→ FORWARD TO THE MOON

Media kit



ullet







S2



Contents

Introduction	
Moon facts	4
Moonwalkers	7
Spacecraft, landers and rovers	8
Travel time	9
Moon calling Earth	
Moon drift	
Lunar dust	12
Water on the Moon	13
The Moon has an atmosphere	14
Resources on the Moon	15
Moon flashes	16

What is Orion?	
The spacecraft	
The rocket – how to get to the Moon	
Dimensions	
The journey	21

Exploration Mission-1 step-by-step	22
The European powerhouse	23
Propulsion	24
Air and water	25
Power	26
Structure	27
Temperature control	28
Avionics	29
An international collaboration	30

Photos	32
Graphics	
Artist impressions	
Videos and animations	
Websites	
Posters	
Media services	







Introduction

The year 2019 marks the 50th anniversary of the Apollo 11 mission that saw the first humans land on the Moon. ESA is teaming up with international partners to return humans to Earth's natural satellite.

The Moon is our closest neighbour and a natural target for setting up a research base as we prepare to go deeper into the Solar System.

The Moon is a treasure trove of Solar System history and it has great scientific potential for looking further afield such as constructing a radio telescope on the far side, offering views of our Universe protected from the constant radio emissions from Earth.

The Moon is again in the spotlight of space agencies worldwide as a destination for both robotic missions and human explorers.

Moving away from one-shot orbital missions, bold ambitions foresee humans exploring the polar regions hand-in-hand with robots, in international cooperation and with commercial partners.

Reaching beyond Earth orbit

While continuing to exploit operations on the International Space Station, Europe is setting its sights on the Moon, preparing for a robotic landing in partnership with Russia as early as 2023 looking for water ice that scientists believe may be found in the dark polar regions. Such a discovery could open the door to future explorers exploiting resources on the surface – living off the land.

NASA's Orion spacecraft, with the European service module at its core, will build bridges to Moon and Mars. Orion will also help to build a space gateway in lunar orbit, a distant human outpost where we can learn to live and work a thousand-times farther out in space than on the International Space Station.

These steps are bringing us closer to our ambition: sending the first Europeans the Moon and beyond, with Europe as a lead actor in humankind's greatest adventure.

ABOUT THIS DOCUMENT

This document contains links to download the images, infographics, videos and to visit web pages for more information. Explore the Moon through the series of infographics. Roll over the graphic elements to discover hyperlinks to more information on related webpages. Links to recommended images, videos and animations are provided towards the end of this media kit. An internet connection is required to access the external webpages.







→ MOON FACTS

Size

The Moon is about one-quarter the size of Earth in diameter, but around 50 times smaller in volume.



Distance

The distance from Earth is not always the same – it varies because the lunar orbit is not circular, but elliptical. On average, you could fit our planet 30 times between Earth and the Moon.









Earth

12 756 km





→ MOON FACTS

Age

The Moon is believed to be around 4.5 billion years old, born from a giant collision of a Mars-sized object with the young Earth early in the Solar System's 4.6 billion year history.



 \mathbf{T}

CONTENTS PRE

Composition

The surface of the Moon is mostly made of oxygen, silicon, magnesium, iron, calcium, aluminium and titanium. At its centre there may be a small, molten iron core.





A day on the Moon

The Moon takes around 29.53 Earth days to

Colour

The surface of the Moon is quite dark. The colour of the lunar landscape is mostly charcoal-grey. The Moon reflects the light of the Sun.

Seen from Earth, the atmosphere scatters certain wavelengths of light. When the Moon is close to the horizon, it often looks reddish. As it goes higher in the sky and is less obscured by the atmosphere, the Moon appears more yellow.



rotate once on its axis. So if you lived on the Moon you would experience about two weeks of day and two weeks of night.





→ MOON FACTS

60 kg

Gravity

On the Moon a person would weigh six times less than they do on Earth. This is because the Moon has one sixth the gravity of Earth.

The far side of the Moon

We call the side that is not visible from Earth the far side of the Moon, and it is also illuminated by the Sun at different times. The Moon takes as long to rotate on its axis as it takes to revolve around Earth, so we only see one 'face' of the Moon from our planet.





10 kg

Temperature

The sunny side of the Moon is hotter than boiling water, but the night side is colder than anywhere on Earth. Lunar temperatures vary from 123 °C in the day and down to -233 °C in permanently shadowed polar craters.

Near side

Far side









Apollo 17

Apollo 16

Apollo 15

• Apollo 14

Apollo 12 •

→ 10 THINGS YOU DID NOT KNOW ABOUT THE MOON

Moonwalkers



Twelve people walked on the Moon between 1969 and 1972.





They left **Scientific experiments** on the surface and came back to Earth with nearly **400 kg of lunar rocks and soil.**



ESA is looking with international partners to **bring back**

Apollo 12 19 November 1969 Charles Conrad Apollo 14 5 February 1971 Alan Shepard Apollo 16 21 April 1972 John Young **more rocks** from the Moon using robots as part of the Heracles mission.









2. Spacecraft, landers and rovers

Over **50 spacecraft** have successfully launched from Earth to fly past, orbit, impact and land on the Moon.

19 landers and **6 rovers** have visited the lunar surface.

> ESA's next hardware to land on the MOON is on the Russian Luna-25 lander.









Travel time

The time to get from Earth to the Moon depends on the **trajectory and propulsion system** of the spacecraft.

> Apollo missions took about **three days** to reach the Moon.



The quickest trip

was NASA's New Horizons mission – it flew past the Moon in just 8 hours and 35 minutes on its way to Pluto.

ESA's first mission to the Moon,
SMART-1, was the second spacecraft
to use **ion thrust** technology.
It took one year to reach the Moon
using solar-electric propulsion.











4. Moon calling Earth

It takes on average **1.27 seconds** for a radio signal to travel from Moon to Earth. So to talk to somebody on the Moon you would have to wait at least **2.54 seconds for a reply.**



Lasers are now used to communicate with spacecraft and measure the distance to the Moon using reflectors left on the Moon.

ESA has a partnership to develop **Commercial**









5. The Moon is drifting away from Earth!

The Moon is slowly moving away from Earth, about 4 cm farther away each year.



Gravity and tidal forces between these two celestial bodies are **Slowing down the rotation of Earth** and increasing the distance from each other.



Missions to the Moon will help us understand **how it was created** and learn more about its orbit.









6. Dangerous lunar dust

Lunar dust is made of sharp, abrasive nasty particles, but it is yet unknown **how toxic** it is for humans.

> From sneezing to nasal congestion, all 12 people who have stepped on the Moon described **Symptoms similar to hay fever.**

> > **ESA research** on the International Space Station is helping understand lung health in space.







7. There is scientific evidence for water on the Moon

Scientists have measured the **presence of Water** in the Cabeus crater on the Moon by smashing a spacecraft into it and measuring the chemicals that were ejected.

ESA is taking part in missions









8. The Moon has an atmosphere



will carry up to **four** astronauts close to and beyond the Moon.









³He

9. Resources on the Moon



for nuclear energy

Sunlight Solar energy

Hydrogen

Propellant to power rockets

ESA's concept mission 'in-situ resource utilisation'



Can be split into hydrogen and oxygen for fuel is considering options to **find and use** these resources on the Moon.



Η







Moon flashes 10.

Every few hours, **brilliant flashes of light** can be seen through a telescope across the lunar surface – the result of a meteorite striking our rocky neighbour at great speed.













What is Orion?

Orion is a NASA spacecraft set for missions to the Moon, Mars and beyond.

ESA has designed Orion's European Service Module – the **powerhouse** that will supply the spacecraft with electricity, propulsion, thermal control, air and water.

#Space19plus #ExploreFarther



This is the first **collaboration between ESA and NASA**

on a transportation vehicle that will carry astronauts farther into space than ever before.





.eesa

E.





The spacecraft

CREW MODULE

Habitat for **four astronauts** and cargo from launch to landing.

Only part of the spacecraft that lands back on Earth.



CREW MODULE ADAPTER

Connects electrical, data and fluid systems between the main modules.

Contains electronic equipment for communications, power and control.

EUROPEAN SERVICE MODULE

Provides electricity, propulsion, air and water.

Keeps the spacecraft **at the** right temperature and on course to its

destination and back.

The solar array turns on two axes to remain aligned with the Sun for maximum power.

SOLAR ARRAYS





22





The rocket – how to get to the Moon



Solid rocket boosters















#Space19plus #ExploreFarther





The spacecraft is designed for astronauts. Up to four people can travel inside the Crew Module.





The journey



Celebration European Service Module and Crew Module Adapter connected

8

5 🕅

Transport

2

3

Service Module and solar arrays transported from Germany to USA

2 Assembly The Europe

The European Service Module is assembled in Germany





8

OR *K*YA

The European Service Module structure is built in Italy



Assembly Complete Orion Service Module and Crew Module at NASA's Kennedy Space Center, Florida

5

Certificate

Shake test
 Acoustic test
 Vacuum test

Testing before launch At NASA's Plum Brook station, Ohio

6

7 Rocket integration









Exploration Mission-1 step-by-step

















Propulsion

Orion relies on the engines of ESA's European Service Module to navigate and orient itself in space. The engines can be fired individually to move the spacecraft and rotate it to any position.

<section-header>

50 kg each on Earth



Fuel

- Mixture: MON oxidiser with MMH fuel
- Four tanks with
 2000 | capacity
 each
- Helium tanks
 push the fuel to
 the engines



provide attitude control













Air and water

The European Service Module provides air and water for the astronauts in the Orion spacecraft. The oxygen and nitrogen are stored separately, and mixed into the Crew Module for the astronauts to breathe.



























Power

Four solar arrays provide electrical power to Orion. Each wing is made of three panels. The solar array uses gallium arsenide cells that are more efficient, resistant and lightweight.

Provides more than **double the power** of ESA's cargo spacecraft







Can swivel and rotate to

Provides enough electricity for two households: 11.2 kW











Structure

The European Service Module's structure is the backbone of the entire vehicle. The spacecraft withstands many stresses, from launch vibrations to temperature and pressure changes on its way to space.

Like the chassis of a car, the structure holds everything to get here.

Absorbs vibrations

from launch — similar to the thrust of 34 Jumbo Jets

Covered with Kevlar



to absorb shocks from micrometeorites

and debris impacts











Temperature control

Space is a harsh place with sharp changes in temperature. Radiators and heat exchangers control the temperature of the spacecraft to keep the astronauts comfortable and its equipment operating optimally.

Six radiators outside the Service Module





Insulation:

multi-layer insulation blankets













Computers

control all aspects of

the service

module.

Avionics

The European Service Module's brain combines the full automatic capabilities of an unmanned vehicle and human spacecraft safety requirements.

Fly-by-wire:

automatically regulates propulsion, water, electronics and temperature.

Over 11 km of cables

send commands and receive information from sensors.











An international collaboration

Germany

- Prime contractor
- European Service Module assembly integration and verification
- Propulsion and propulsion drive electronics
- Centralised parts procurement agent
- Data network harness for Qualification Module
- Reaction control thrusters

Italy

- Structure
- Thermal control system
- Consumable storage system
- Power control and distribution unit
- Photovoltaic assembly
- Meteoroid and debris protection system

Switzerland

- Secondary structure
- Solar array drive assembly
- Solar array simulator
- Mechanical ground support equipment

Belgium

USA

- Gas tank
- Valves, pressure regulators and pumps
- Data network harness
- for Flight Module
- Main and auxiliary engines
- Solar cells

France

- System tasks
- Avionics qualification
- Direct current harness
- Electronics
- Helium filters

Denmark

Sweder

Propulsion
 Qualification Module
 integration

Norway

Hydrophobic filter

The Netherlands

Solar array wings

Spain

• Thermal control unit

Tank bulkhead
Electrical ground support equipment
Pressure regulation units



 Electrical ground support equipment









Photos



European Service Module acoustic testing, Structural Model









inside a rocket's belly





Orion's wings

working on propulsion



test article



European Service Module waiting for the burn Packing the EuropeanEuropean Service ModuleEuropean Service ModuleService Moduleteamtransport toKennedy Space CenterKennedy Space Center







Graphics







Moon facts

6058



Moon facts

Cesa



Moonwalkers



Spacecraft, landers and rovers



Travel time



Moon calling Earth



Moon drift



Lunar dust



Water on the Moon



The Moon has an atmosphere



Resources on the Moon



Moon flashes



What is Orion



Orion the spacecraft



Orion the rocket



Orion dimensions



Orion the journey







Orion The European powerhouse





































Artist impressions



Orion front view



Orion side view



Orion side view with solar arrays unfolding



Orion side view with solar arrays unfolded



Orion



Orion back view



Orion back view with solar arrays unfolded



Orion



Orion spacecraft launch configuration



Orion spacecraft launch configuration



Orion spacecraft in Earth orbit



Orion leaving Earth



Orion initial design



Orion spacecraft

of the Moon



Orion

of the Moon









of the Moon









Videos and animations



Destination: Moon



Lunar exploration ESA's missions



What is the origin of the Moon?



Moon Village



Paxi explores the Moon!



Paxi and our Moon: phases and eclipses



How to photograph a lunar eclipse



Orion from components to shipping



Orion engine firing



Shaking Orion's solar arrays



Human spaceflight and robotic exploration future



Orion and the European Service Module







European Service Module separation tests

Spacecraft materials kit classroom demonstration

Spacecraft materials kit challenge







Websites



Lunar web documentary



Moon Camp



NASA HD Apollo images



Orion blog



Orion European Service Module Flickr







Posters











Media services

ESA Media Relations

media@esa.int +33 1 53 69 72 99 European Space Agency Headquarters, Paris, France

Rosita Suenson Rosita.Suenson@esa.int **European Space Agency** ESTEC, Noordwijk, The Netherlands



Lunar exploration ESA Orion blog www.esa.int/orion

Facebook ESA **Instagram ESA**

@esaspaceflight @esa @NASA_Orion

Official hashtags: *#Space19plus* #ForwardToTheMoon







An ESA Production

Copyright © 2019 European Space Agency

