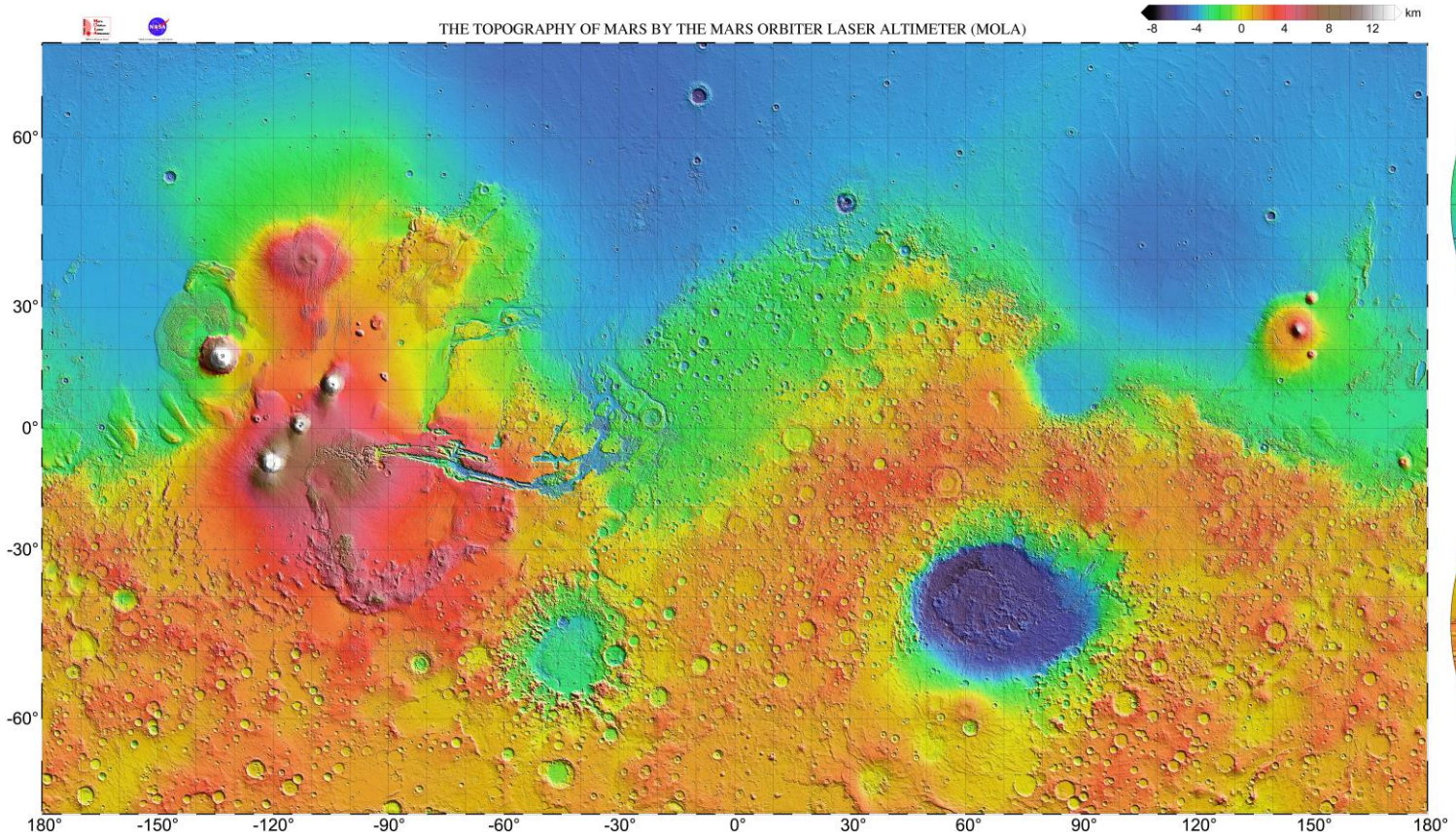
THE MARTIAN DICHOTOMY

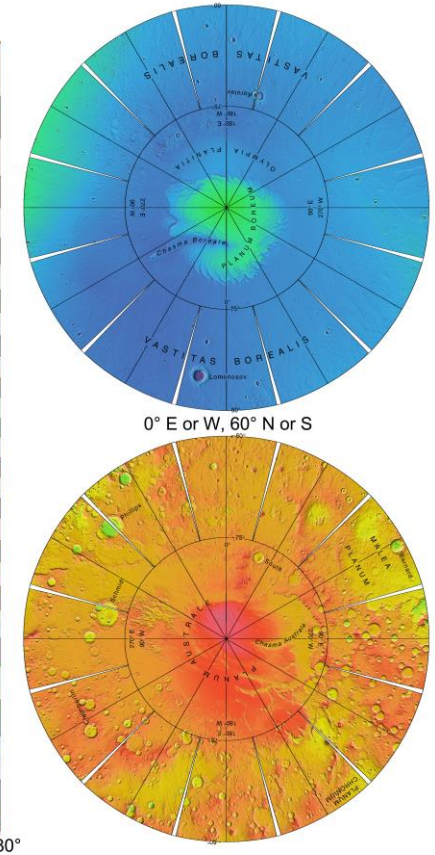
The most conspicuous feature of Mars is a sharp contrast between the Southern and the Northern hemispheres.

Notice the craters and volcanoes in the southern hemisphere and the smooth surface in the North.

The thickness of the Martian crust is 19.9 miles (32 kilometers) in the northern lowlands region,

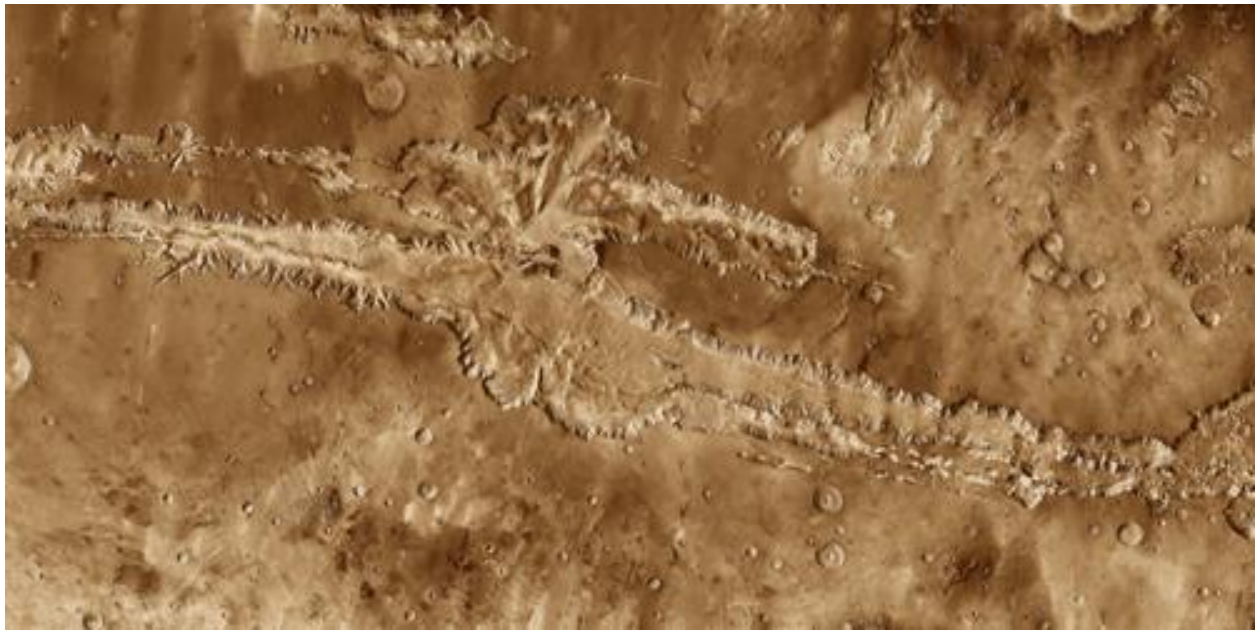
and 36 miles (58 kilometers) in the southern highlands.





Mars Surface Features

- The surface Color is somewhat red
- Features:
  - Impact Craters
  - Largest volcano in the solar system (Olympus Mons)
  - Largest Canyon in the Solar System (Valles Marineris)
  - Ancient river channels
  - Lava Rocks
  - Lots of reddish Dust

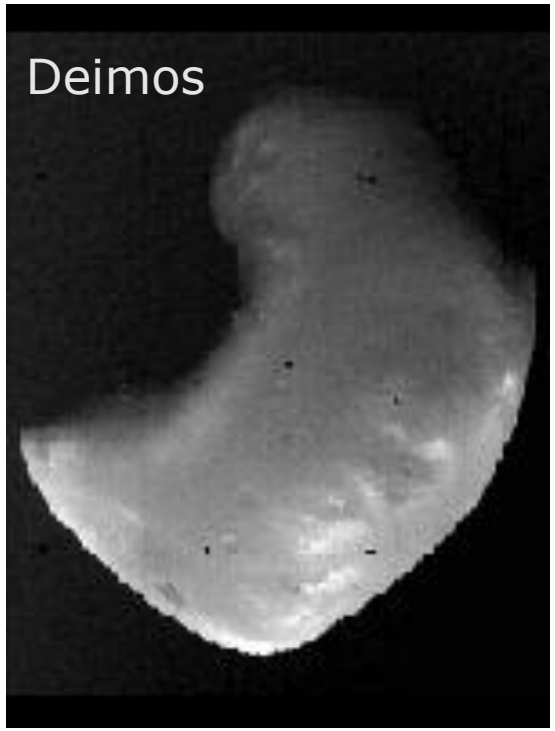


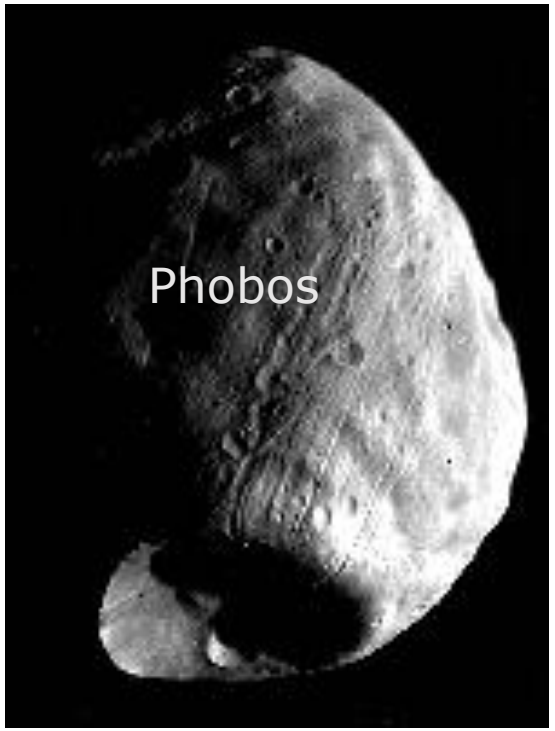
Valles Marineris

Image Courtesy of NASA/JPL-Caltech

The 2 moons of Mars

- Mars has 2 tiny moons named “Deimos” (Panic) & “Phobos” (Fear)
- The moons are irregular and very small in size
- They are probably asteroids captured by Mars





Images Courtesy of NASA

MARS FACTS / MARTIAN MOONS

Phobos

13.8 miles
22.2 km

Deimos

7.8 miles
12.6 km

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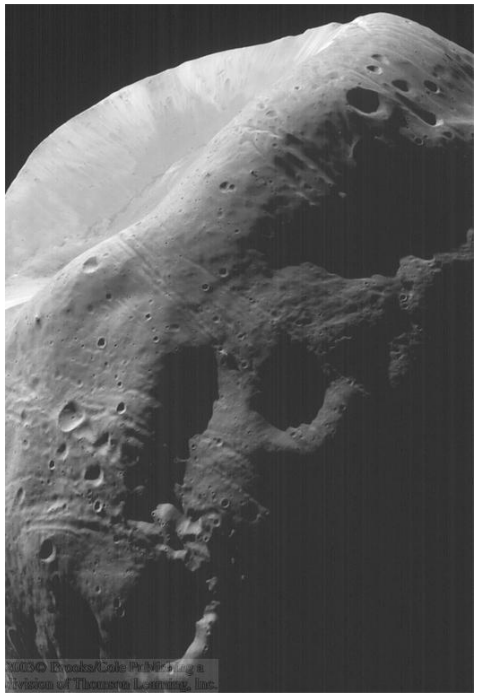
mars.nasa.gov

Phobos

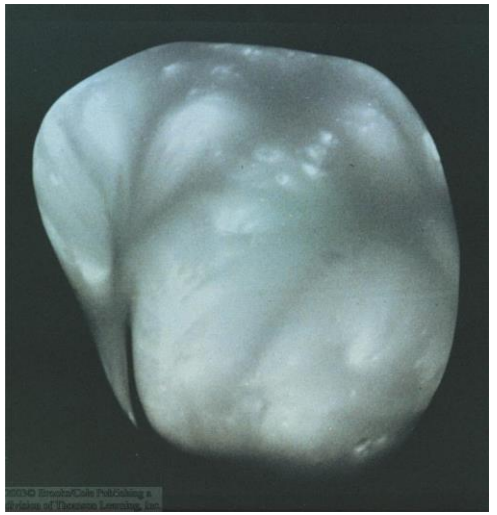


Two small moons: Phobos and Deimos.

Too small to pull themselves into spherical shape.

Typical of small, rocky bodies: Dark grey and low density.

Very close to Mars; orbits around Mars faster than Mars' rotation.

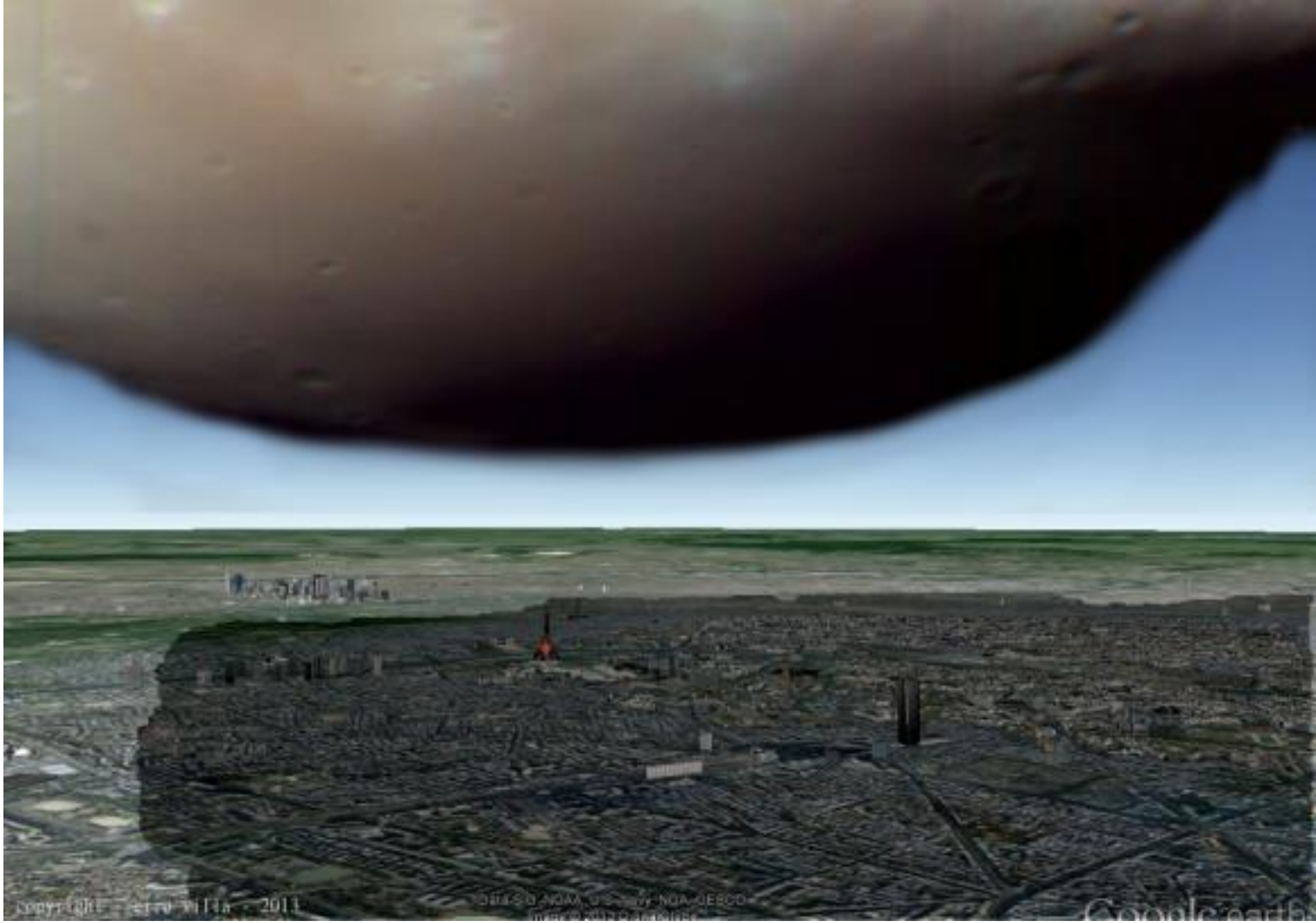


Deimos

A comparison of Mar’s Moon Phobos, if it came down to Earth !!

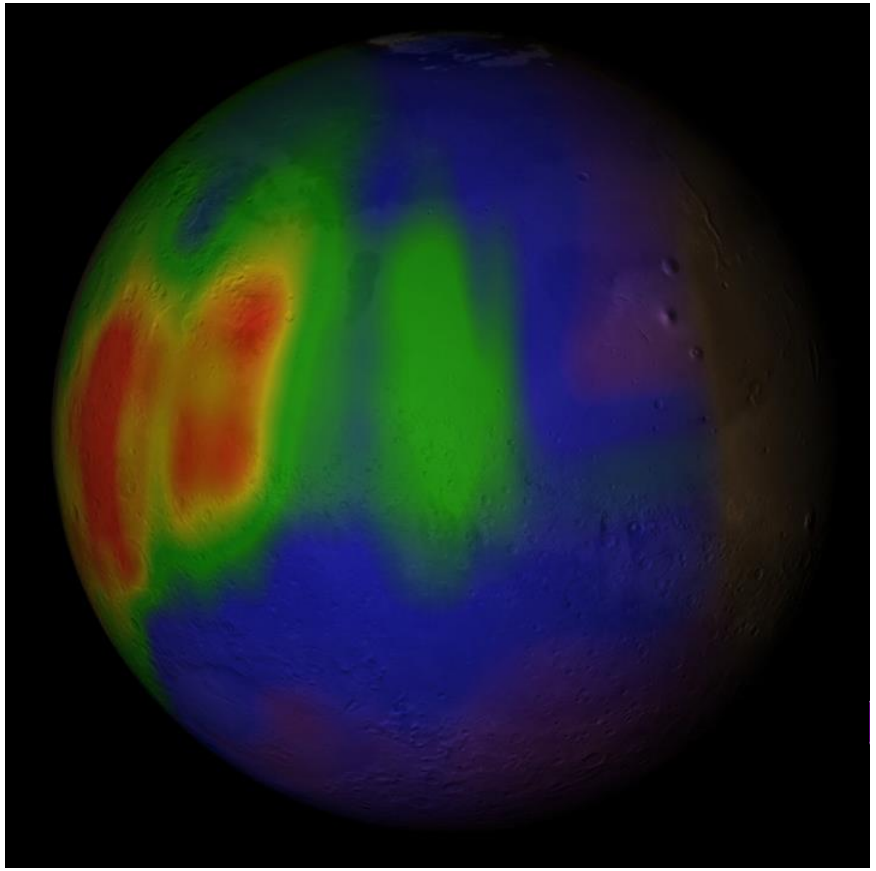
How Mars moon Deimos would look if it hovered over Paris, France.

Credit and copyright: Ciro Villa



Methane in the Martian Atmosphere

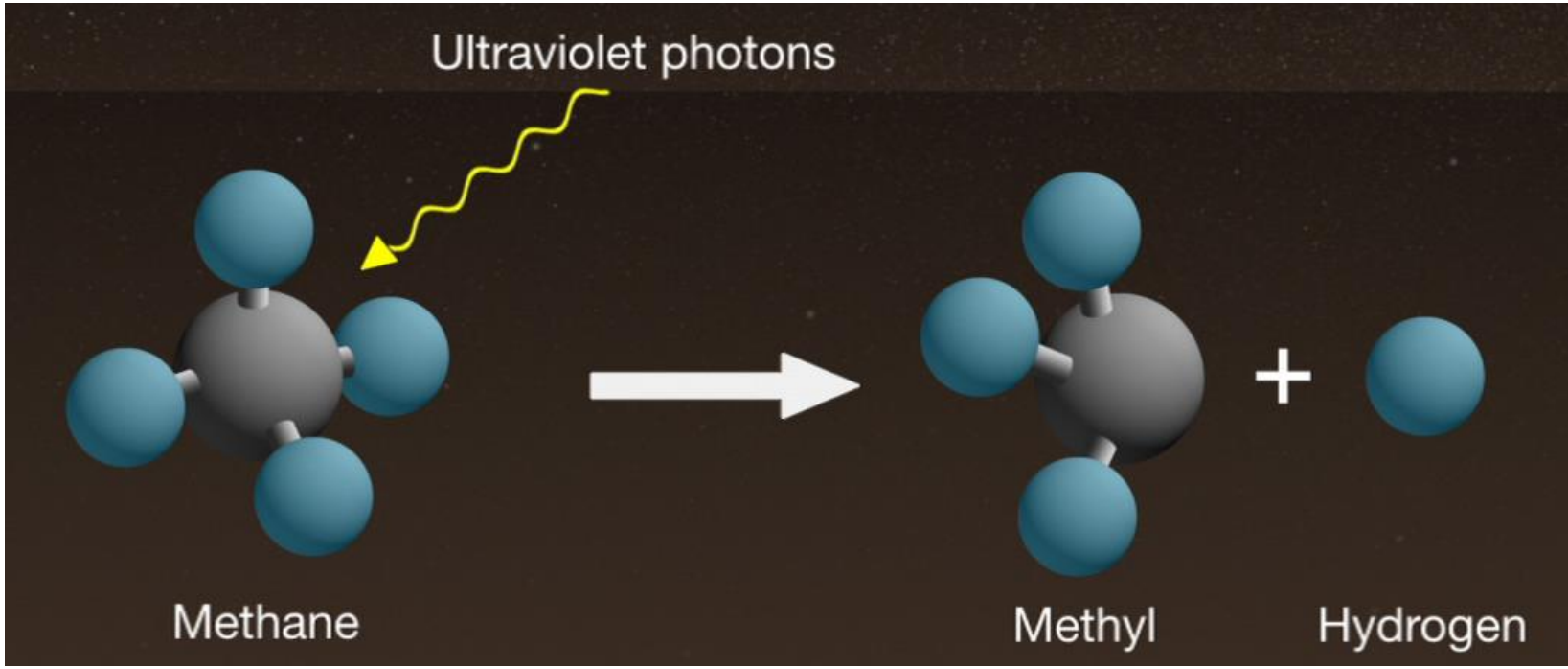
- Methane gas was recently detected in Mars' atmosphere using ground-based telescopes
- The methane gas distribution is patchy and changes with time
- Most methane in Earth's atmosphere is produced by life, raising questions about its origin on Mars



View of Mars colored according to the methane concentration observed in the atmosphere. Warm reddish colors depict high concentrations.

Recent Release of Methane

- The Methane in the atmosphere should be destroyed by Ultraviolet light within a few hundred years.
- The Methane observed now must therefore have been produced recently.
- Variations in space and time suggest that it was recently released from the subsurface in localized areas.



Ultraviolet photons (light particles) have enough energy to break molecules apart

Where can the methane come from?

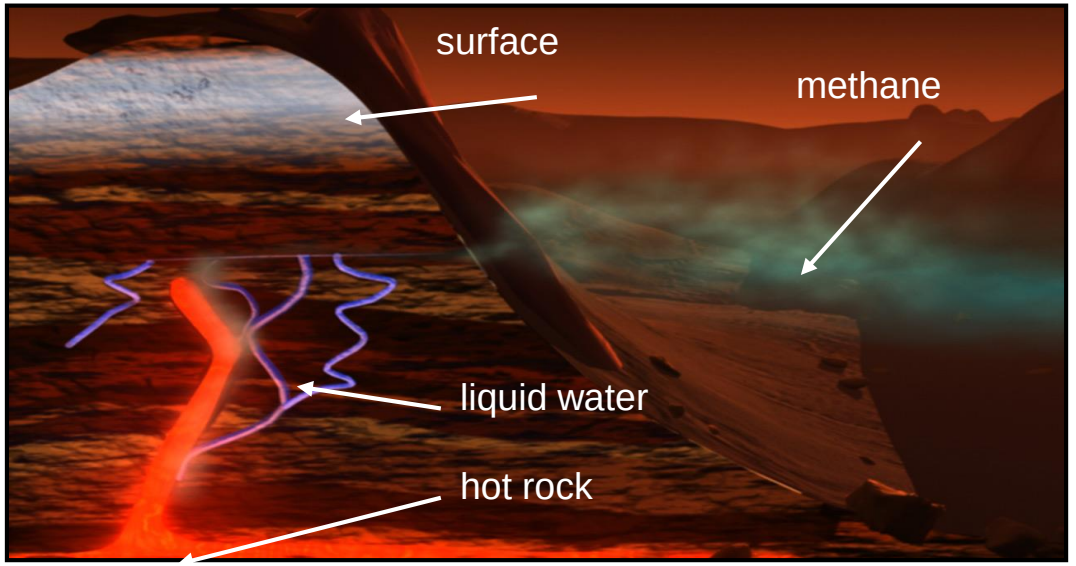
- From an analogy with Earth, there are two leading theories for the origin of recent subsurface methane at Mars:

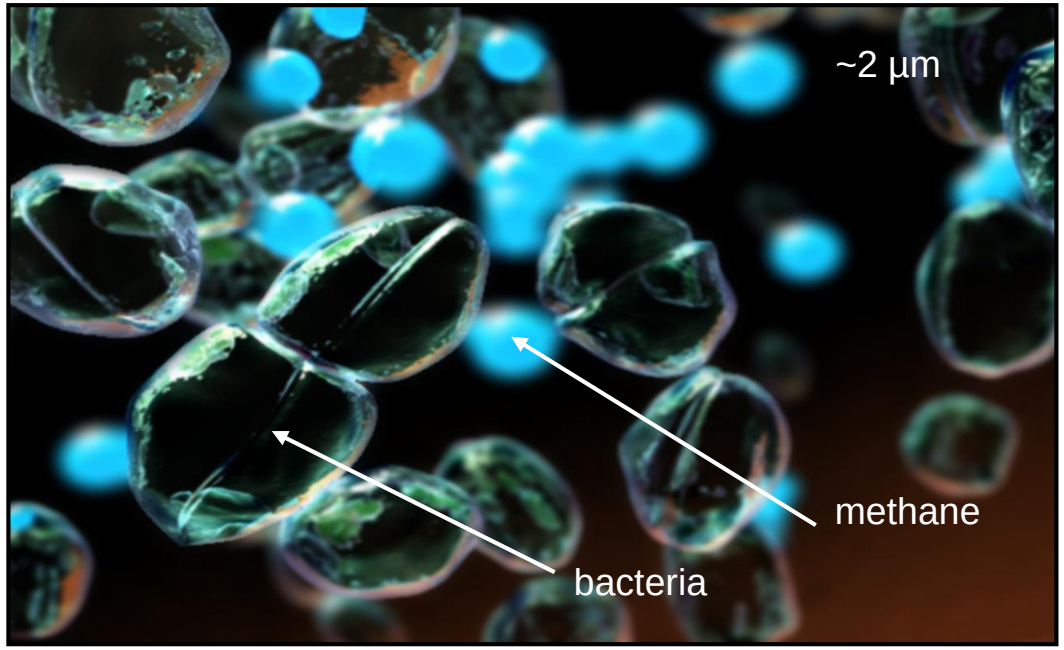
  1. Methane is produced by water-rock interactions

  2. Methane is produced by bacteria, in regions where liquid water is found

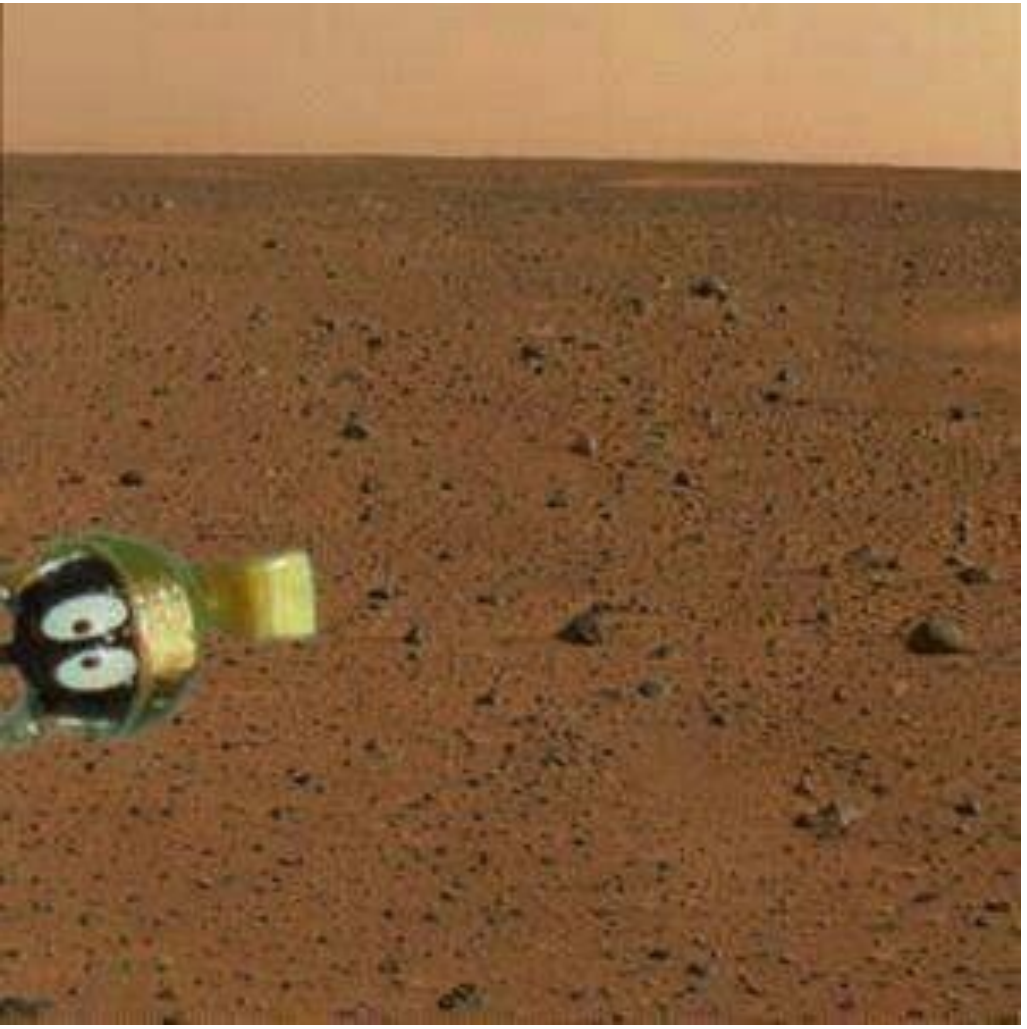
  Either theory implies that the Martian subsurface is dynamic

- Future observations can test for trace chemicals associated with each process

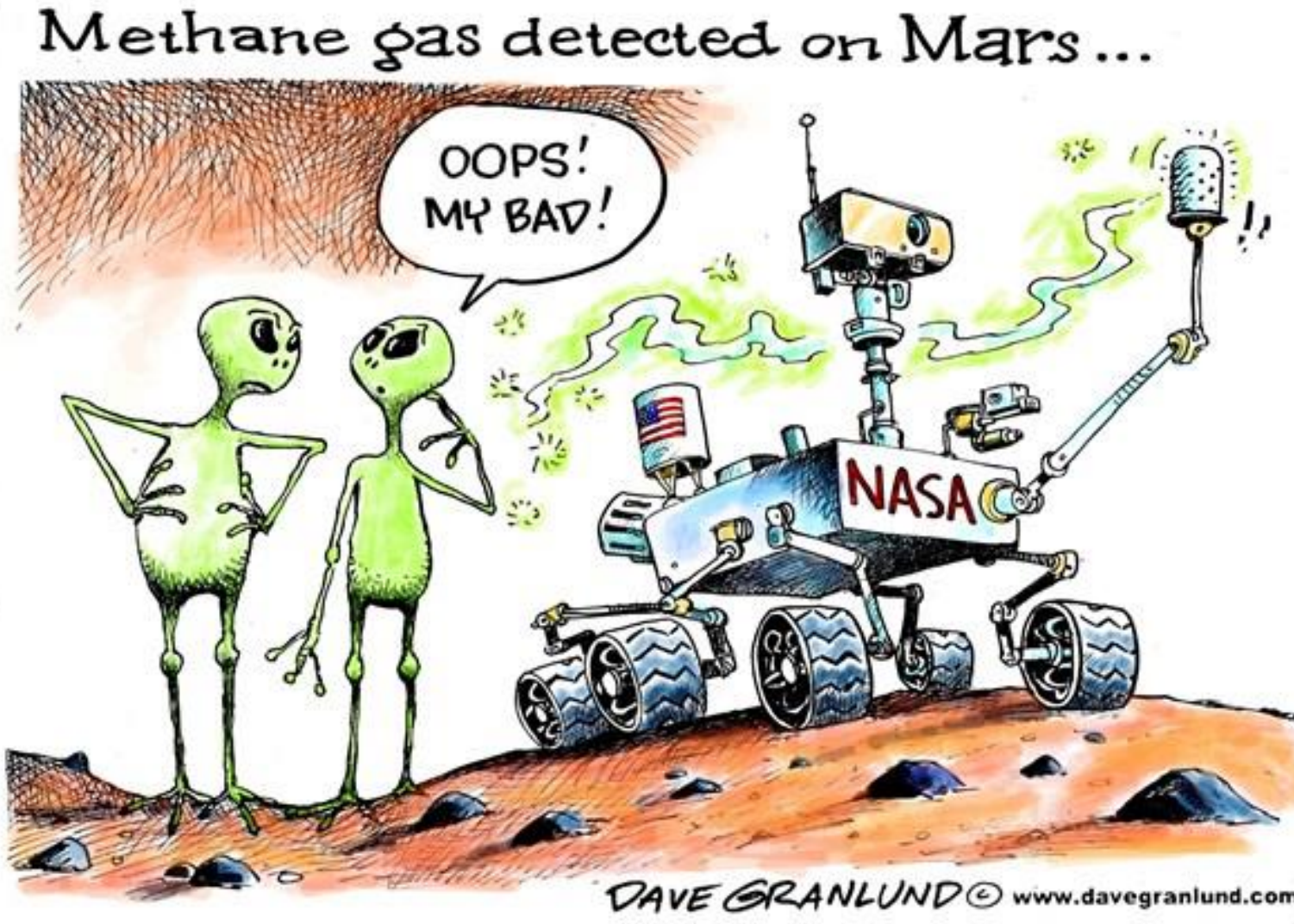




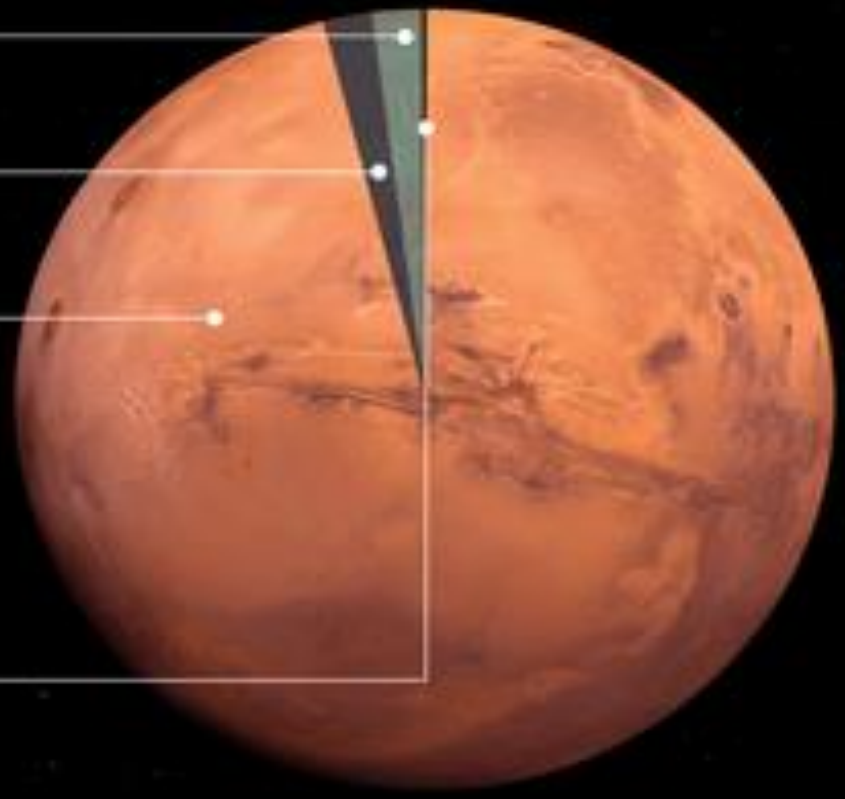
Methane on Mars could be produced chemically through liquid/rock interactions (top) or biologically (bottom)



Marvin, the Martian !!



→ COMPARING THE ATMOSPHERES OF MARS AND EARTH



ARGON
1.9%

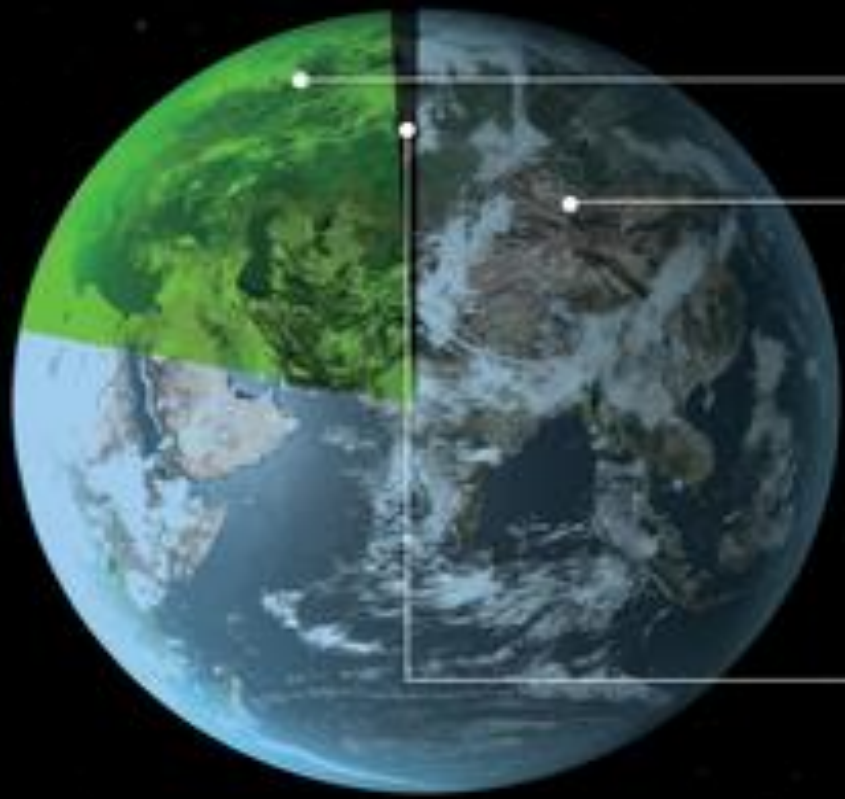
NITROGEN
1.9%

CARBON DIOXIDE
96%

TRACE GASES, INCLUDING:

ACETYLENE
CARBON MONOXIDE
KRYPTON
METHANE
NEON
NITROGEN OXIDE
OXYGEN
OZONE
WATER VAPOUR
XENON

MARS



OXYGEN
20.9%

NITROGEN
78.1%

TRACE GASES, INCLUDING:

ARGON (0.93%)
CARBON DIOXIDE
HELIUM
HYDROGEN
KRYPTON
METHANE
NEON
NITROUS OXIDE
OZONE
SULPHUR DIOXIDE
WATER VAPOUR
XENON

EARTH

Atmospheric composition by volume | Planets not to scale | Atmosphere of Mars is less than 1% of Earth's | Trace gases listed alphabetically

MARS FACTS / MARS

4th Planet From the Sun

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MARS FACTS / DISTANCE

Average distance from the Sun to
the orbit paths of Earth and Mars

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MARS FACTS / GRAVITY

On Mars, you'd experience 62.5% less gravity than you're used to.

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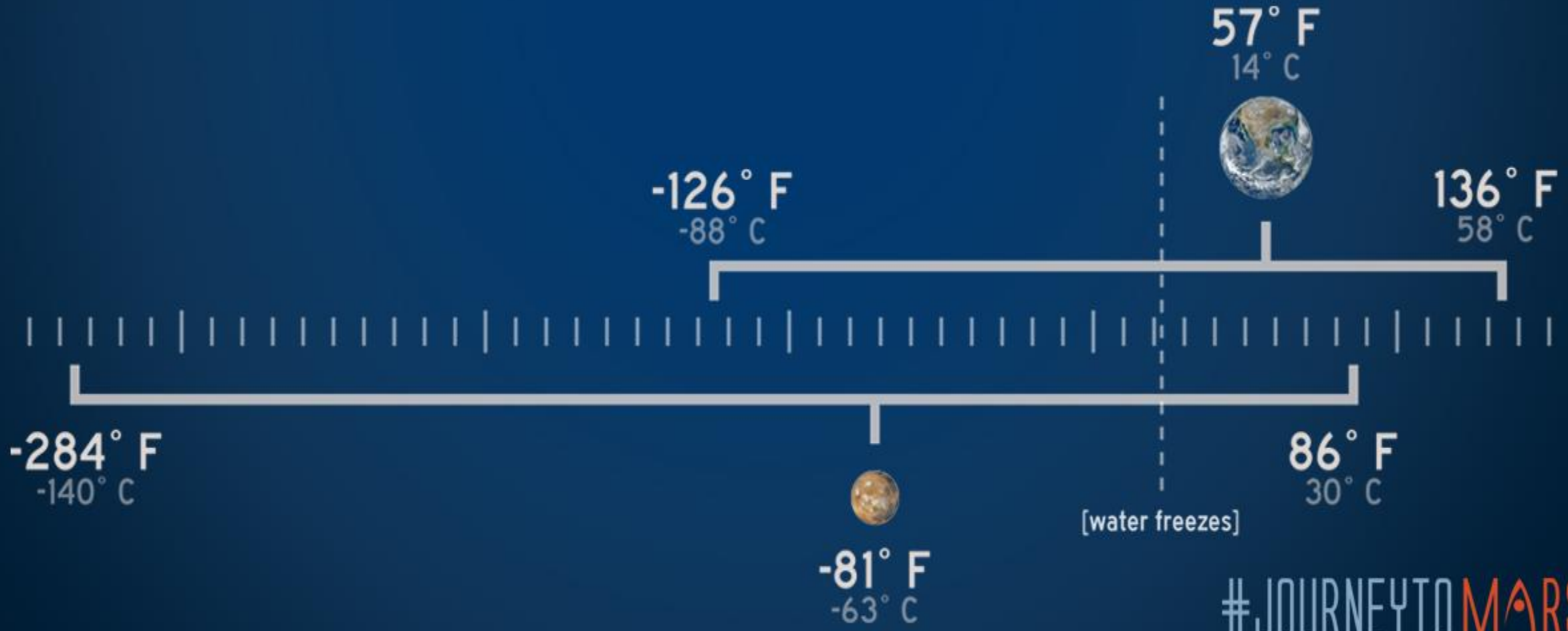
MARS FACTS / TEMPERATURE



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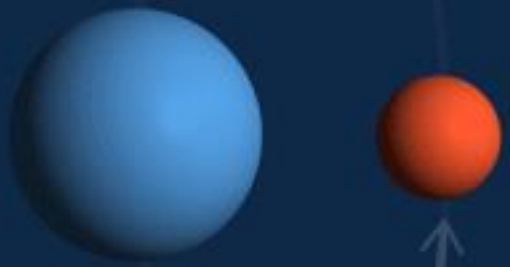
MARS FACTS / YEAR

365 DAYS

687 DAYS



A year on Mars is almost twice as long as a year on Earth.

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MARS FACTS / WEIGHT

If you weighed 100 lbs on Earth,
you would weigh only 38 lbs on Mars!

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MARS FACTS / ATMOSPHERE

OVER 100 TIMES DENSER THAN MARS' ATMOSPHERE

78% NITROGEN
21% OXYGEN
1% OTHER

Earth

96% CARBON DIOXIDE
<2% ARGON
<2% NITROGEN
<1% OTHER

Mars

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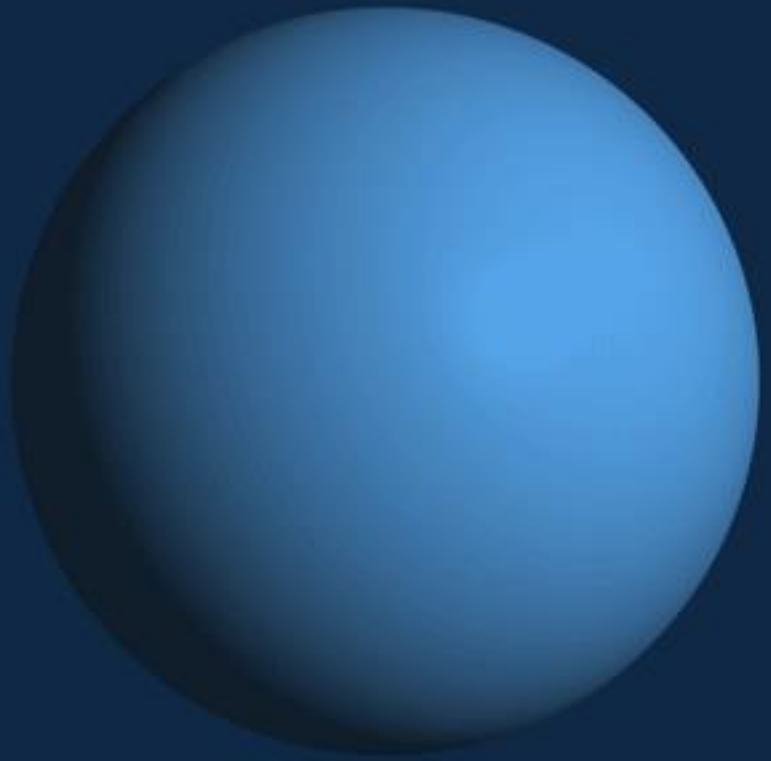
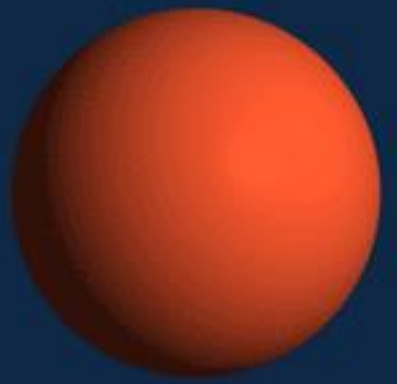
MARS FACTS / SIZE



EARTH
7926 miles



MARS
4220 miles

MOON
2159 miles

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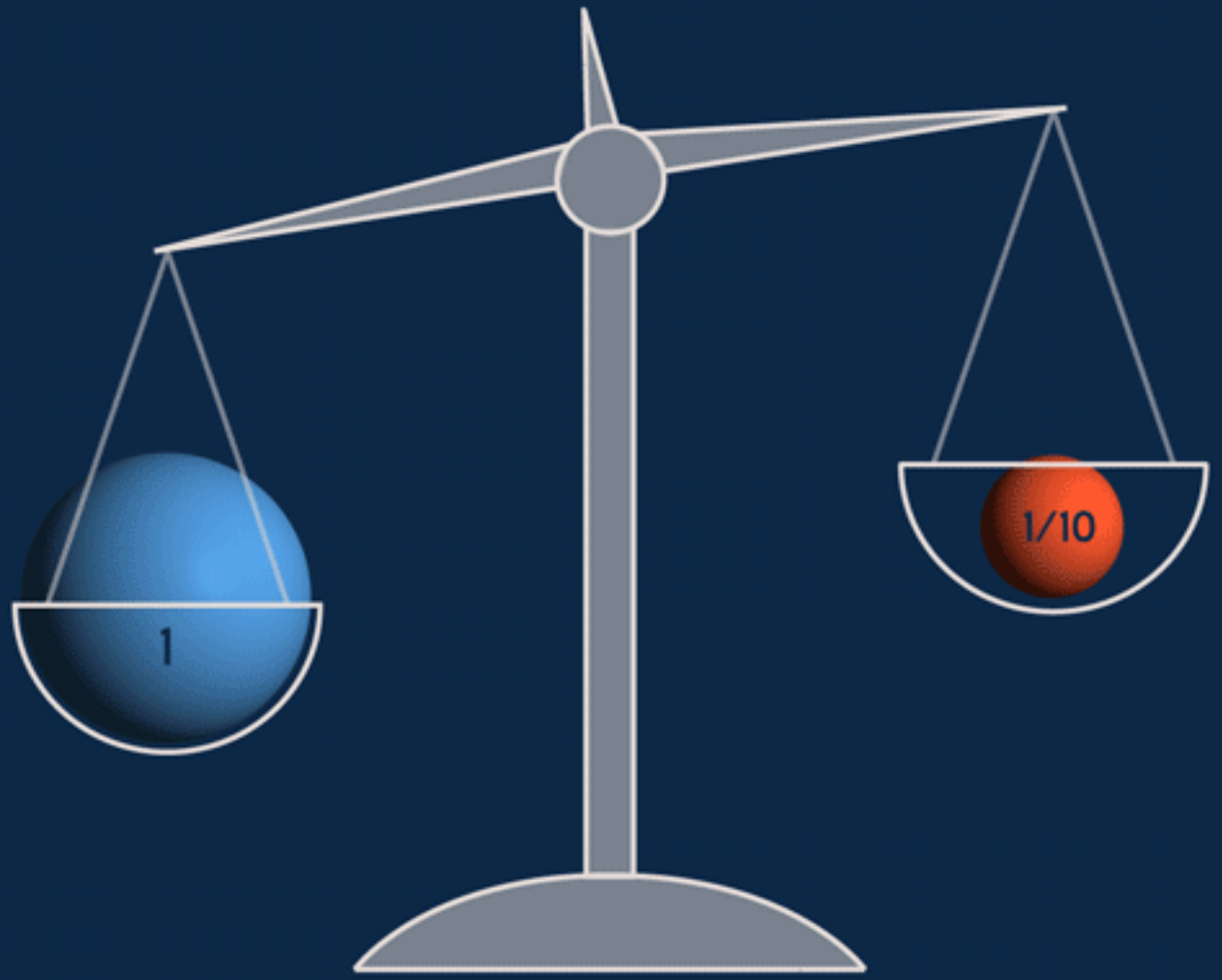
mars.nasa.gov

MARS FACTS / MASS



Mars has about one tenth of the mass of Earth.

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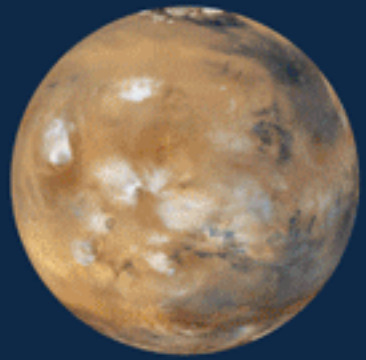
MARS FACTS / STRUCTURE

Crust

Mantle

Liquid Outer Core

Solid Core



The core of Mars may be similar to Earth's, but its exact structure is not yet known.

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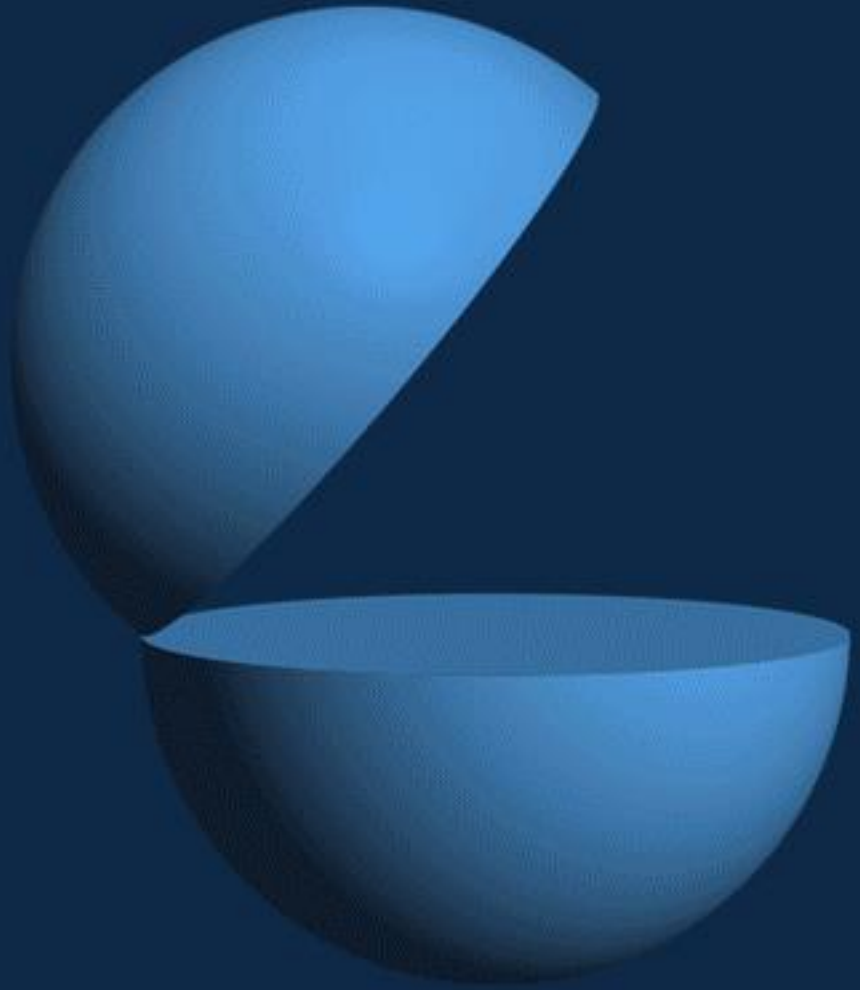
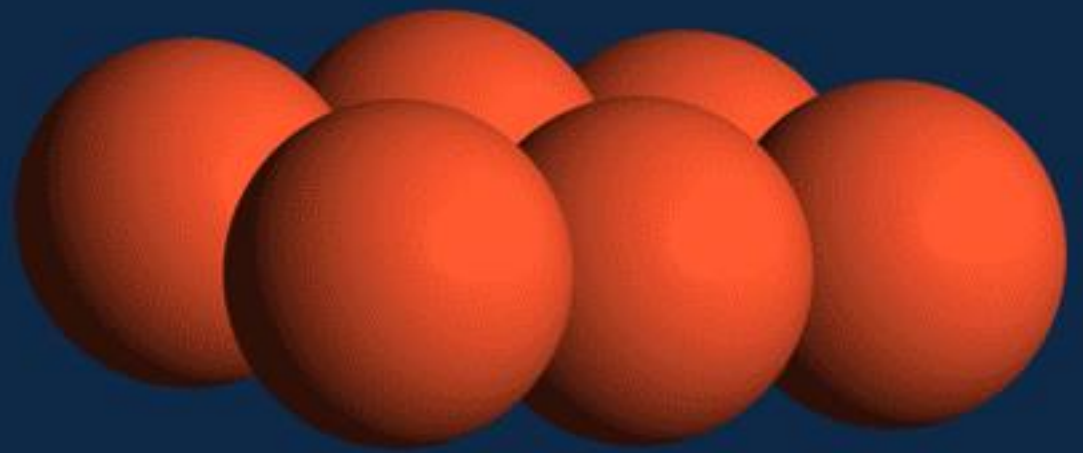
MARS FACTS / VOLUME



It would take more than six of Mars to fill the volume of Earth.



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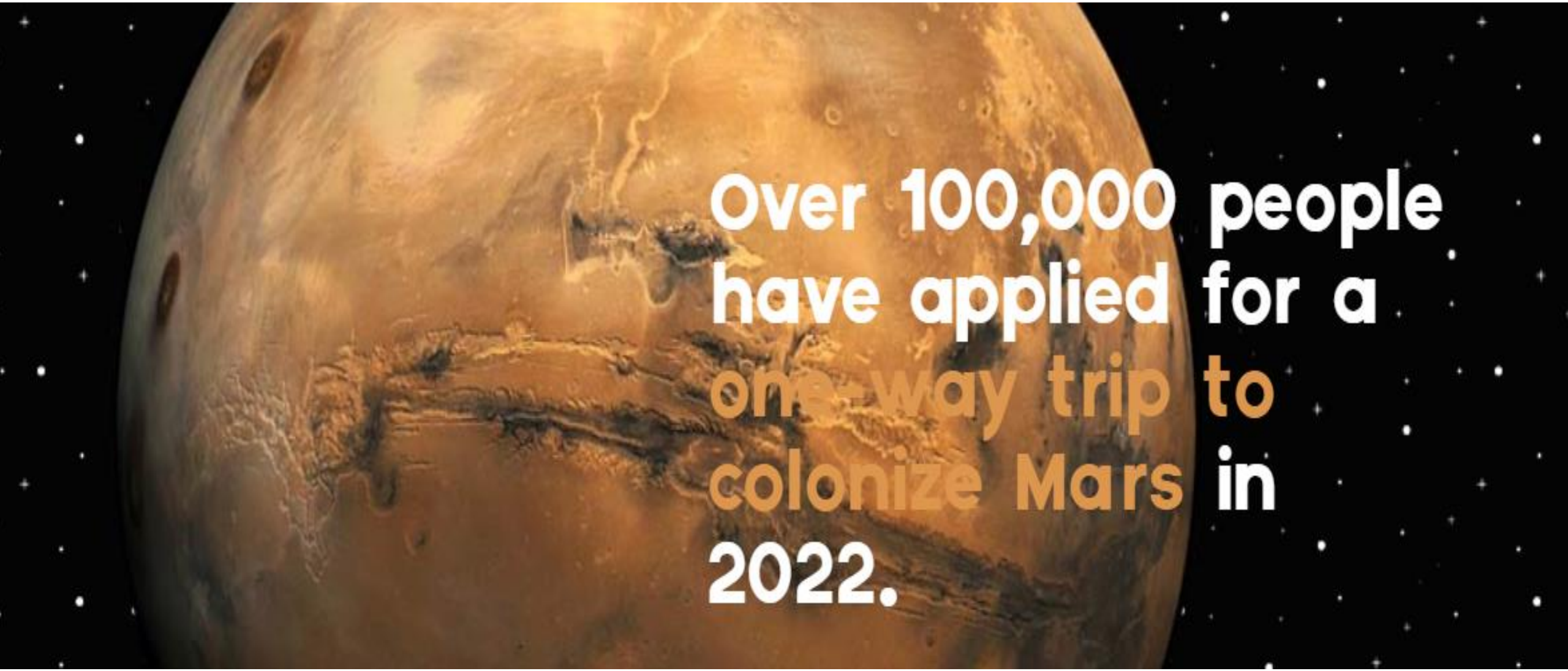

Over 100,000 people
have applied for a
one-way trip to
colonize Mars in
2022.


On Mars, sunsets are blue.

Mars has the tallest known mountain on a planet of our Solar System, with a height of 22 km (14 mi).

♦ SOURCE ♺ SHARE

On its one-year anniversary, the NASA's Curiosity Rover sang the "Happy Birthday" tune to itself on Mars.

♦ SOURCE ♺ SHARE

The average temperature in Mars is -81°F (-63°C).

♦ SOURCE △ SHARE

Your weight in Mars
is over 60% less
than on Earth.


The soil on Mars is particularly good for growing asparagus.

Scientists want to introduce global warming on Mars to make life habitable for colonization.

♦ SOURCE ♺ SHARE

Mars

had an oxygen-rich

atmosphere around

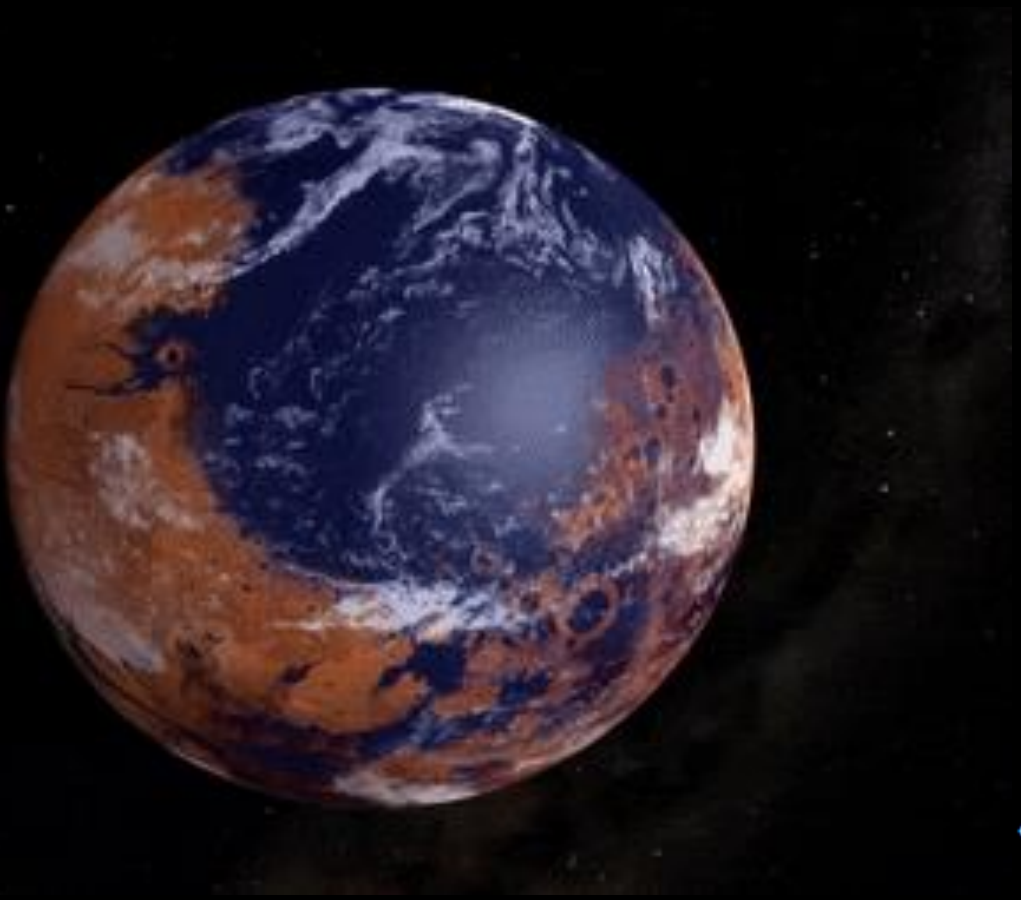
4 billion years ago.


Mars has the largest dust storms in the Solar System. They can last for months and can cover the entire planet.
SOURCE
SHARE


Mars is the second smallest planet
in the Solar System, after Mercury.

Mars is located closer to the asteroid belt, so it has an increased chance of being struck by materials from that source.

♦ SOURCE ♺ SHARE



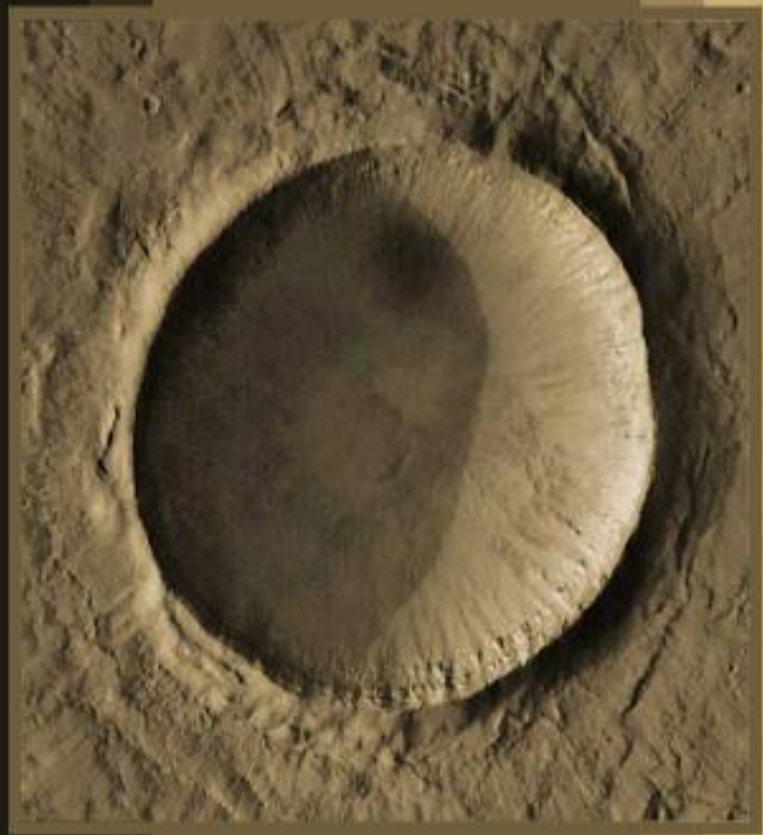
4 billion years ago, Mars had an ocean covering 19% of the planet's surface.

♦ SOURCE ♺ SHARE

A Martian day is about 44 minutes longer than an Earth day.

♦ SOURCE ♺ SHARE

Craters on Mars under 60 kilometres in diameter are named after towns on Earth with populations under 100,000.



♦ SOURCE ♺ SHARE

Mars has no magnetic field.

♦ SOURCE ♺ SHARE

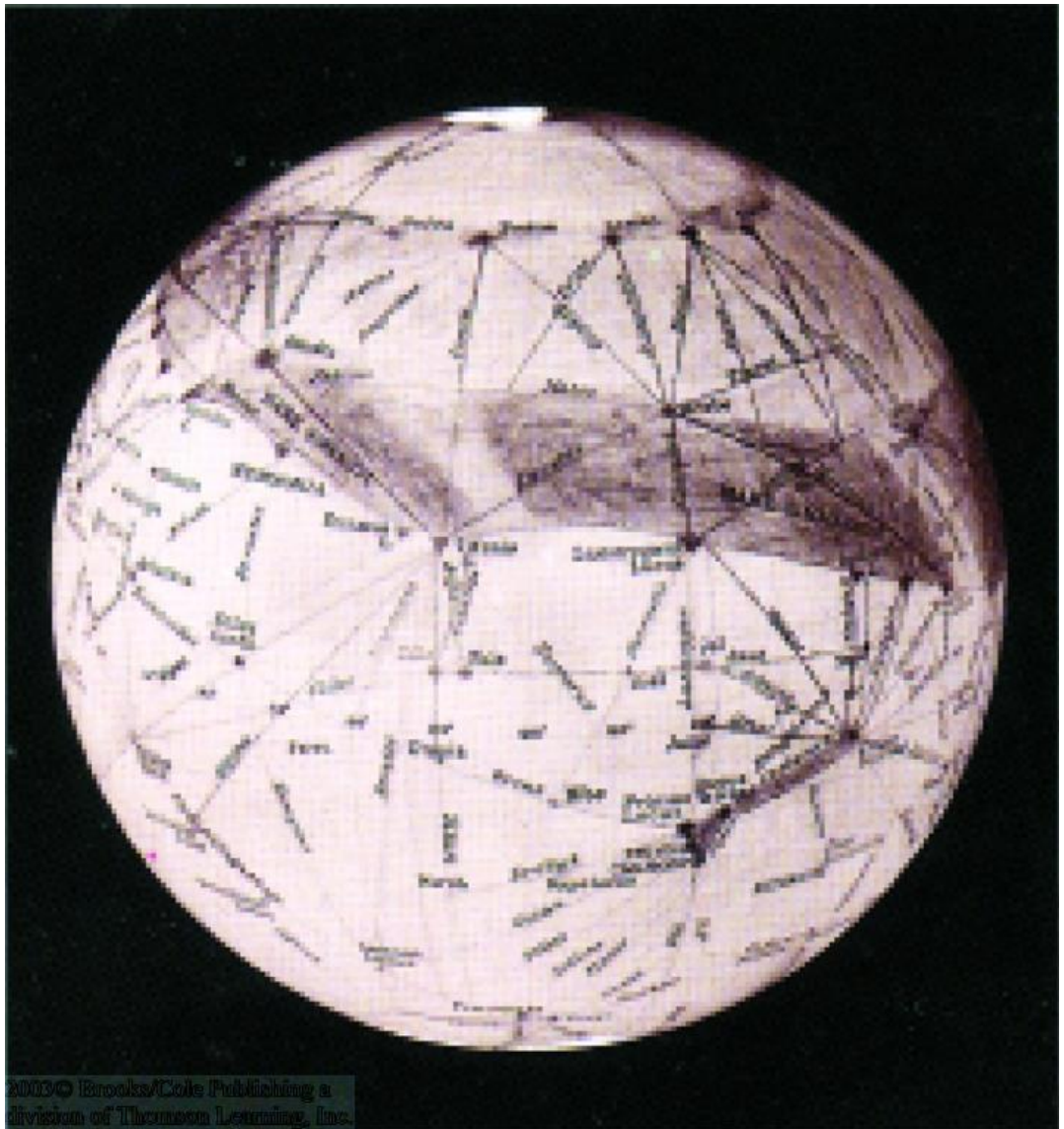
TALES OF CANALS AND LIFE ON MARS

Early observers (Schiaparelli, Lowell) believed that they saw canals on Mars, through early telescope designs.

This, together with growth/shrinking of polar cap, sparked imagination and sci-fi tales of life on Mars.

We know today: The “canals” were an optical illusion and do not exist!

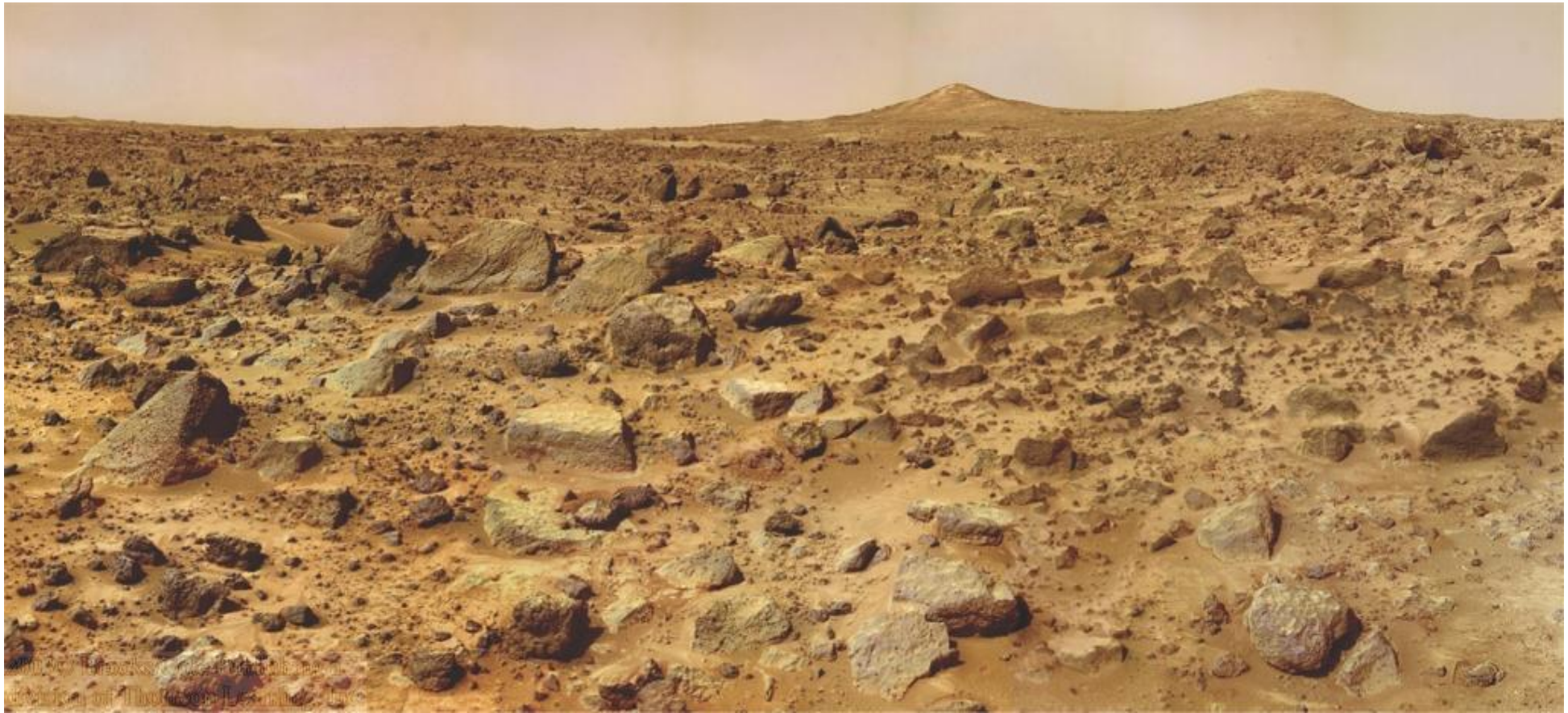
There is no evidence of life on Mars at this time.



THE ATMOSPHERE OF MARS

Most of the Oxygen is bound in oxides in rocks

Iron Oxide is what produces the Reddish color of the surface



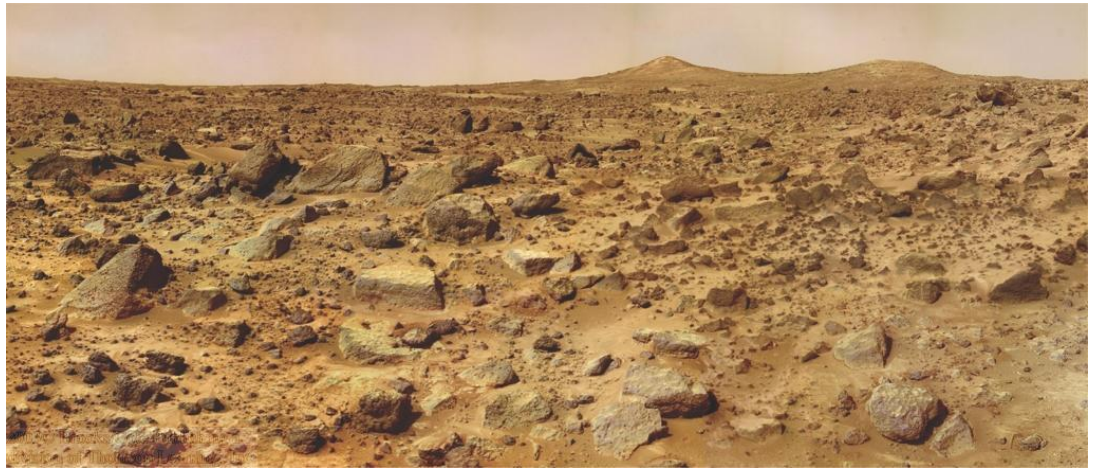
THE GEOLOGY OF MARS

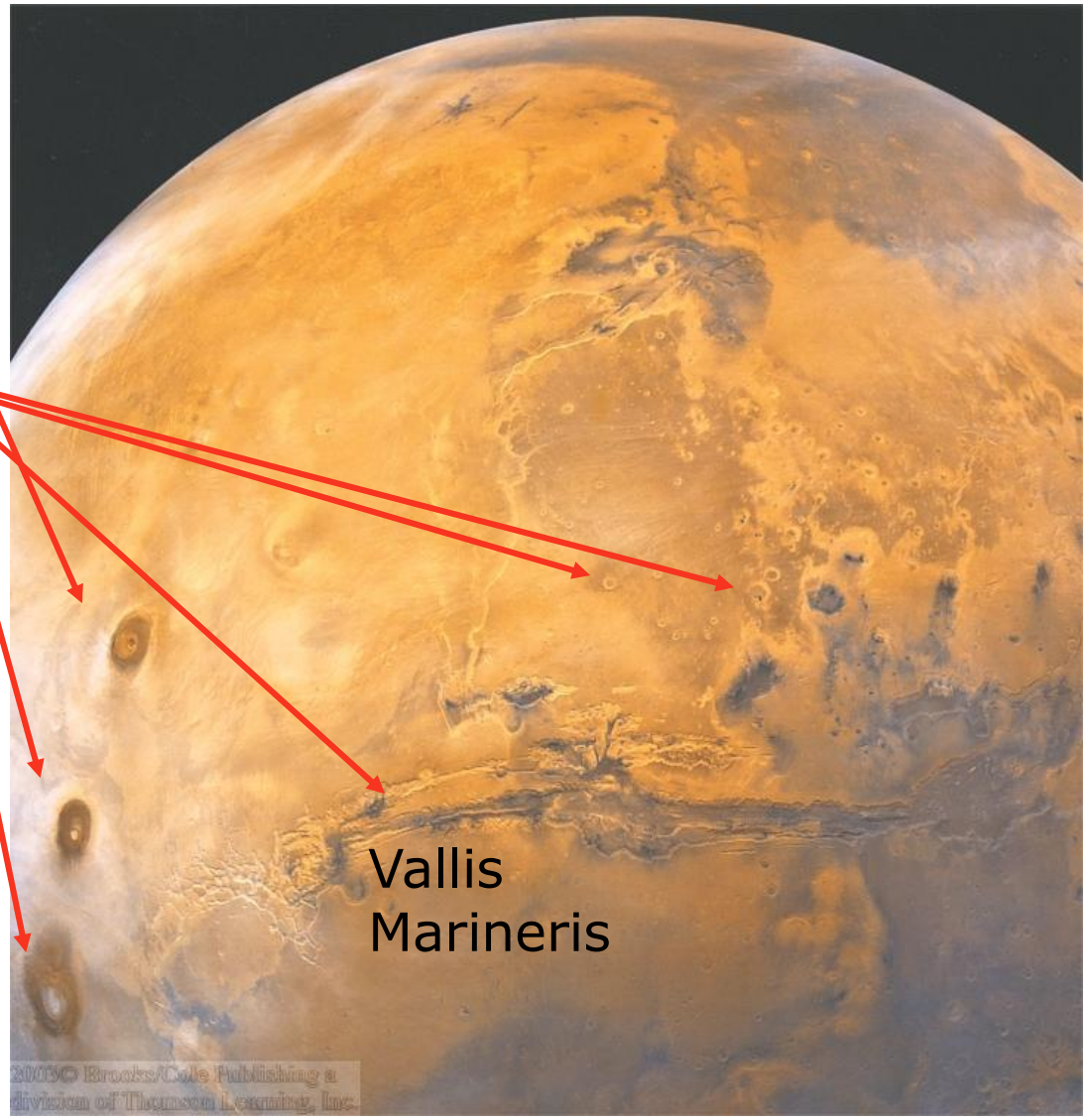
Giant volcanoes

Valleys

Impact craters

Reddish deserts of broken rock, probably smashed by meteorite impacts.

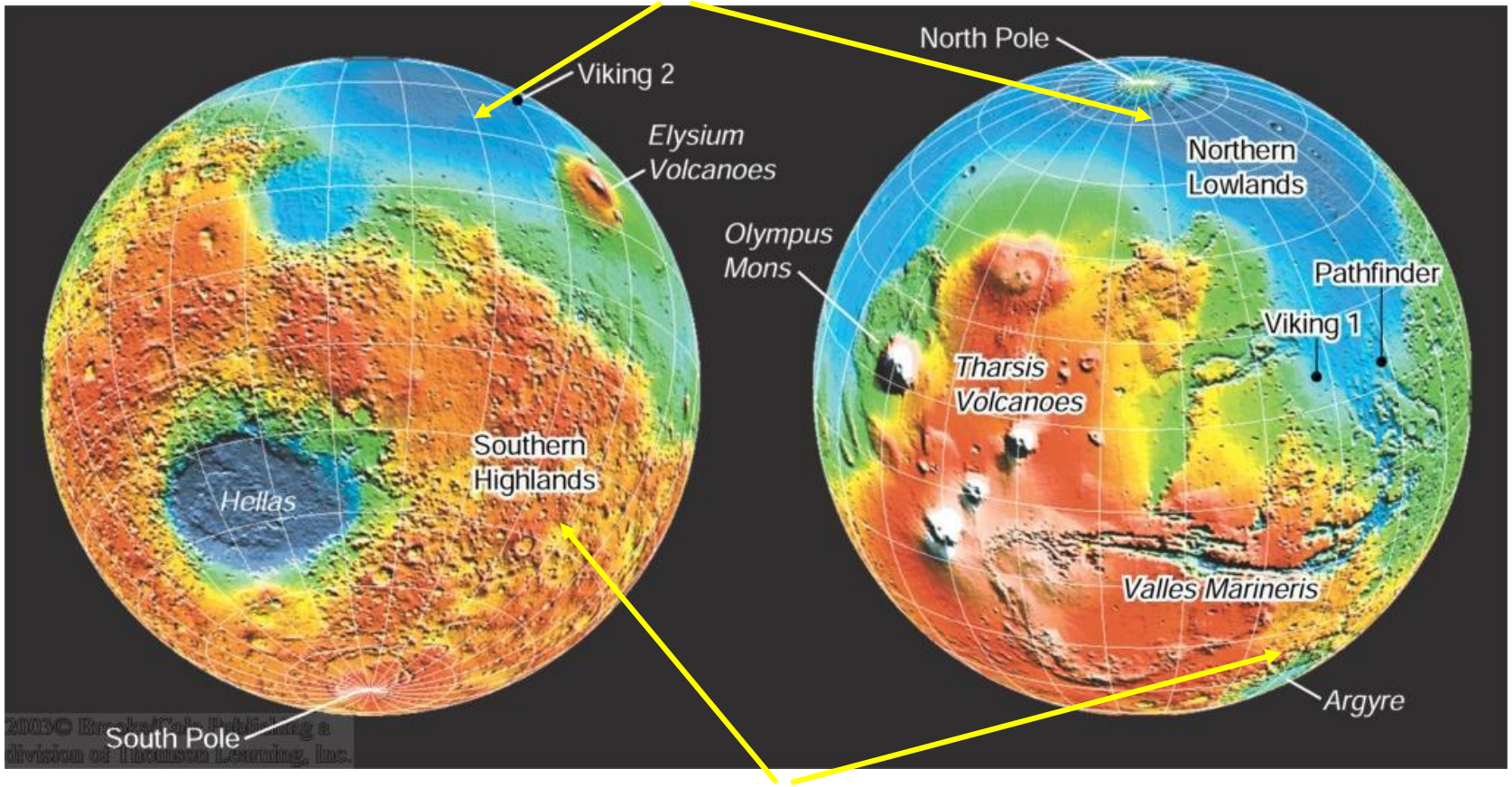




THE GEOLOGY OF MARS

Northern Lowlands: Free of craters; probably re-surfaced a few billion years ago.

Possibly once filled with water.



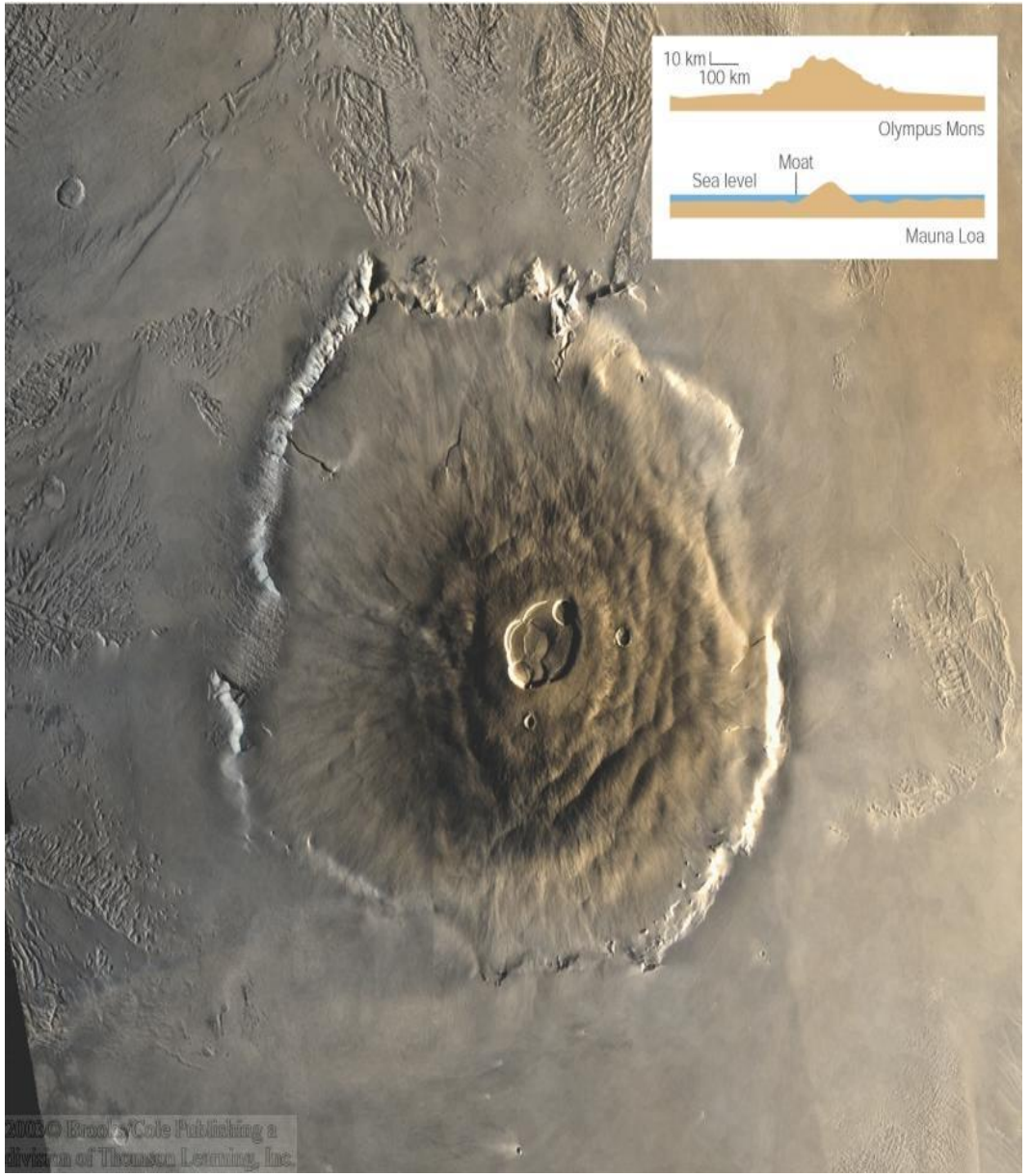
Southern Highlands: Heavily cratered; probably 2 – 3 billion years old.

VOLCANISM ON MARS

Volcanoes on Mars are shield volcanoes, which are broad domed volcanoes with gently sloping sides,

Olympus Mons:

Highest and largest volcano in the solar system.



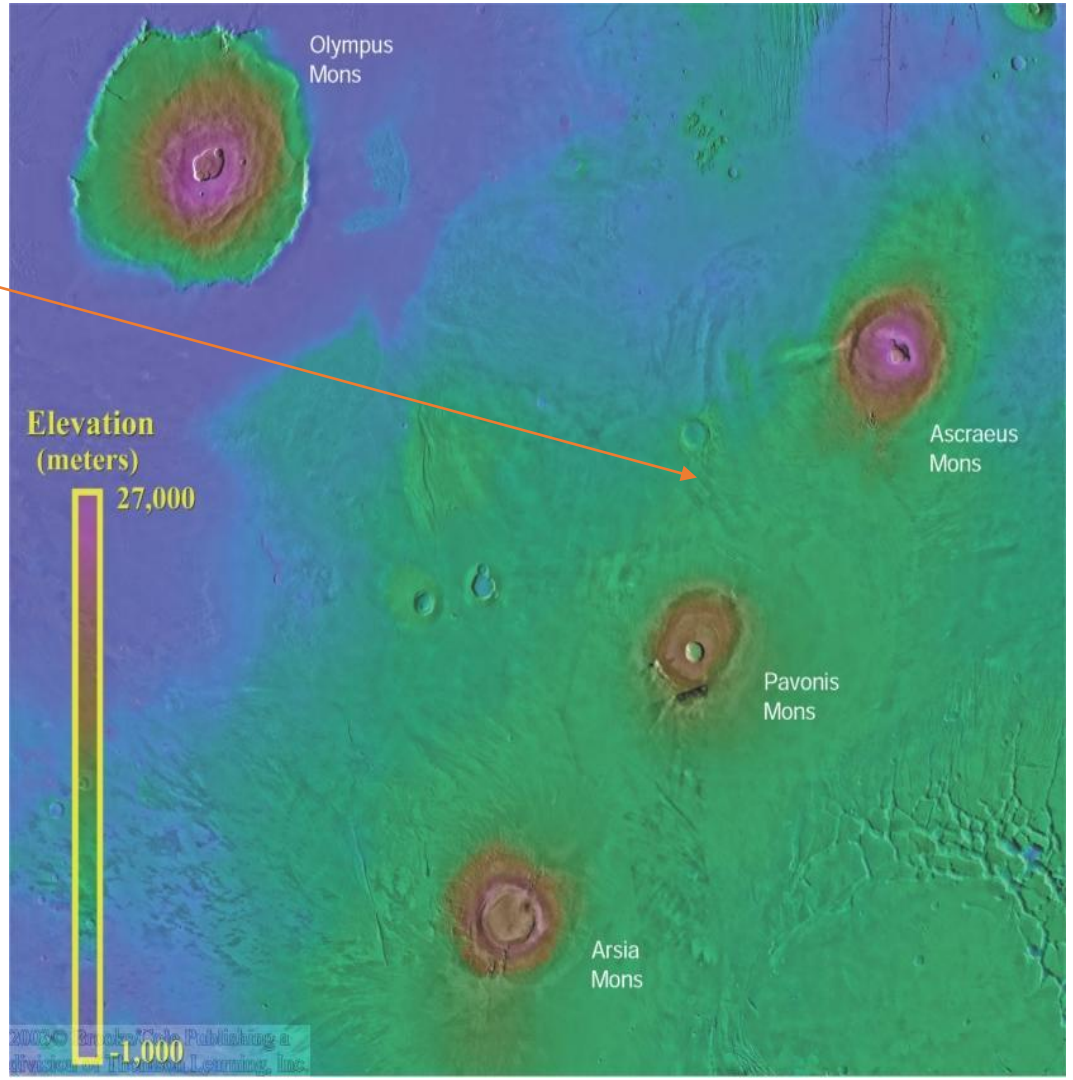
VOLCANISM ON MARS

Tharsis rise (volcanic bulge):

Nearly as large as in the U.S.

Rises about 6 miles above the main surface of Mars.

Rising magma has repeatedly broken through the crust to form volcanoes.



HIDDEN WATER ON MARS

No liquid water on the surface:

It would evaporate due to low pressure.

But evidence shows liquid water in the past:

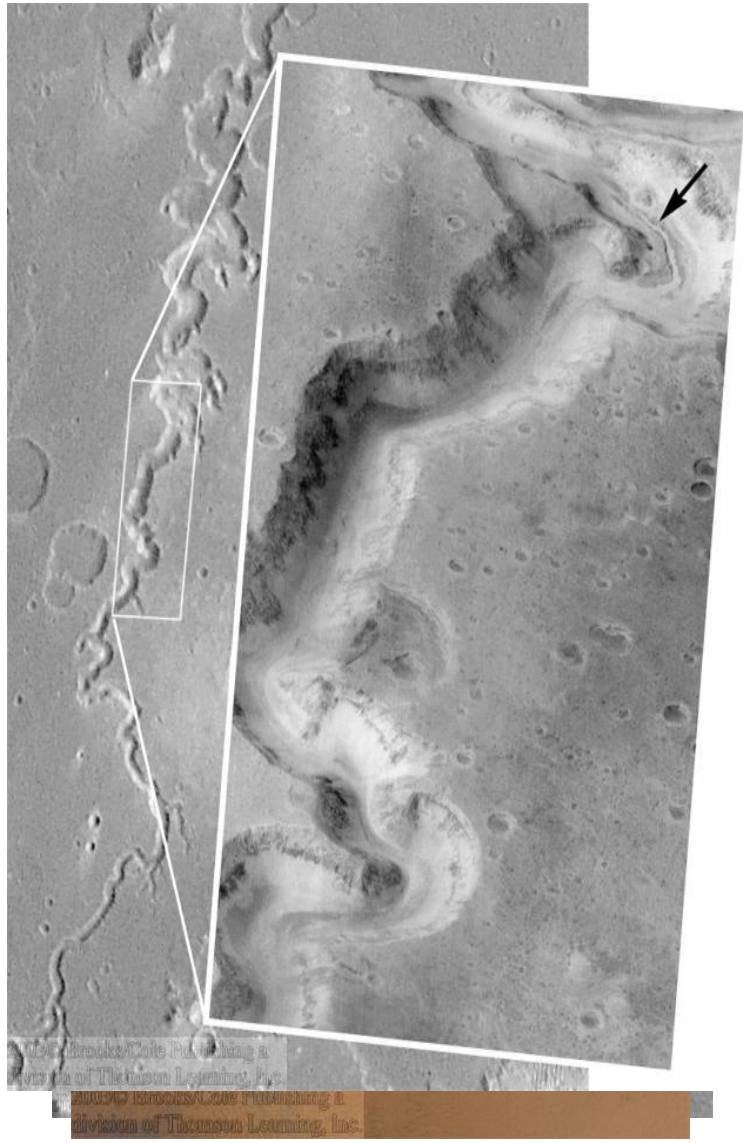
Outflow channels from sudden, massive floods

Collapsed structures after withdrawal of sub-surface water

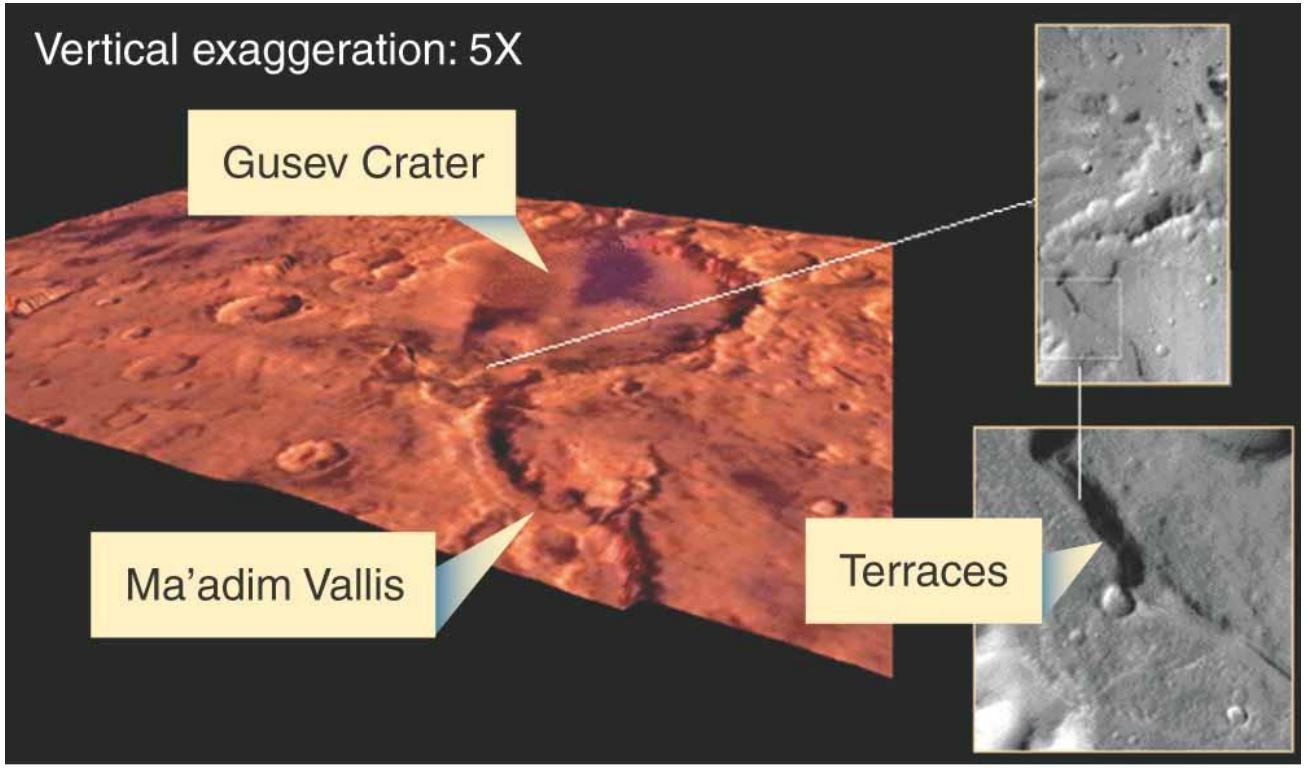
Splash craters and valleys resembling meandering river beds

Gullies, possibly from debris flows

Central channel in a valley suggests long-term flowing water



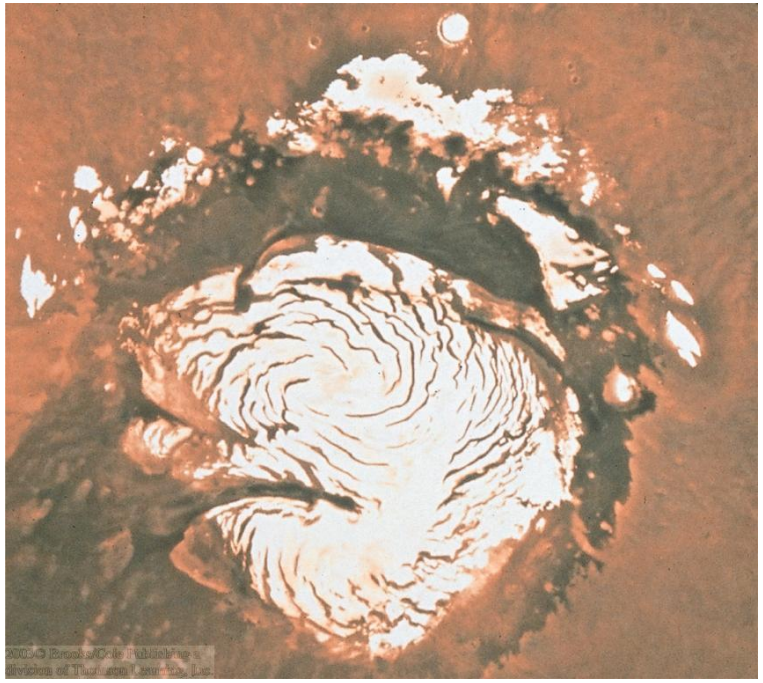
HIDDEN WATER ON MARS

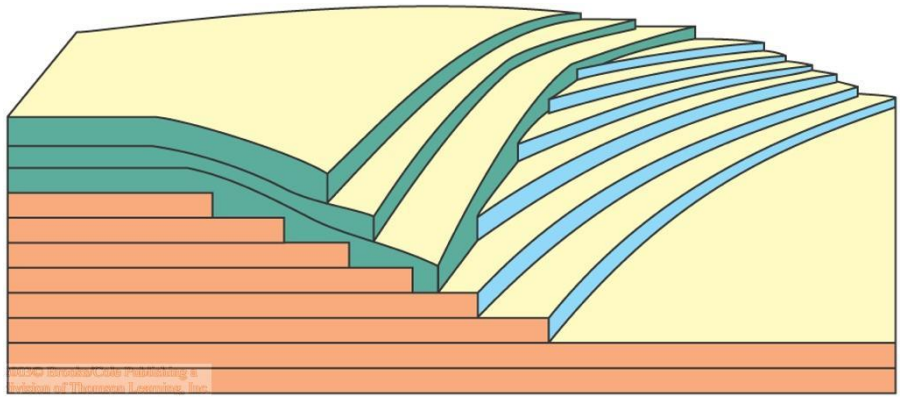


Gusev Crater and Ma'adim Vallis:

Giant lakes might have drained repeatedly through the Ma'adim Vallis into the crater.

ICE IN THE POLAR CAPS

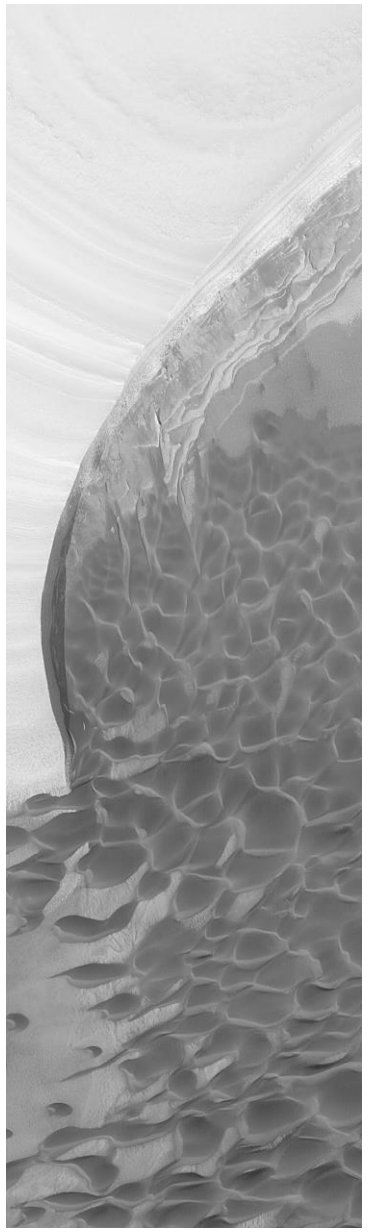




The Polar caps contain mostly Carbon Dioxide ice (like our Dry Ice), and also water.

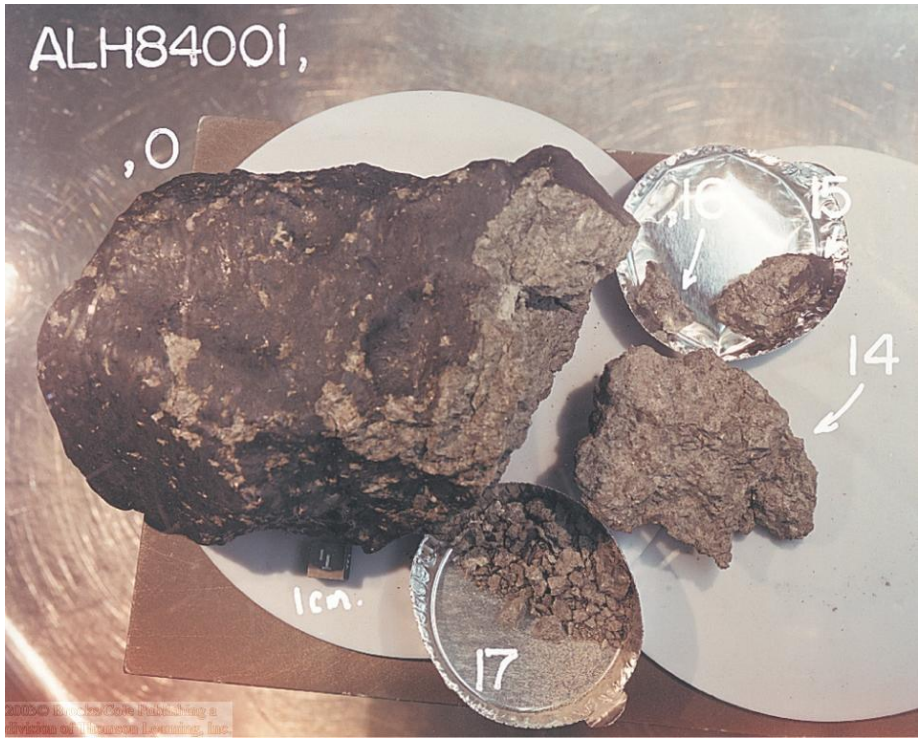
Multiple ice regions are separated by valleys free of ice.

Boundaries of polar caps reveal multiple layers of dust, left behind by repeated growth and melting of polar-cap regions.



EVIDENCE FOR WATER ON MARS

Large impacts may have ejected rocks into space.



Meteorite ALH84001

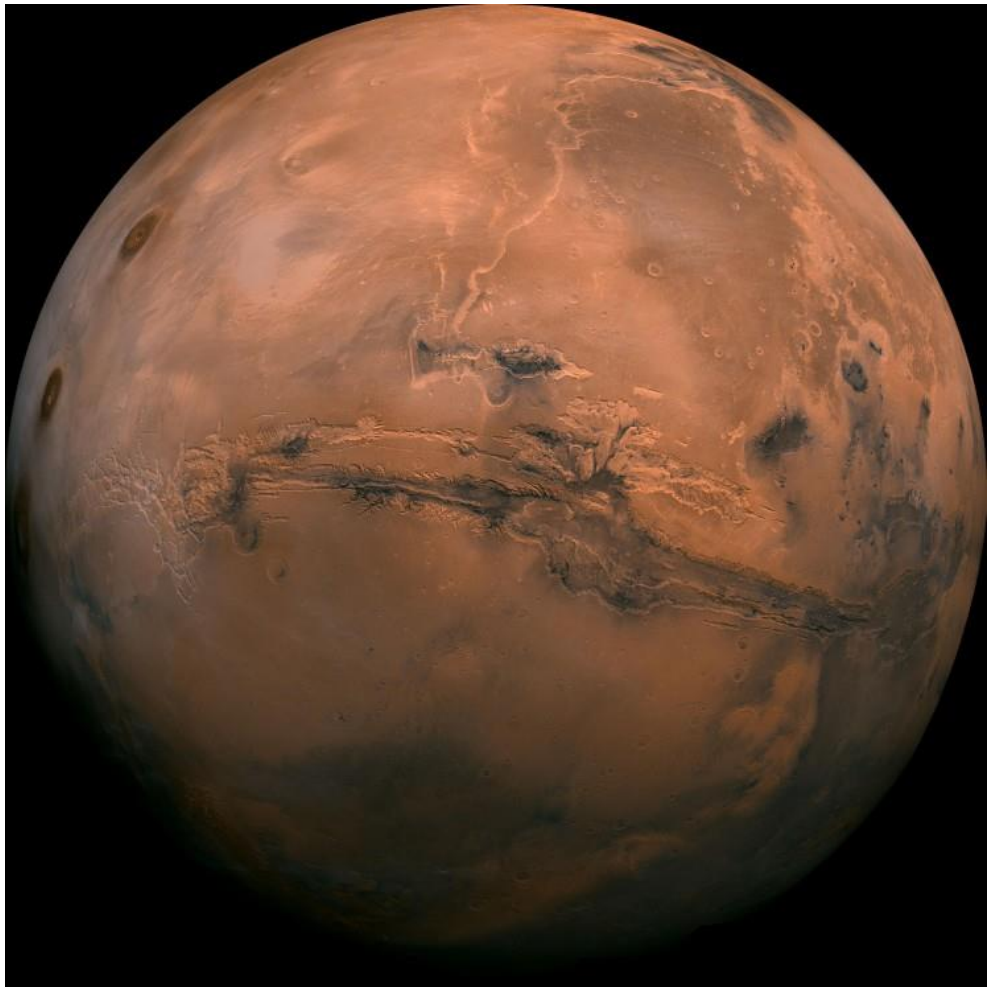
Identified as an ancient rock from Mars

Some minerals in this meteorite were deposited in water so the Martian crust must have been richer in water than it is today.

SUCCESSFUL MISSIONS TO MARS

Unmanned missions to Mars began in 1960.

There have been 56 Mars missions so far, of which 26 have been successful — 46%, a testament to the difficulty in reaching the red planet.

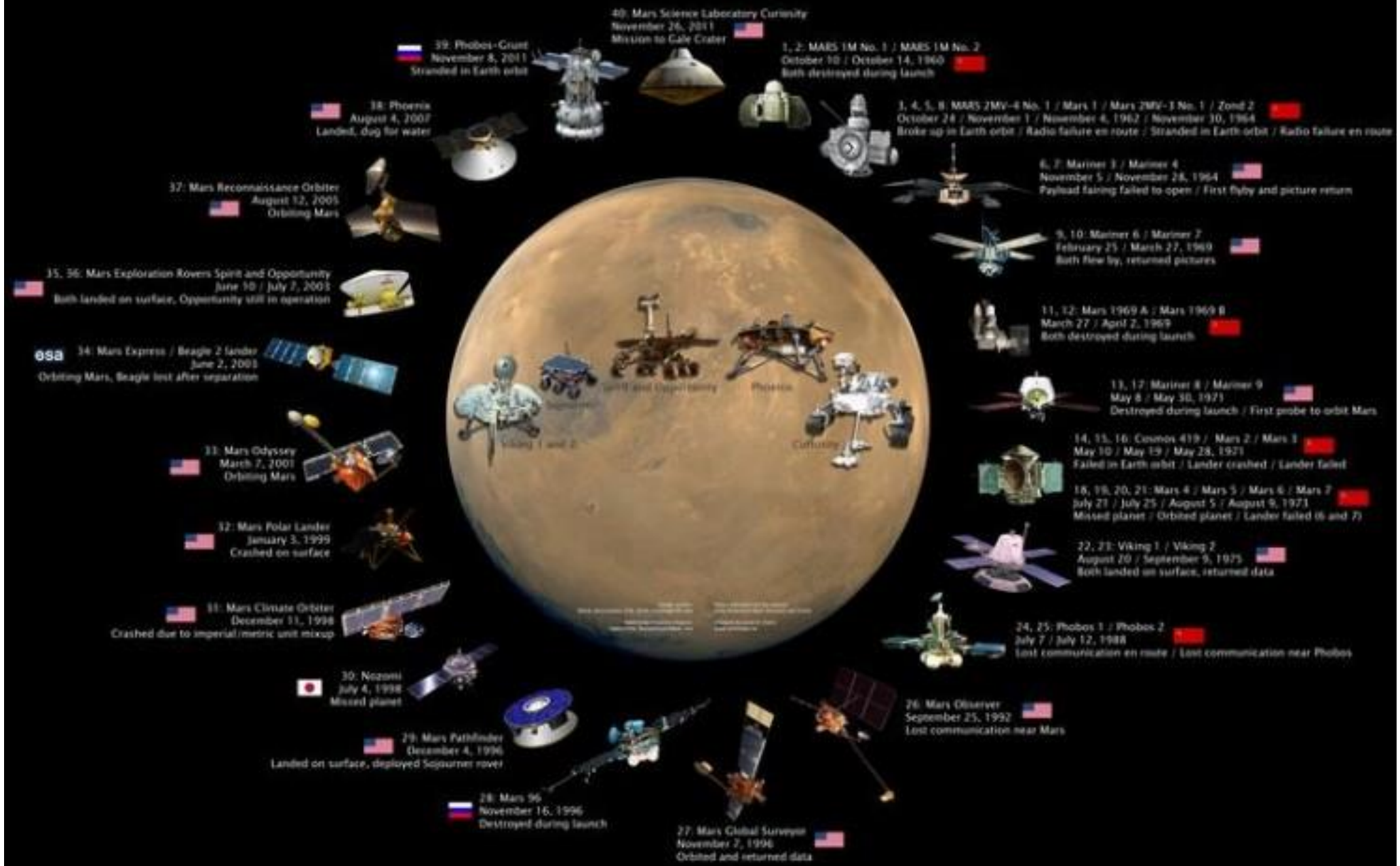


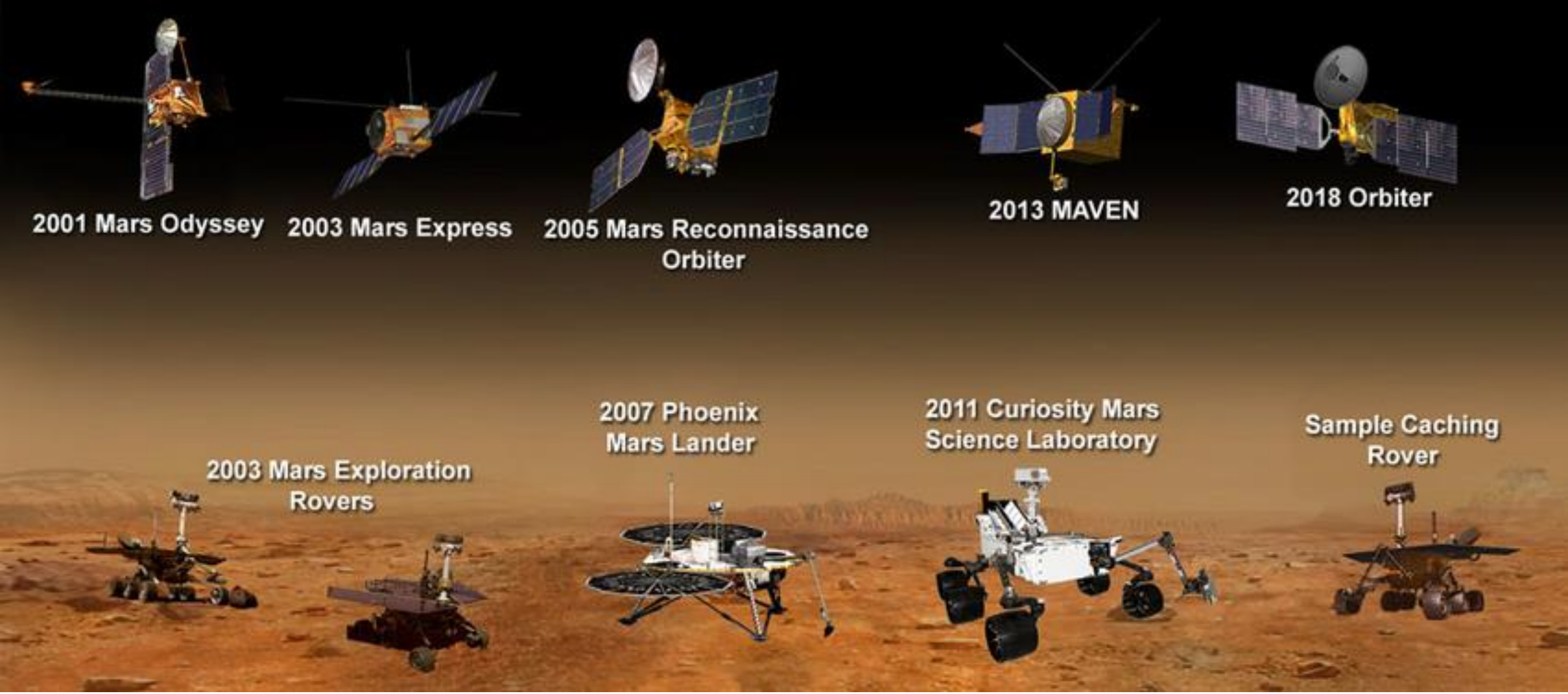
The Russians took the early lead and the U.S. caught up and overtook them with more missions as well as more complexity too.

This is a list of how many of each type, were successful to get there:

- **Fly-By spacecraft – 4**
- **Landers – 6**
- **Orbiters – 12**
- **Rovers – 4**

Mars Exploration Family Portrait





Currently operating missions to Mars. This program architecture provides a high degree of synergy and scientific leverage between missions.

The upcoming sending of the new Rover Perseverance and other items will be discussed on another slide.

MARS ROVER SOJOURNER

The first Mars rover, Sojourner, landed on Mars on July 4th, 1997.

It has front and rear cameras and hardware to conduct several scientific experiments.

it was active for 85 days and traveled a distance of just over 330 ft., by the time communication was lost.

It is the first wheeled vehicle to rove another planet.

MARS ODYSSEY

Sent up in 2001 and named after the iconic sci-fi novel and film 2001: A Space Odyssey

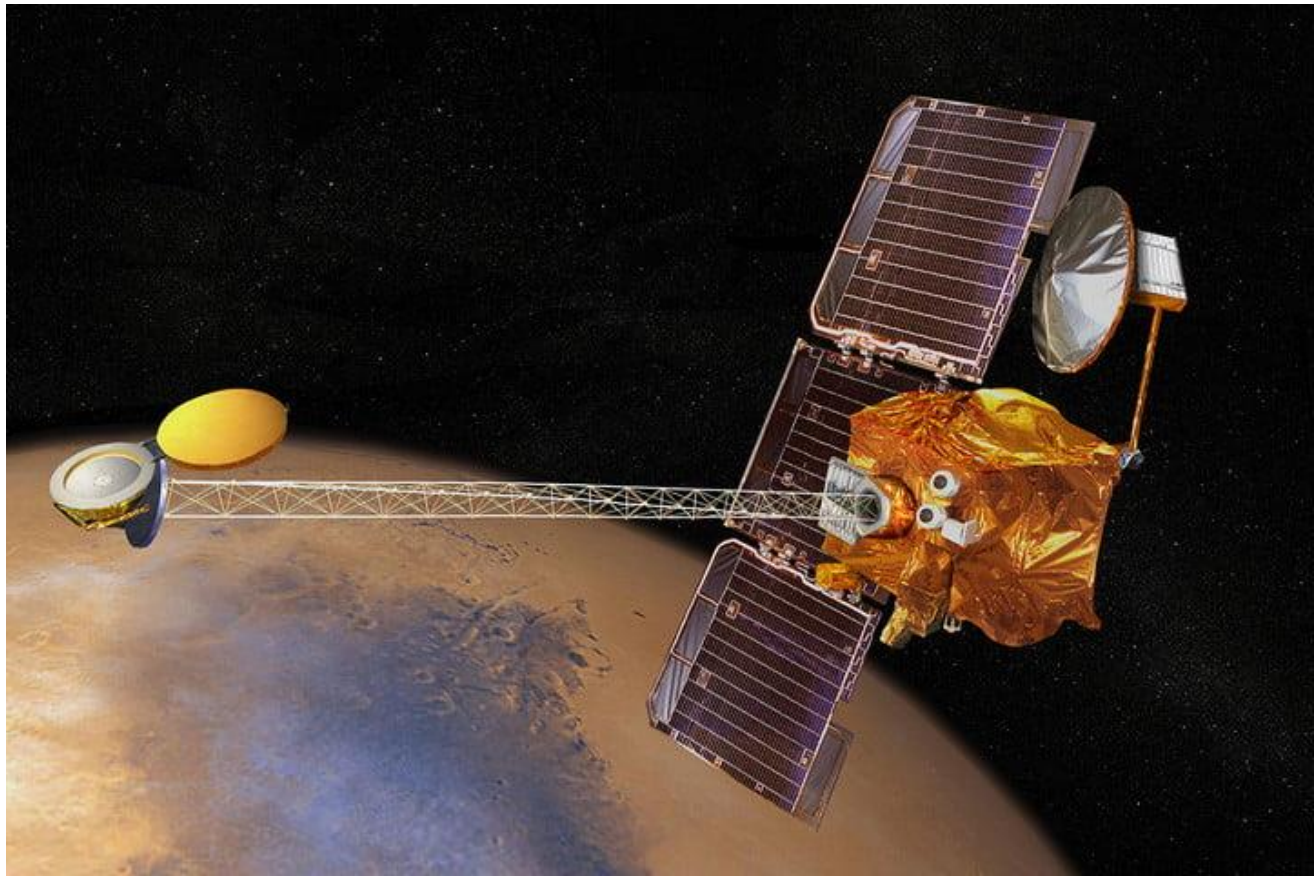
It is a NASA orbital satellite that is currently about 2,400 miles above Mars' surface.

It holds the record as the longest operating spacecraft orbiting Mars.

Mars Odyssey's mission was to find proof of past or present water on Mars which was successfully proven on July 21, 2008, by the Phoenix lander.

It also serves as a communications relay between Earth and Martian rovers, the Mars Science Lab, and the Phoenix lander.

It is projected to remain in operation until 2025.



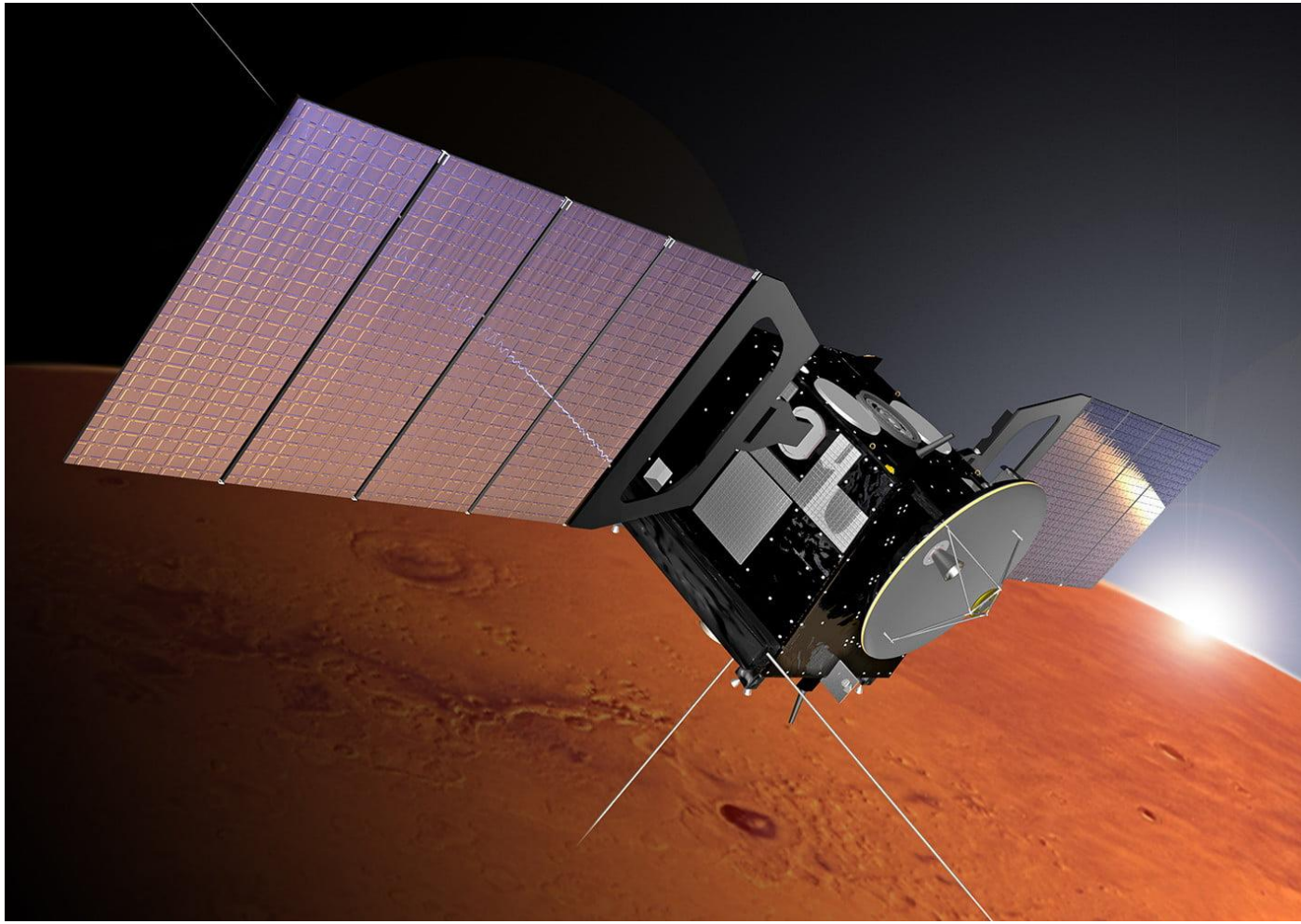
MARS EXPRESS

It was launched on June 2, 2003, along with the Beagle 2 lander (which failed to work) by the European Space Agency.

Mars Express was launched with the intent of surveying Mars' surface using high-resolution cameras, radars, and spectrometers which looks for the types of elements on the surface and for water.

So far it has discovered water ice and carbon dioxide ice in Mars' southern ice cap, along with an area of liquid water underneath

It's currently scheduled to remain in operation until the end of 2026.



MARS SPIRIT AND OPPORTUNITY

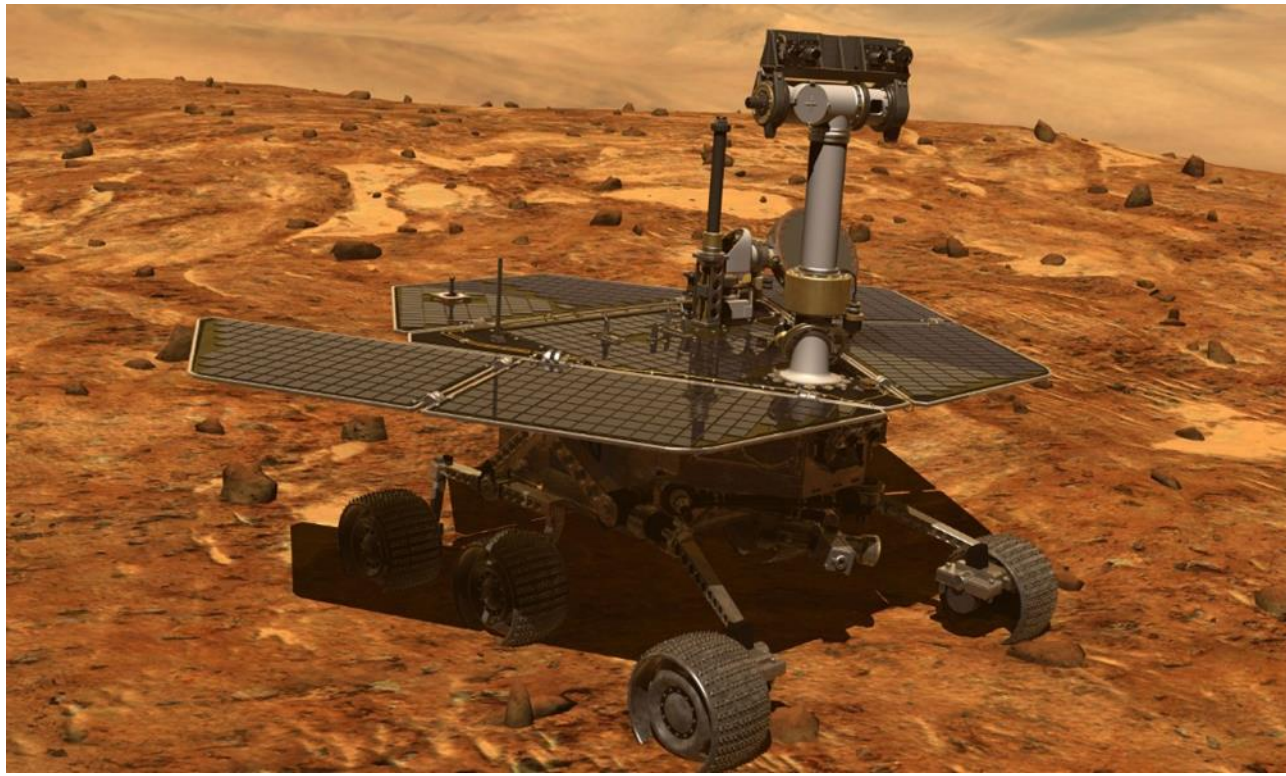
The Spirit and Opportunity rovers represent one of the biggest success stories of the current NASA space program.

Launched separately in summer 2003, the pair of rovers arrived on the red planet after about six months.

Initially, the plan was for a 90-day mission to study the geology and atmosphere of Mars.

Spirit continued to transmit until March 2010, and Opportunity until June 2018!

They are credited with providing the first solid "ground truth' that at one time" Mars was much wetter than it is today.

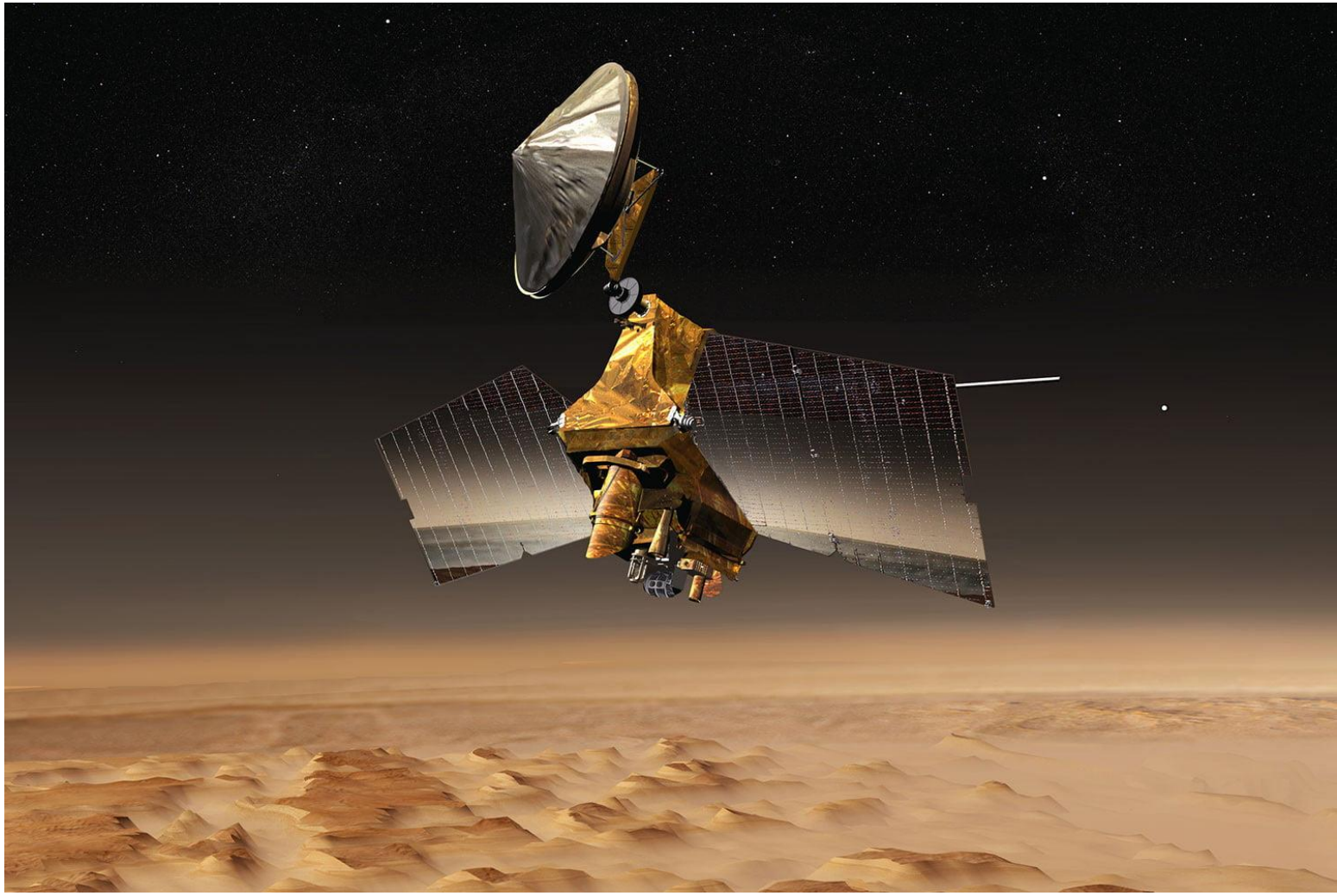


MARS RECONNAISSANCE ORBITER (MRO)

On August 12, 2005, NASA launched the orbiter, which entered Mars' orbit on March 10, 2006.

It has been observing the landscape there and has made numerous high-profile discoveries, including the recent observance of flowing saltwater on the surface and subsurface of the planet.

It was also used to find a landing zone for the Phoenix Lander, and acts as a relay for communications between active rovers and Earth.

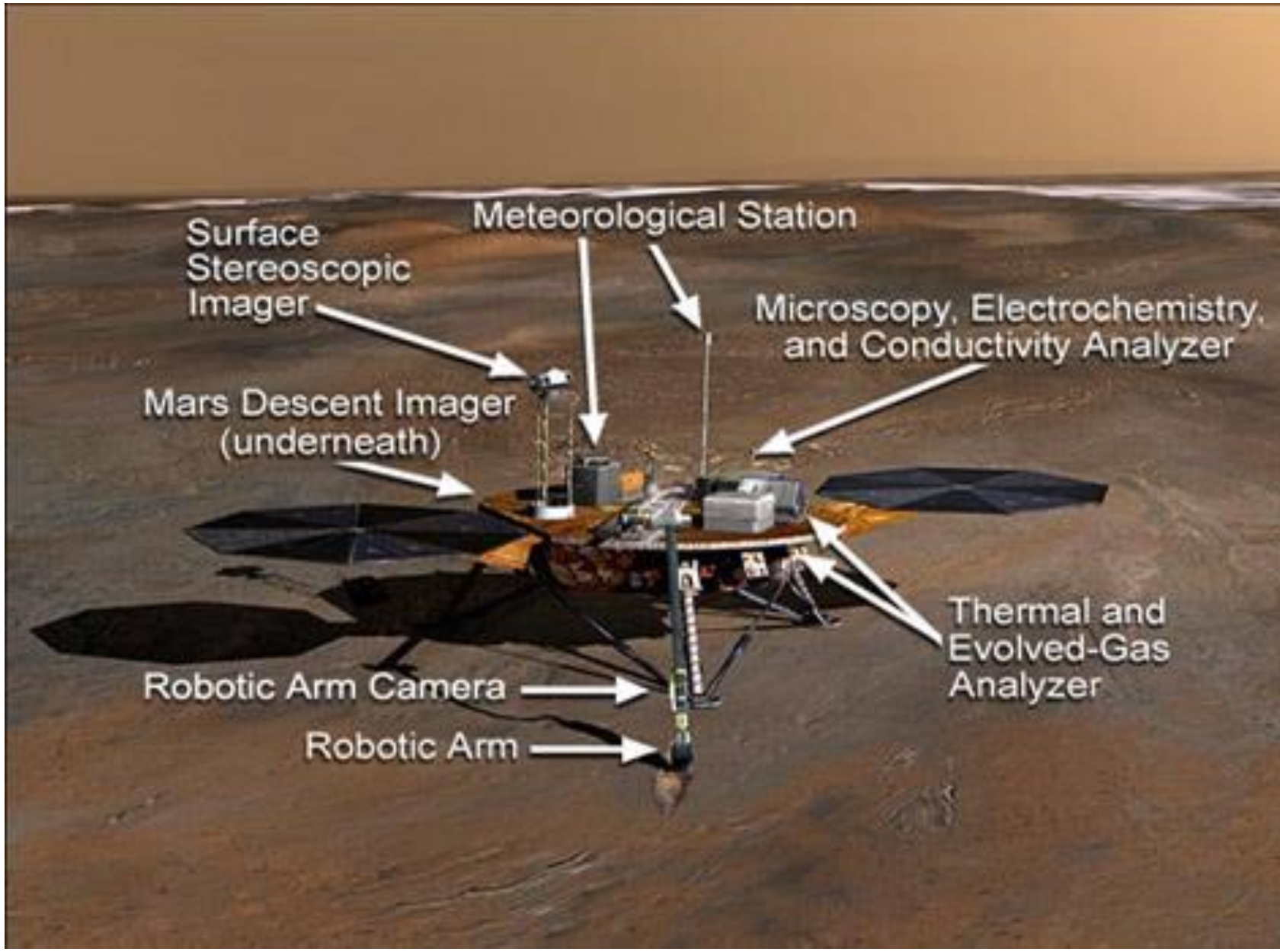


PHOENIX ROBOTIC LANDER

Phoenix was a robotic spacecraft that landed on Mars on May 25, 2008 and operated until November 2.

Its instruments were used to assess the local habitability and to research the history of water on Mars.

The multi-agency program was led by the Lunar and Planetary Laboratory at the University of Arizona, with project management by NASA's Jet Propulsion Laboratory (JPL).



THE CURIOSITY ROVER

NASA's Curiosity has been on Mars since 2012 and was made to study the landscape and climate of Mars, comprising the rover portion of NASA's Mars Science Laboratory (MSL).

It was launched from Cape Canaveral on November 26, 2011 and landed inside the Gale crater on August 6, 2012.

It is still operating fine, after almost 7 years on the planet !! So far, it has traveled 12.5 miles !

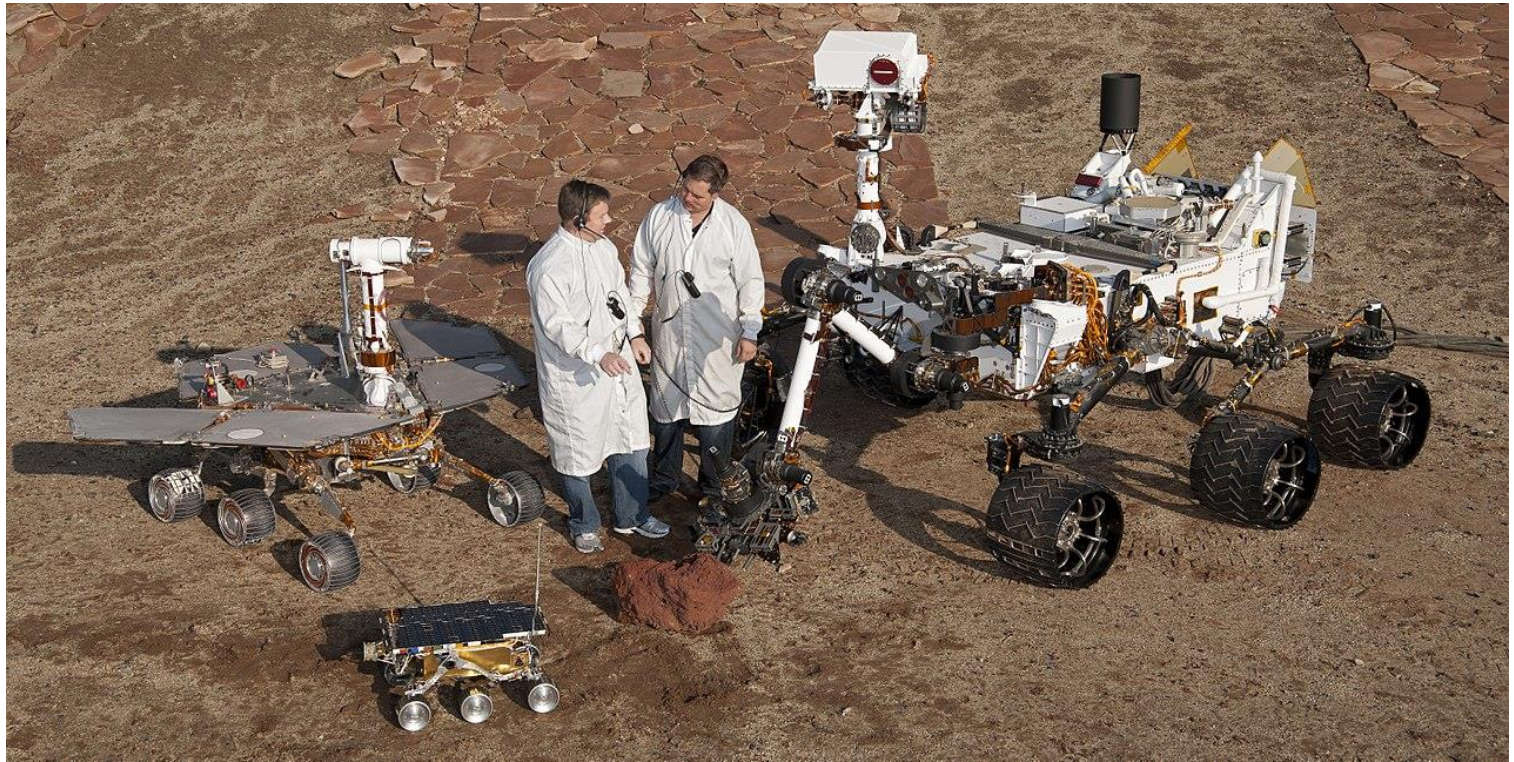
It's most notable find so far is the <u>discovery of organic molecules</u> on the planet's surface in 2018.

Two Jet Propulsion Laboratory engineers stand with three vehicles, providing a size comparison of three generations of Mars rovers.

Front and center is the flight spare for the first Mars rover, *Sojourner*, which landed on Mars in 1997 as part of the Mars Pathfinder Project and is 2.13 feet long.

On the left is a Mars Exploration Rover (MER) test vehicle that is a working sibling to *Spirit* and *Opportunity*, which landed on Mars in 2004 and are 5.2 feet long.

On the right is a test rover for the Mars Science Laboratory, the same size and design of *Curiosity* on Mars in 2012, which is 9.8 feet long.



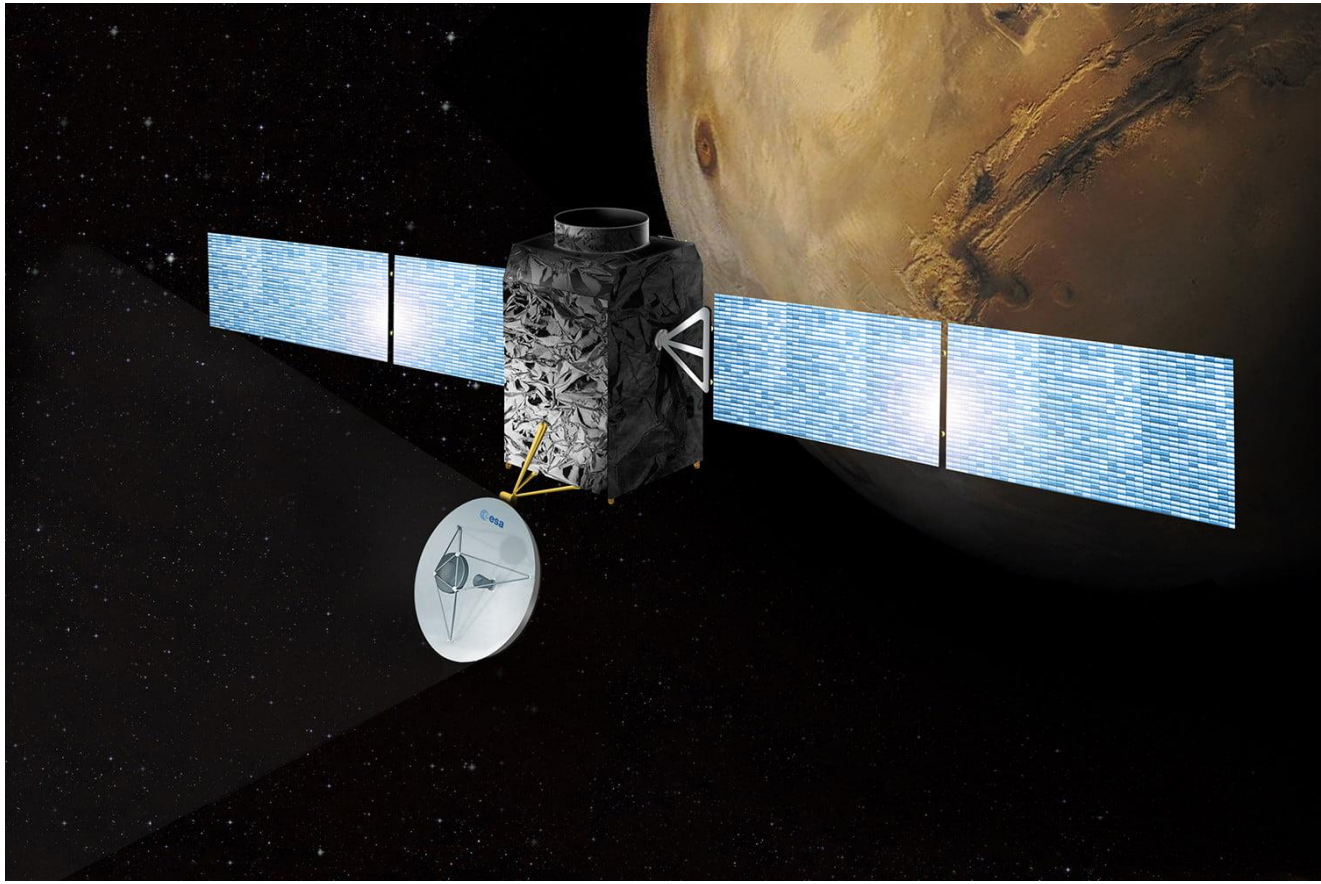
MANGALYAAN (MARS ORBITER MISSION)

The Indian Space Research Organization (ISRO) launched its first interplanetary mission on November 5, 2013.

Dubbed “Mangalyaan,” the craft is an orbiter that has primarily been used as a proof of concept for ISRO’s interplanetary tech capabilities, testing various flight and communications systems, and providing telemetry data.

Mangalyaan is also outfitted with a small suite of research instruments designed to capture atmospheric data.

It is also the cheapest Mars mission to date, costing only $73 million U.S.

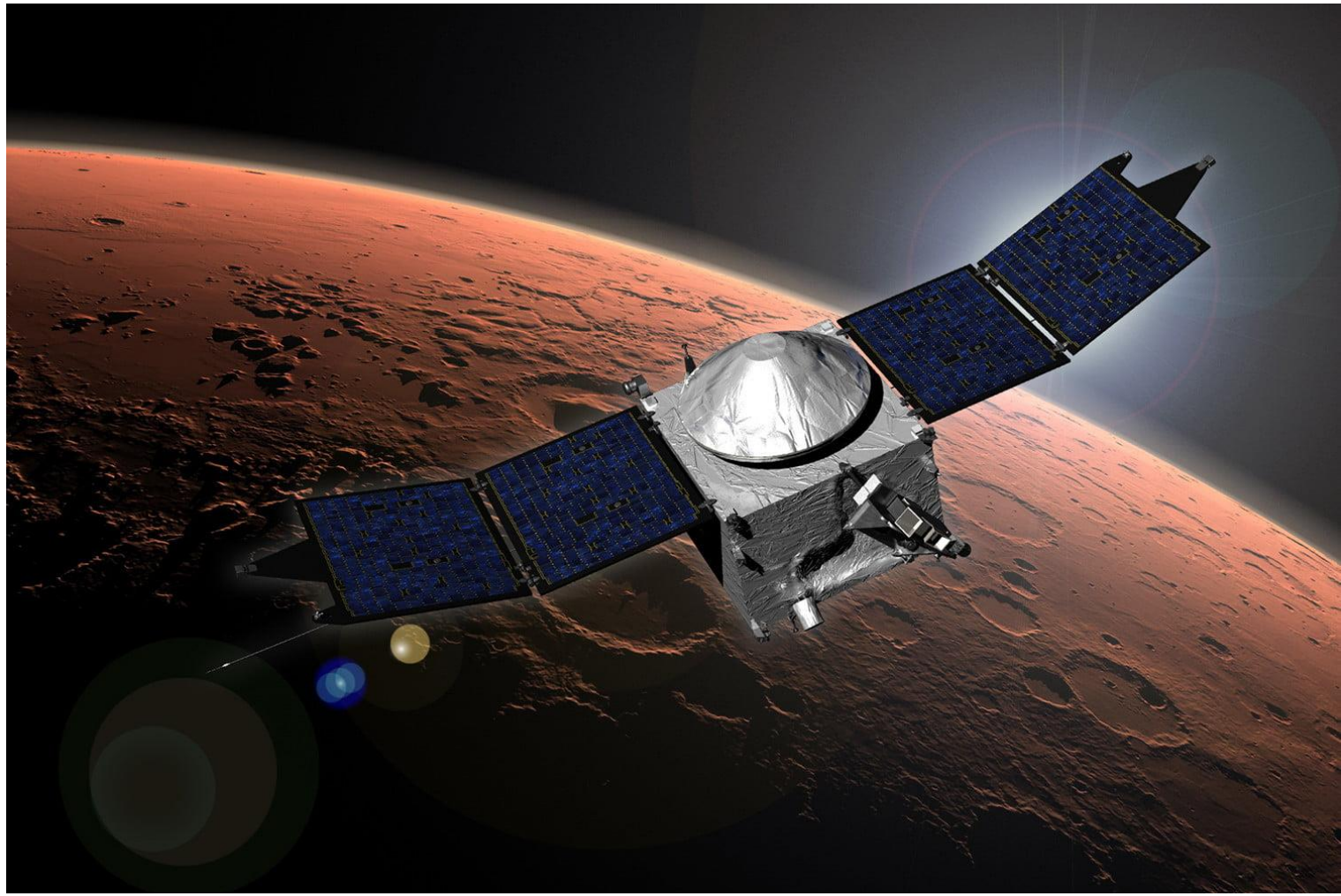


MAVEN

The Mars Atmosphere and Volatile Evolution Mission (MAVEN) is currently searching for explanations for how and why Mars' water and atmosphere have been slowly deteriorating and escaping.

After entering orbit in 2014, it was quickly able to confirm that Mars' atmosphere was escaping into space, and further observations found the planet's magnetic field is more like a tail, disrupted by the solar wind.

This could explain the Red Planet's loss of atmosphere, but scientists are still investigating.

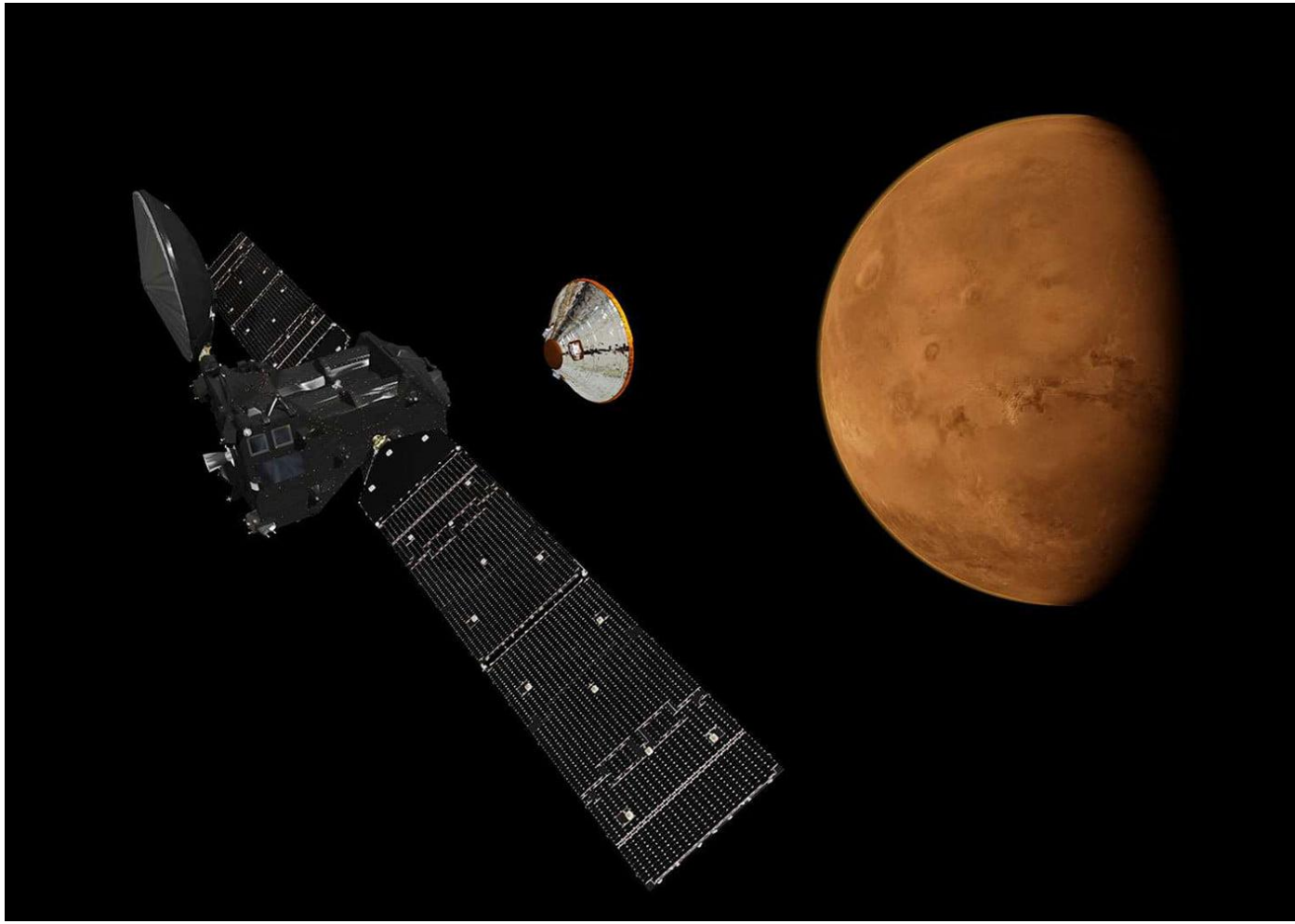


EXOMARS TRACE GAS ORBITER

Launched in 2016, ExoMars is the first in a series of joint Mars missions through a partnership between the European Space Agency and Russia's Roscosmos.

The mission actually included two probes, the ExoMars Trace Gas Orbiter (TGO) and the Schiaparelli EDM Lander, however the lander crashed on the Mars surface after being delivered by the TGO.

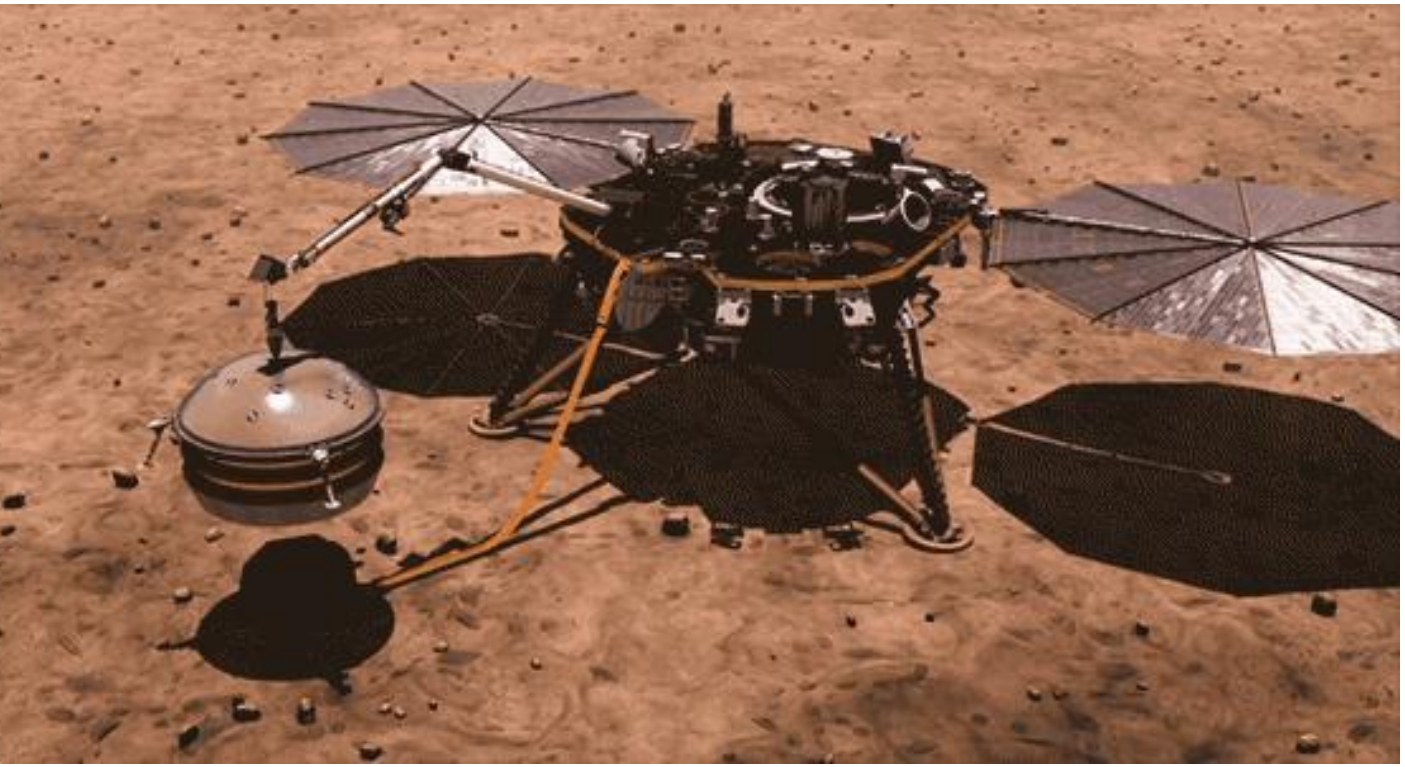
Researchers hope to gain a better understanding of methane and other trace gases present in the Martian atmosphere that could be evidence for possible biological activity.

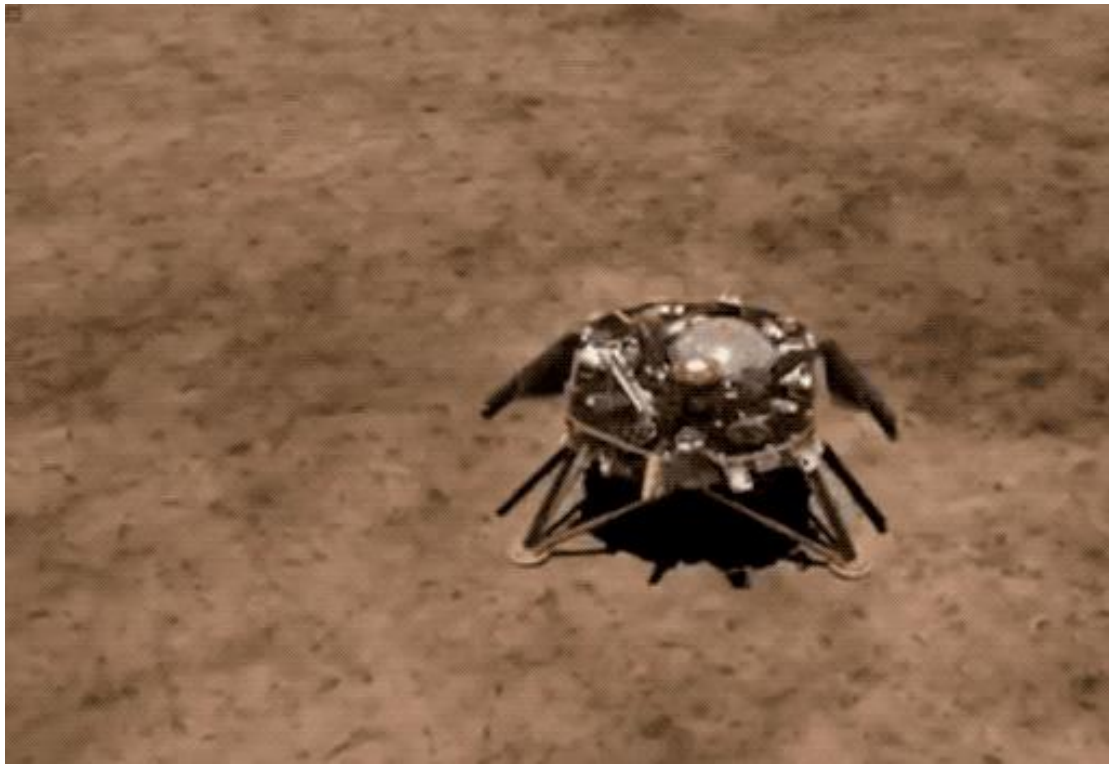


The **INSIGHT** lander - **Interior Exploration using Seismic Investigations, Geodesy and Heat Transport** mission is a robotic lander designed to study the deep interior of the planet Mars.

It was manufactured by Lockheed Martin, is managed by NASA's Jet Propulsion Laboratory, and most of its scientific instruments were built by European agencies.

The mission launched on May 5, 2018, aboard an Atlas V-401 rocket and successfully landed at Elysium Planitia on November 26, 2018.



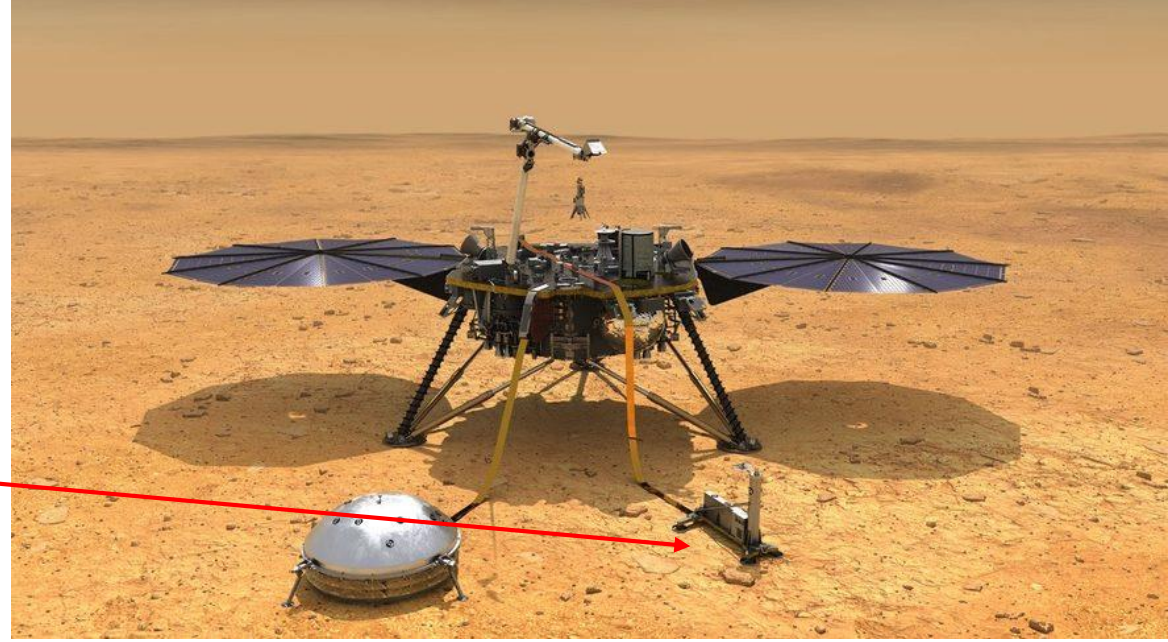


https://www.youtube.com/watch?v=MusWmN1i5vE 4.5 minutes

PROBLEM WITH PUTTING THE MOLE PROBE INTO THE SURFACE

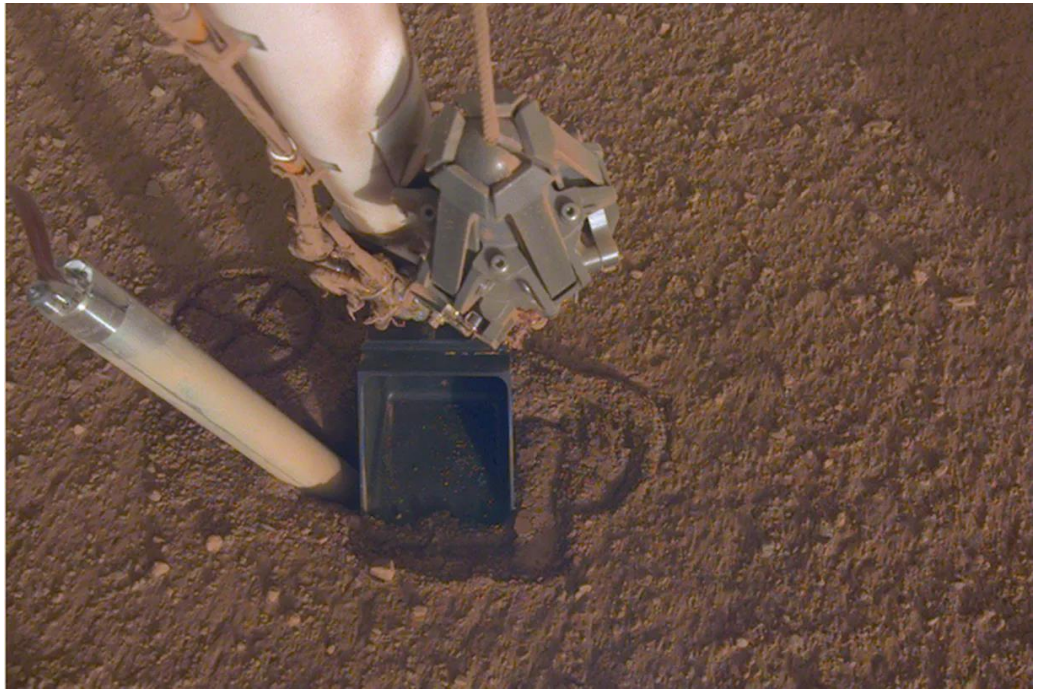
Engineers are continuing to work to free an instrument on NASA's InSight Mars lander that remains stuck just below the surface.

The Heat Flow and Physical Properties Probe (HP3), one of the two main instruments on the spacecraft, features a probe, or "mole," designed to hammer its way into the surface to a depth of about 16.4 feet.



Once in place, it will measure how much heat is flowing out of the planet's interior.

The instrument, placed on the surface weeks after the spacecraft's landing last November, started the hammering process in late February, but project scientists stopped that work, days later when it appeared the mole was stuck about 11.8 inches below the surface. Engineers have since been trying to determine why the mole is stuck and how to get it moving again.
https://www.youtube.com/watch?v=o5q7AugWo3o



PLANNED MISSIONS

Thanks to a launch window when Mars is closer to the Earth, enabling shorter trips, and a bit of coincidence, there are 3 Mars mission launches scheduled for summer, 2020.

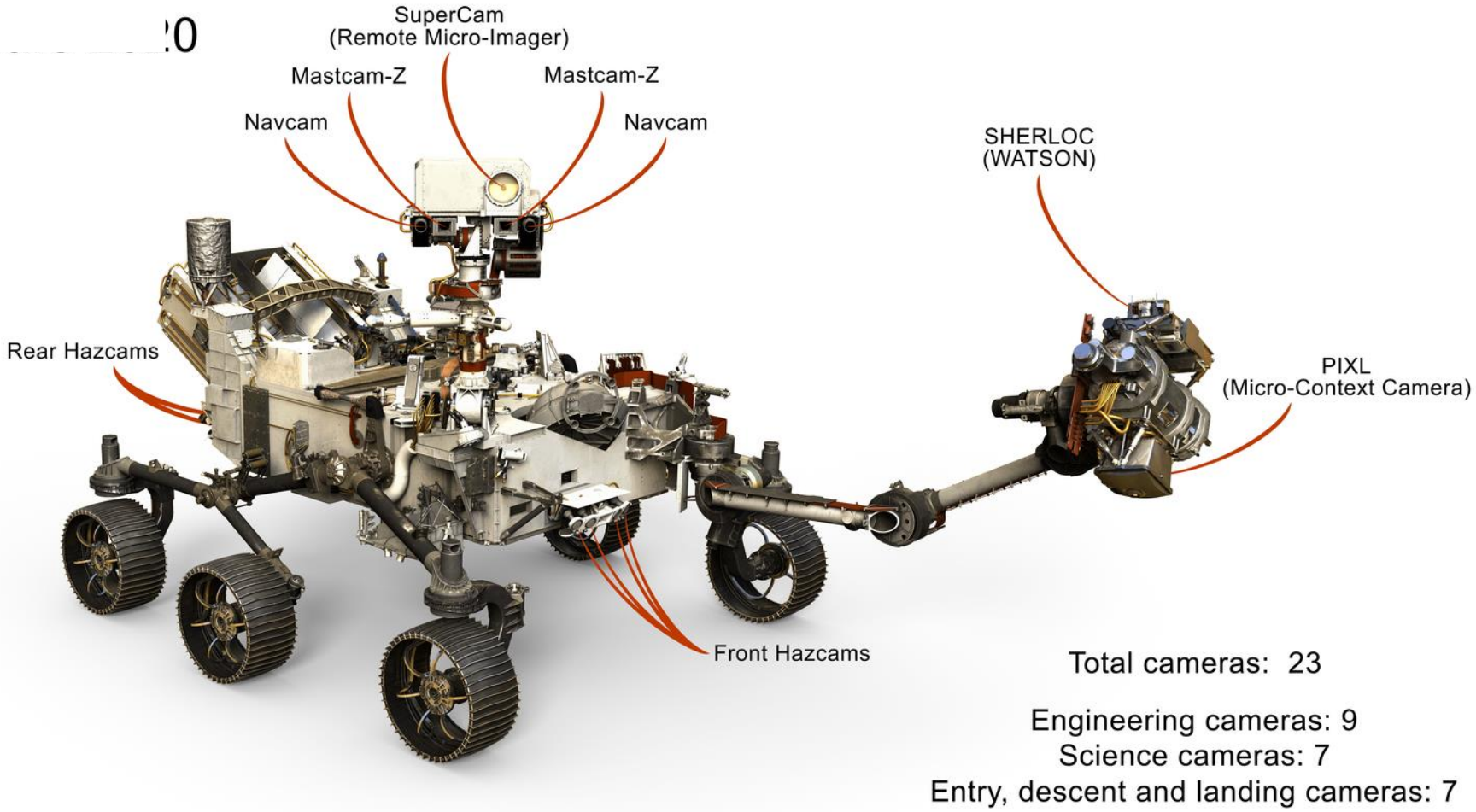
The ones that will be shown are by no means the only ones. There are no less than seven already confirmed missions through 2024, and at least a dozen more through the mid-2040s.

3 MARS MISSIONS WILL BE LAUNCHING TO THE RED PLANET IN JULY 2020 (THE 4TH ONE IS DELAYED)

Earth and the Red Planet align favorably for interplanetary travel just once every 26 months, for a few weeks at a time.

The next such window opens in mid-July 2020, and 3 big-ticket missions aim to take full advantage to get there.

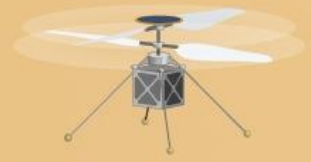
1) NASA's car-size Mars 2020 rover Perseverance is scheduled to lift off on July 17.



https://www.youtube.com/watch?v=987RDiG63h0 4.5 minutes

SAMPLING MARS

In 2020, NASA plans to send a rover to Mars to collect and store tubes of rock and dirt. The plutonium-powered vehicle will have seven instruments and may also carry a helicopter.



HELICOPTER

The rover may carry a helicopter that would fly through the thin atmosphere and scout out the path ahead.

SUPERCAM

A laser blaster that can investigate chemical compositions of Martian rocks and dirt from a distance.

RIMFAX

A ground-penetrating radar to explore beneath the surface.

A plutonium power source supplies electricity to the rover.

MASTCAM-Z

A zoomable panoramic camera.

MEDA

The rover's weather station, to measure temperature, wind speed and other meteorological factors.

SHERLOC

An ultraviolet spectrometer to study mineralogy and chemistry. (Its camera is named WATSON.)

PIXL

An X-ray spectrometer for probing the chemical composition of rocks and dirt close up.

ROBOTIC ARM

The rover arm can extend outwards to make scientific measurements and gather samples. Its instruments can study, in detail, an area about the size of a postage stamp.

MOXIE

An instrument to produce oxygen from carbon dioxide in the Martian atmosphere, as a test for creating resources for future astronauts.

PERSEVEARANCE DESIGN AND GOALS

Roughly 85% of the new rover will be heritage designs — the chassis, the power and communications systems and other elements are copied from those of Curiosity.

What's new are the parts that will do science:

- The tools that will make measurements on Mars
- Those that will gather and store the rock samples.
- This includes 7 instruments, all either brand new or improved designs.
- The panoramic camera atop the rover's mast will have
- a zoom function to zero in on areas of interest.
- The vehicle's laser instrument will add extra wavelengths to help with investigations of rock chemistry and mineralogy.
- The rover's robotic arm will sport ultraviolet and X-ray spectrometers that will map rocks in more detail than the instruments on Curiosity can.

The Perseverance rover has 4 science objectives that support the Program's science goals:

1) Looking for Habitability - Identify past environments capable of supporting microbial life

2) Seeking Biosignatures - Seek signs of possible past microbial life in those habitable environments, particularly in special rocks known to preserve signs of life over time

3) Caching Samples - Collect core rock and "soil" samples and store them on the Martian surface

4) Preparing for Humans - Test oxygen production from the Martian atmosphere

SCIENCE GOAL 1: Determine Whether Life Ever Arose on Mars

SCIENCE GOAL 2: Characterize the Climate of Mars

SCIENCE GOAL 3: Characterize the Geology of Mars

SCIENCE GOAL 4: Prepare for Human Exploration

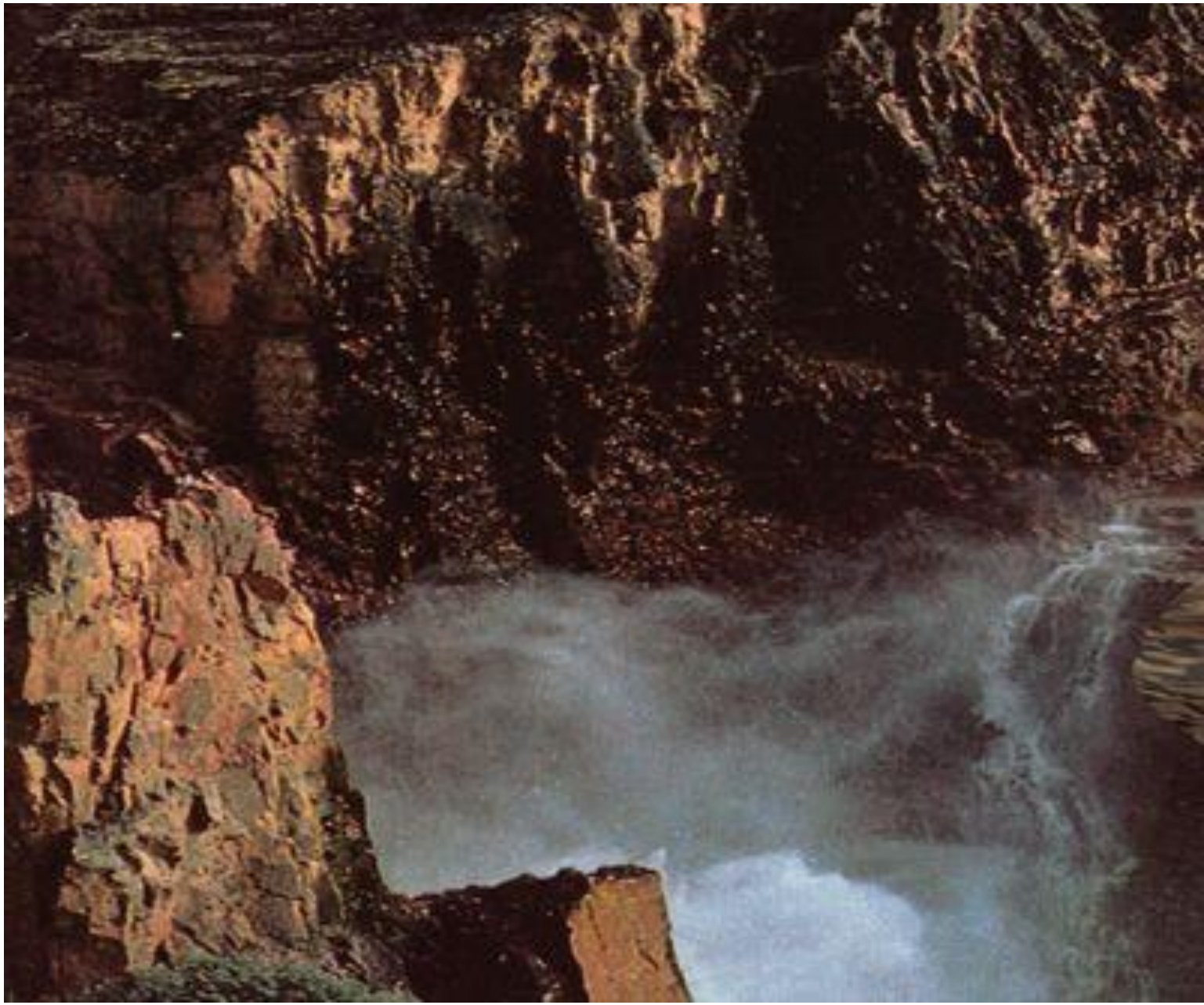
GOAL 1:

DETERMINE WHETHER LIFE EVER EXISTED ON MARS

The mission of the Mars 2020 Perseverance rover focuses on surface-based studies of the Martian environment, seeking preserved signs of biosignatures in rock samples that formed in ancient Martian environments with conditions that might have been favorable to microbial life.

It is the first rover mission designed to seek signs of past microbial life.

Earlier rovers first focused on and confirmed that Mars once had habitable conditions.



GOAL 2:

CHARACTERIZE THE CLIMATE OF MARS

Past Martian climate conditions are a focus of the Perseverance rover mission.

The rover's instruments are looking for evidence of ancient habitable environments where microbial life could have existed in the past.

GOAL 3

CHARACTERIZE THE GEOLOGY OF MARS

The Perseverance rover is designed to study the rock record to reveal more about the geologic processes that created and modified the Martian crust and surface through time.

The rover seeks evidence of rocks that formed in water and that preserve evidence of organics, the chemical building blocks of life.

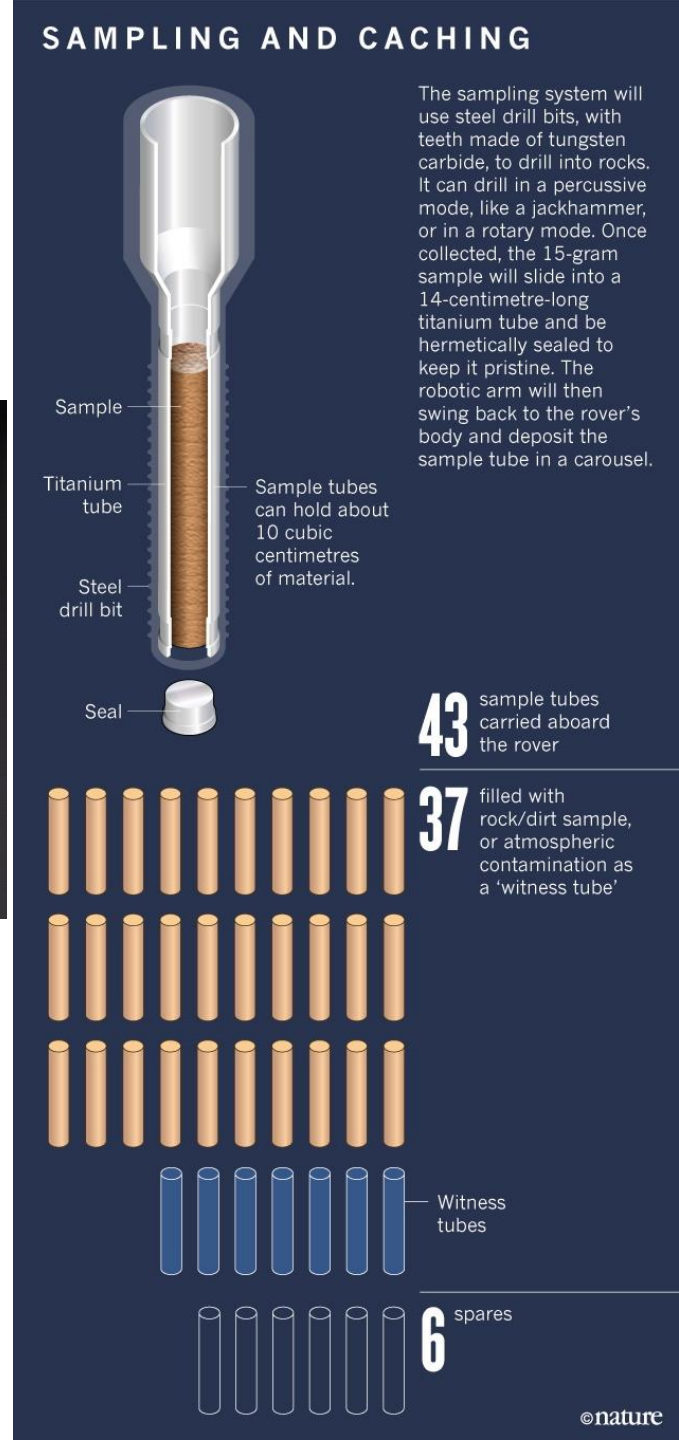
It will collect samples of soil in many different locations and put them into sealed tubes for eventual return to Earth.

The rover will carry enough supplies to fill and seal at least 31 titanium tubes, each roughly 5.5 inches long and 8/10 of an inch across and carries several spares in case of problems.

Some will serve as ‘witness’ tubes, filled with material such as aluminum mesh or ceramics to trap environmental contaminants.

On the way to Mars, one of the tubes will be left uncovered to capture whatever might vaporize off the spacecraft during flight. That tube will be sealed on arrival.

Other tubes will be exposed sequentially on the Martian surface to gather samples of anything that happens to be blowing in the air at each location. Later, scientists will be able to use the witness tubes to work out whether the drilled samples were contaminated and when.



GOAL 4

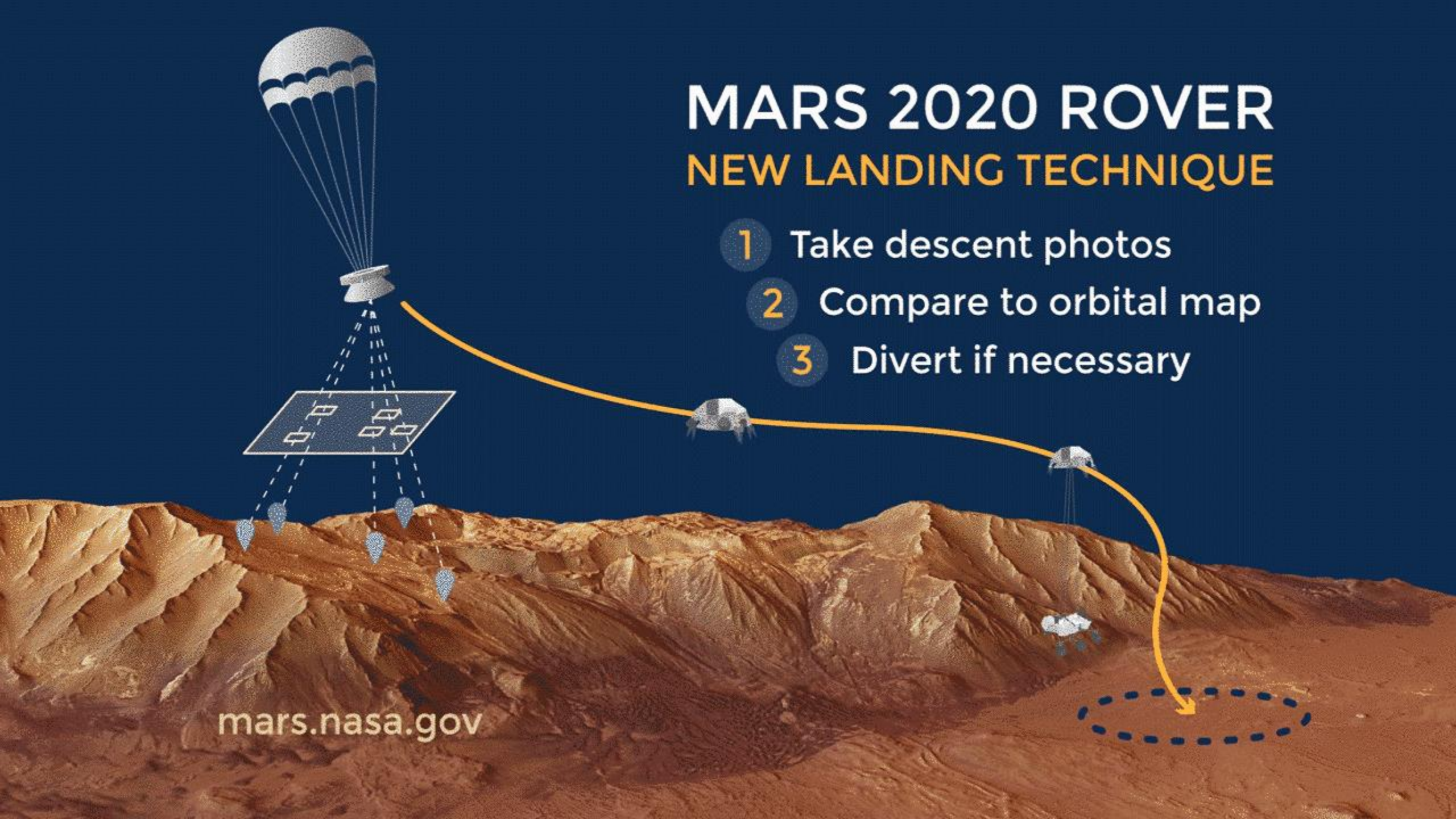
PREPARE FOR HUMAN EXPLORATION

The Perseverance rover is demonstrating key technologies for using natural resources in the Martian environment for life support and fuel.

It is also monitoring environmental conditions, so mission planners understand better how to protect future human explorers, who are planned to be sent to Mars in the 2030’s.

Similar to the history of the exploration of Earth's moon, robotic missions to Mars provide a crucial understanding of the environment and test innovative technologies for future human exploration.


MARS
2020
ROVER
FINAL 3
LANDING
SITES


MARS 2020 ROVER
NEW LANDING TECHNIQUE
1 Take descent photos
2 Compare to orbital map
3 Divert if necessary
mars.nasa.gov

MARS HELICOPTER

The Mars Helicopter has been attached underneath Perseverance and it will be the first aircraft in history to attempt power-controlled flight on another planet. It was named Ingenuity by a teenage girl, in a contest by NASA.

The helicopter, which weighs only 4 pounds (1.8 kilograms) and features Carbon fiber propellers 4 feet (1.2 meters) in diameter, and is cocooned within the delivery system.

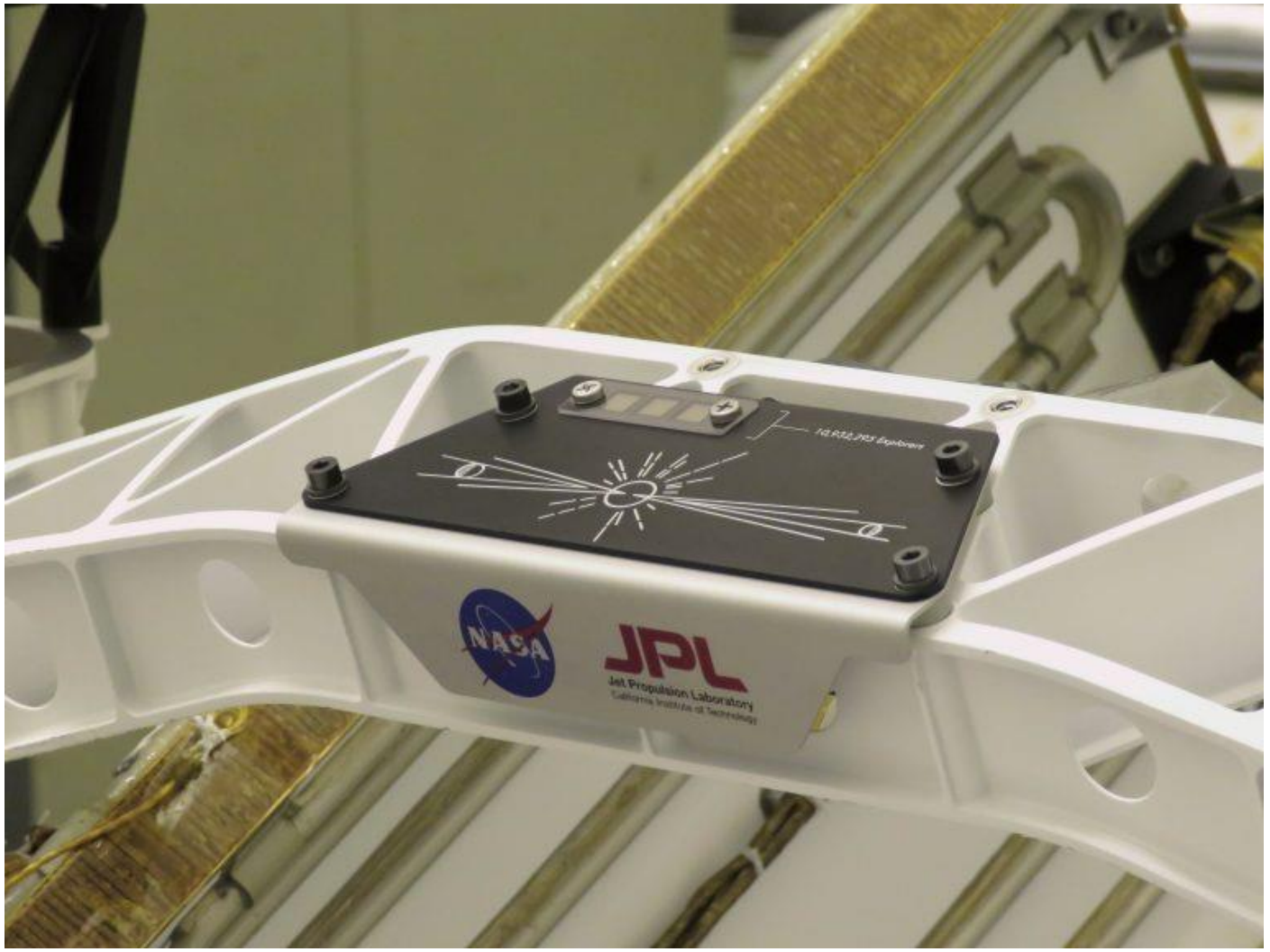
In one of the first steps in the day-long process on April 6, technicians and engineers made 34 electrical connections between the rover, the helicopter and its delivery system on the rover's belly.

https://www.youtube.com/watch?v=oOMQOqKRWjU

When the Mars Perseverance rover begins its seven-month journey to the Red Planet in mid-July of 2020, it will be carrying the names of more than 10 million people throughout the world.

Those names were etched onto three microchips, which were placed aboard Perseverance.

Those who took advantage of a special public promotion also had the opportunity to receive a souvenir boarding pass and obtain "frequent flyer points" as part of humanity's first round trip to another planet.



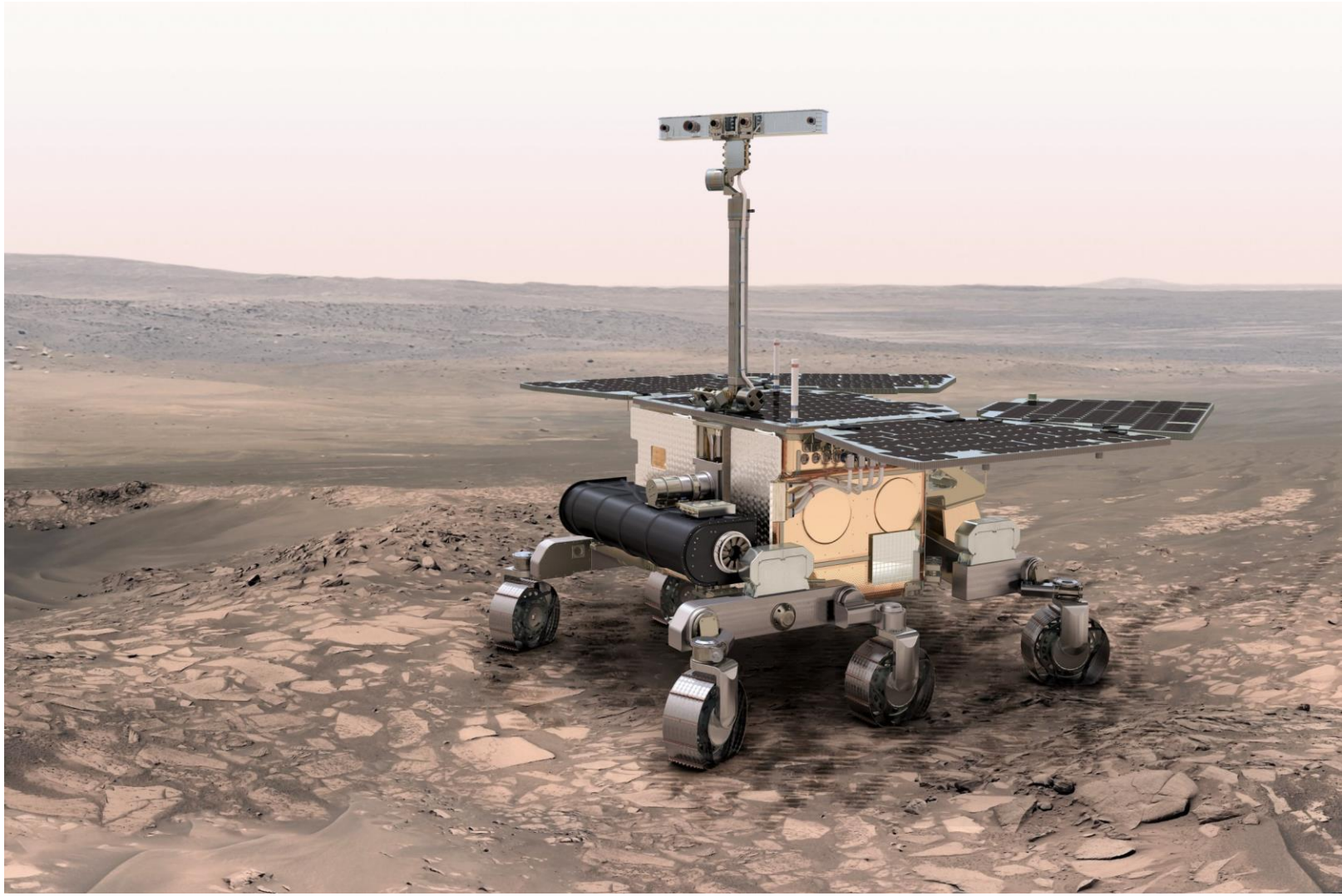
The "Send Your Name to Mars" logo was installed on the Mars Perseverance rover on March 16, 2020, at NASA's Kennedy Space Center in Florida. Photo credit: NASA/JPL

2) THE ROSALIND FRANKLIN EUROPEAN-RUSSIAN ROVER

The European-Russian ExoMars rover, named Rosalind Franklin after the renowned scientist who was the first person to learn about DNA but wasn't recognized for it, at the time.

It was to be sent 8 days after Perseverance goes to Mars, but they delayed the mission to 2022 because there was not enough time to qualify the spacecraft's avionics and parachutes, due to the Covid-19 virus situation.

It will look for signs of Martian life and perform a variety of other tasks.



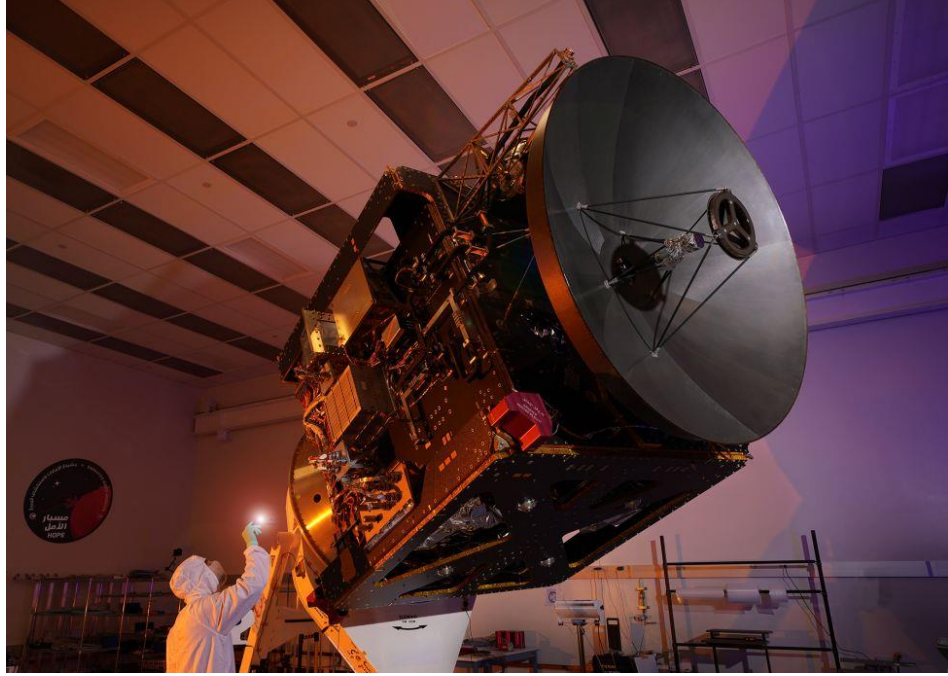
3) THE UNITED ARAB EMIRATES (UAE) IS ALSO GOING TO MARS, USING IT'S HOPE ORBITER

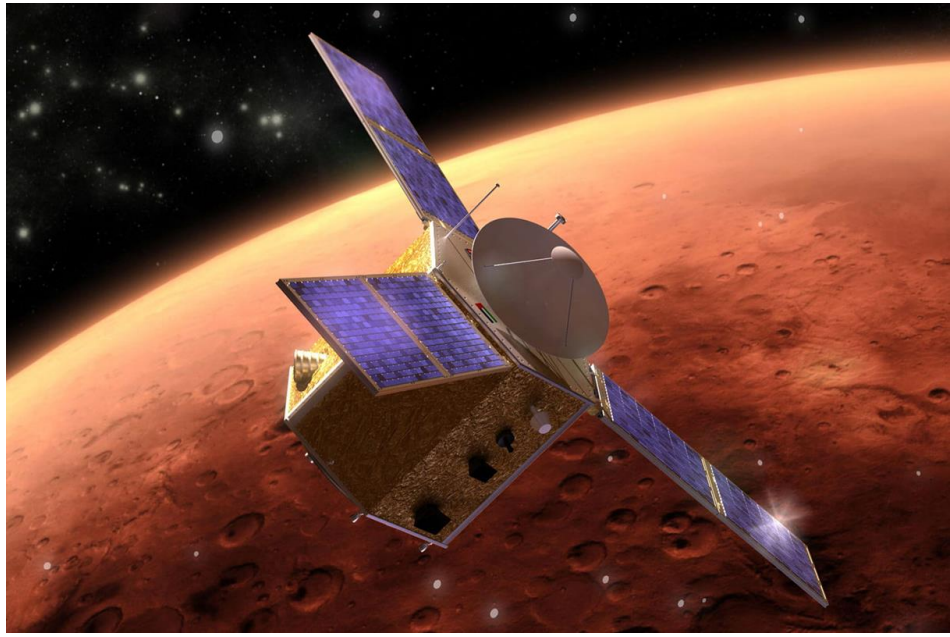
The Emirates Mars Mission, an orbiter also known as **Hope**, is scheduled to launch on an H-2A rocket from Japan during a three-week launch window that opens July 14.

The spacecraft will go into orbit around Mars in early 2021 to do a detailed study of the Martian atmosphere.

The mission is also timed to celebrate the UAE nation's 50th anniversary.

The spacecraft completed environmental testing in the United States last December and was then transported to Dubai for a final set of tests.





https://www.space.com/united-arab-emirates-hope-mars-mission.html 6 minutes

4) CHINA'S HX-1 GLOBAL ORBITER & ROVER

China also aims to hit the mid-2020 launch window with its Mars Global Remote Sensing Orbiter and Small Rover mission, known as HX-1.

Between them, they will carry 13 science instruments.

The solar-powered rover will weigh 530 pounds (240 kilograms).

THE END

YOU HAVE BEEN CHOSEN AS ONE OF THE FIRST GROUP OF PERSONS TO GO TO MARS !!

All of the 21 students in our class, myself, and some OLLI Staff have been chosen as the first Cohort, to go to Mars !! We will be leaving Earth in 2021 !!

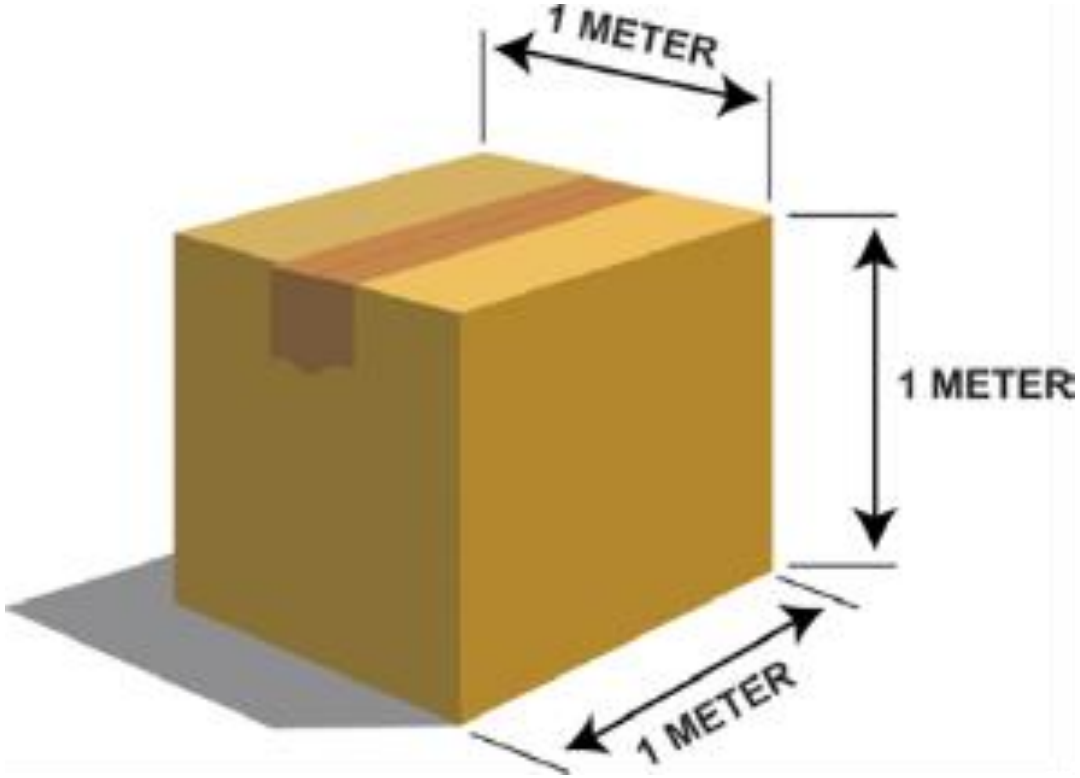
Your official Boarding Pass is shown below.

Your ticket and all non-personal supplies have been paid for and approved, as I know you want to be one of the first persons to go there !!

You will also get some frequent flier points too, to use for future flights !!

The trip to Mars will take 7 months and persons will have to stay there for 500 days (1.4 years) so the trip back will be at the right time when the Earth and Mars align correctly for the return trip, which will also be 7 months. This means you will be gone for 2-1/2 years.

PURPOSE OF THIS PROJECT: MAKE A LIST OF THE PERSONAL ITEMS YOU WANT TO TAKE THAT WILL FIT IN A 1 METER CUBE BOX !!



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